Εφαρμογές Γεωγραφικών Συστημάτων Πληροφοριών στην Κύπρο

Χαρτογράφηση των ενεργειακών εισροών και εκροών ενέργειας, της ενεργειακής αποτελεσματικότητας και των εκπομπών αερίων θερμοκηπίου σε ελαιώνες της Κύπρου: Ένα εργαλείο στον σχεδιασμό της βέλτιστης διαχείρισης των εισροών ενέργειας

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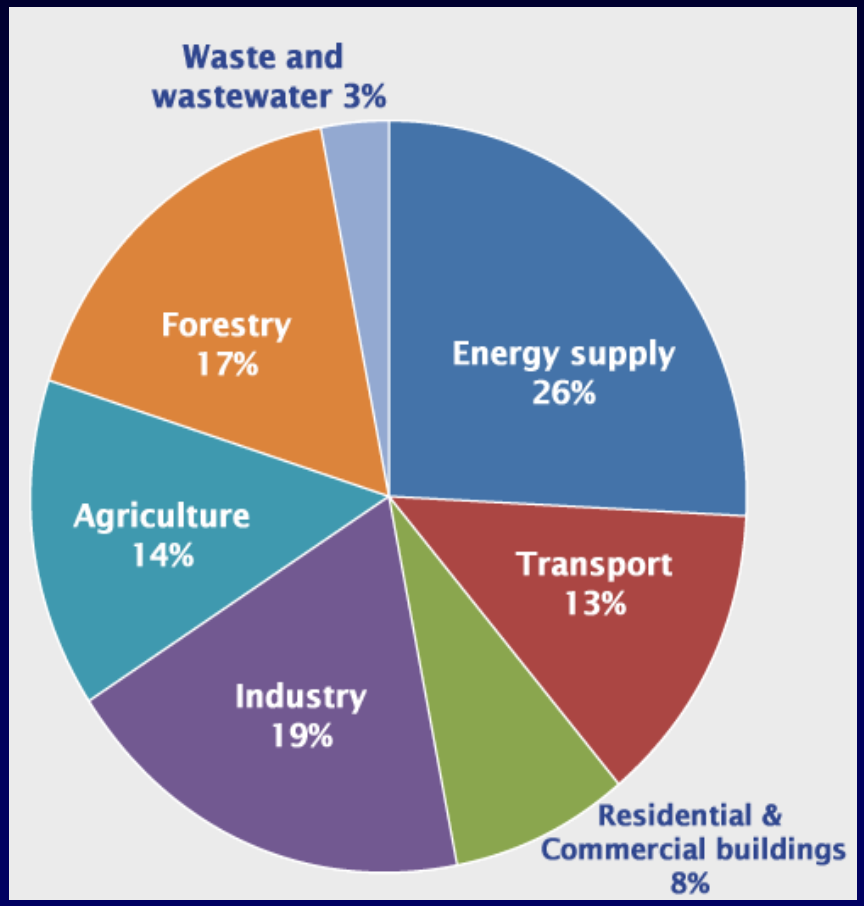
Energy analysis in agriculture

- **The energy analysis may be a useful tool for mapping the variation of**:

- Total energy inputs
- total energy outputs,
- energy efficiency and
- greenhouse gas emissions.

- **aim: best management of energy inputs/protection of the environment**.

GHG emissions by sector, Agriculture



Greenhouse gas emissions from agriculture mostly come from the management of agricultural soils, livestock, rice production, and biomass burning.

Source: IPCC (2007); based on global emissions from 2004. Details about the sources included in these estimates can be found in the Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

<u>Energy analysis studies</u>: Lab. Ecology and Environ. Protection, School of Agriculture, Forestry and Natural Environment

<u>Vineyards, CY</u>

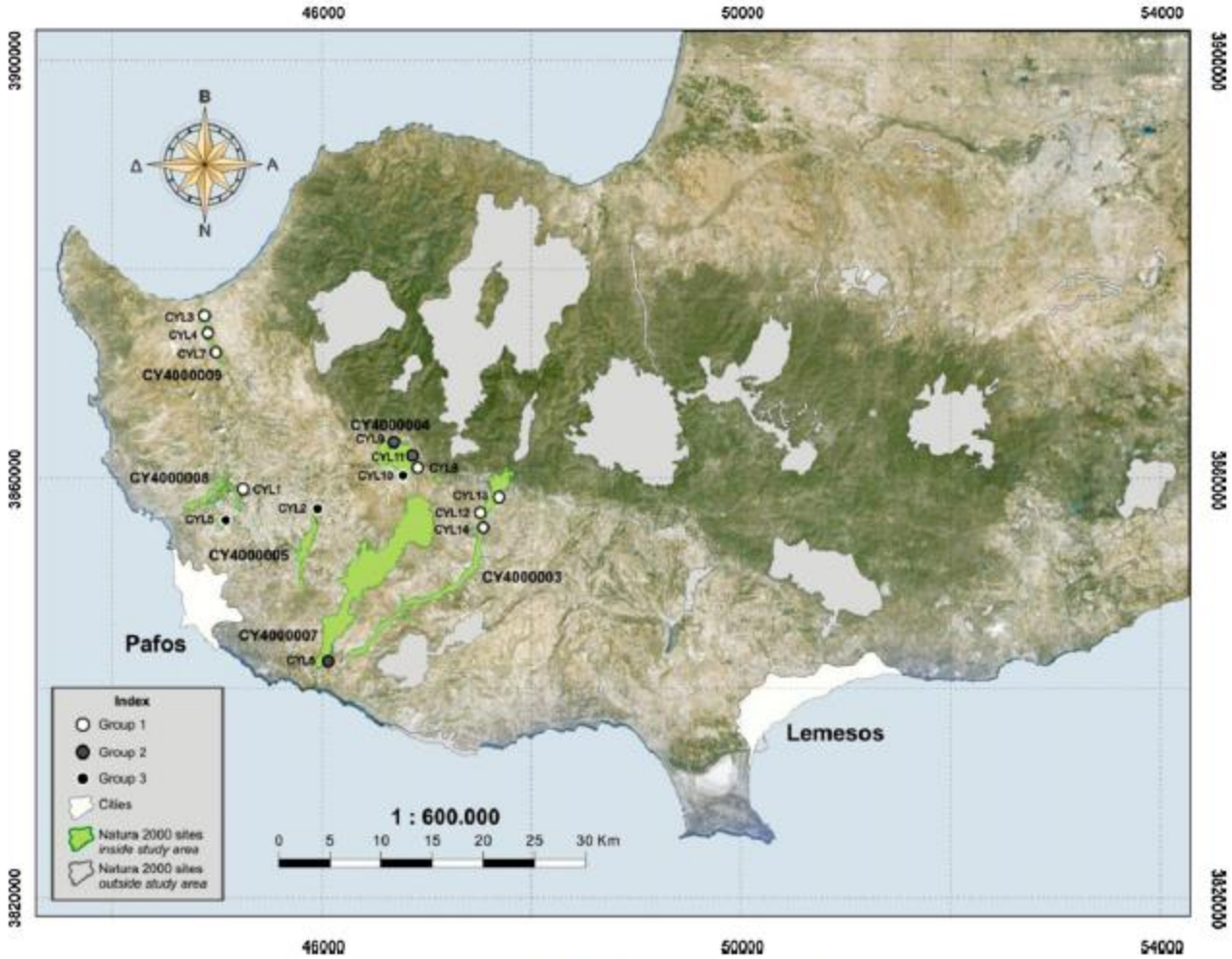


Fig. 1. GIS-based map with respective groups of hierarchical cluster analysis (HCA) of selected vineyards in Natura 2000 network sites in southwest part of Cyprus.

Energy analysis in agriculture

Table 4 – Parameters of energy balance (means; n = 10) for conventional and organic sweet cherry orchards. For each parameter, farming systems' means followed by different uppercase letters are statistically significant different at P < 0.05 according to Mann–Whitney test.

Parameters	Unit	Conventional	Organic
Total energy inputs	GJ ha^{-1}	55.21^{A}	60.15^{B}
Renewable energy inputs	GJ ha^{-1}	9.83^{A}	28.61^{B}
Non-renewable energy inputs	GJ ha^{-1}	45.62^{A}	31.53^{B}
Energy shoot outputs	GJ ha^{-1}	33.94^{A}	23^{B}
Energy fruit outputs	GJ ha^{-1}	11.32^{A}	5.68^{B}
Energy shoot + fruit outputs	GJ ha^{-1}	45.26^{A}	28.68^{B}
Fruit production	Mg ha^{-1}	4.30^{A}	2.16^{B}
Energy use for irrigation application[a]	Mg MJ^{-1}	0.38^{A}	0.11^{B}
Energy use for fertilizer application[a]	Mg MJ^{-1}	0.59^{A}	0.05^{B}
Energy use for fuel[a]	Mg GJ^{-1}	0.22^{A}	0.13^{B}
Energy use for fertilizer[a]	Mg GJ^{-1}	0.54^{A}	0.08^{B}
Intensity[b]	MJ kg^{-1}	17.09^{A}	27.85^{B}
Energy shoot efficiency[c]		0.61^{A}	0.38^{B}
Energy fruit efficiency[d]		0.21^{A}	0.09^{B}
Energy shoot + fruit efficiency[e]		0.82^{A}	0.48^{B}
Non-renewable energy efficiency[f]		1.08^{A}	0.91^{B}
Non-renewable energy consumption[g]	GJ Mg^{-1}	10.52^{A}	14.93^{B}

a Fruit production/energy inputs for each factor.
b The reciprocal of energy productivity.
c Shoot outputs/total inputs.
d Fruit outputs/total inputs.
e Shoot + fruit outputs/total inputs.
f (Shoot + fruit) outputs/non-renewable energy inputs.
g The ratio of non-renewable energy inputs/fruit production.

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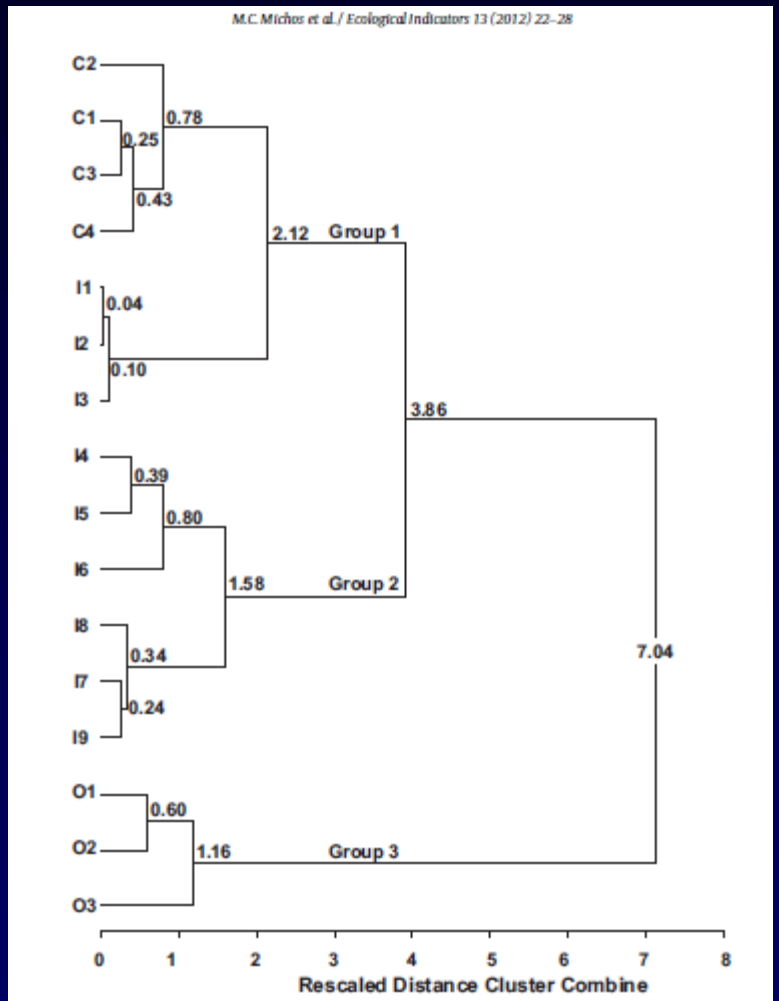


Fig. 3. Dendrogram of HCA. Numbers indicate the rescaled cluster linkage distance.

Ecological Indicators 13 (2012) 22–28

Cherry and Peach, N. Greece

Agricultural production methods

- **Is it organic, conventional, integrated?**

or

- **Low inputs and high inputs agriculture?**

Study

The variation of management practices in olive groves was related to:

- total energy inputs,
- total energy outputs,
- energy efficiency and
- greenhouse gas emissions.

Methods

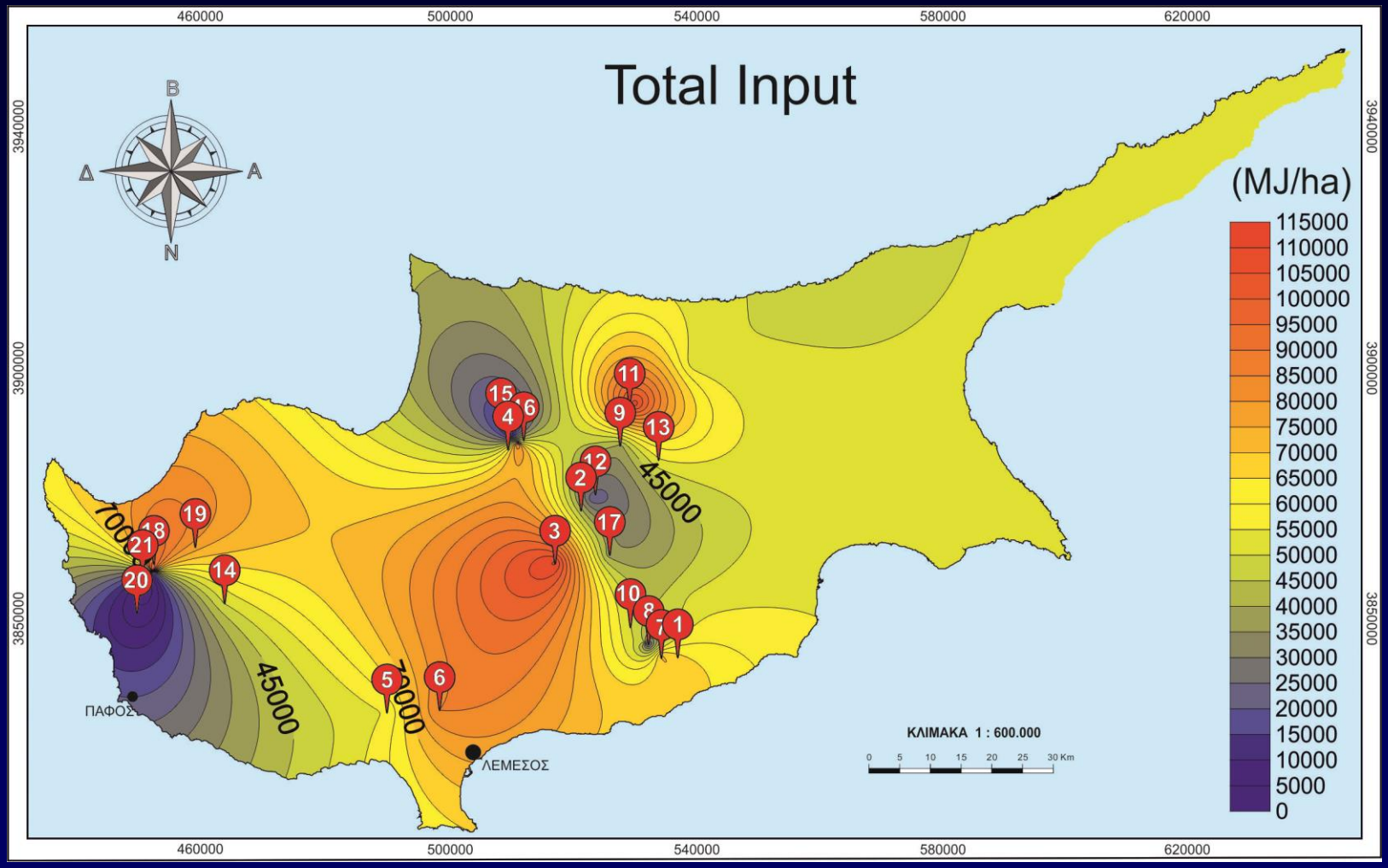
- Twenty one olive groves from different sites in Cyprus were selected.
- Management practices were recorded (e.g. all inputs and outputs for olive cultivation).
- All data were converted to energy according to LCA and IPCC methodologies.
- The *Kriging interpolation method was used*, a system of linear equations, to create a grid of values for mapping the variation of energy inputs and outputs, energy efficiency and greenhouse gas emissions.

Methods-GIS

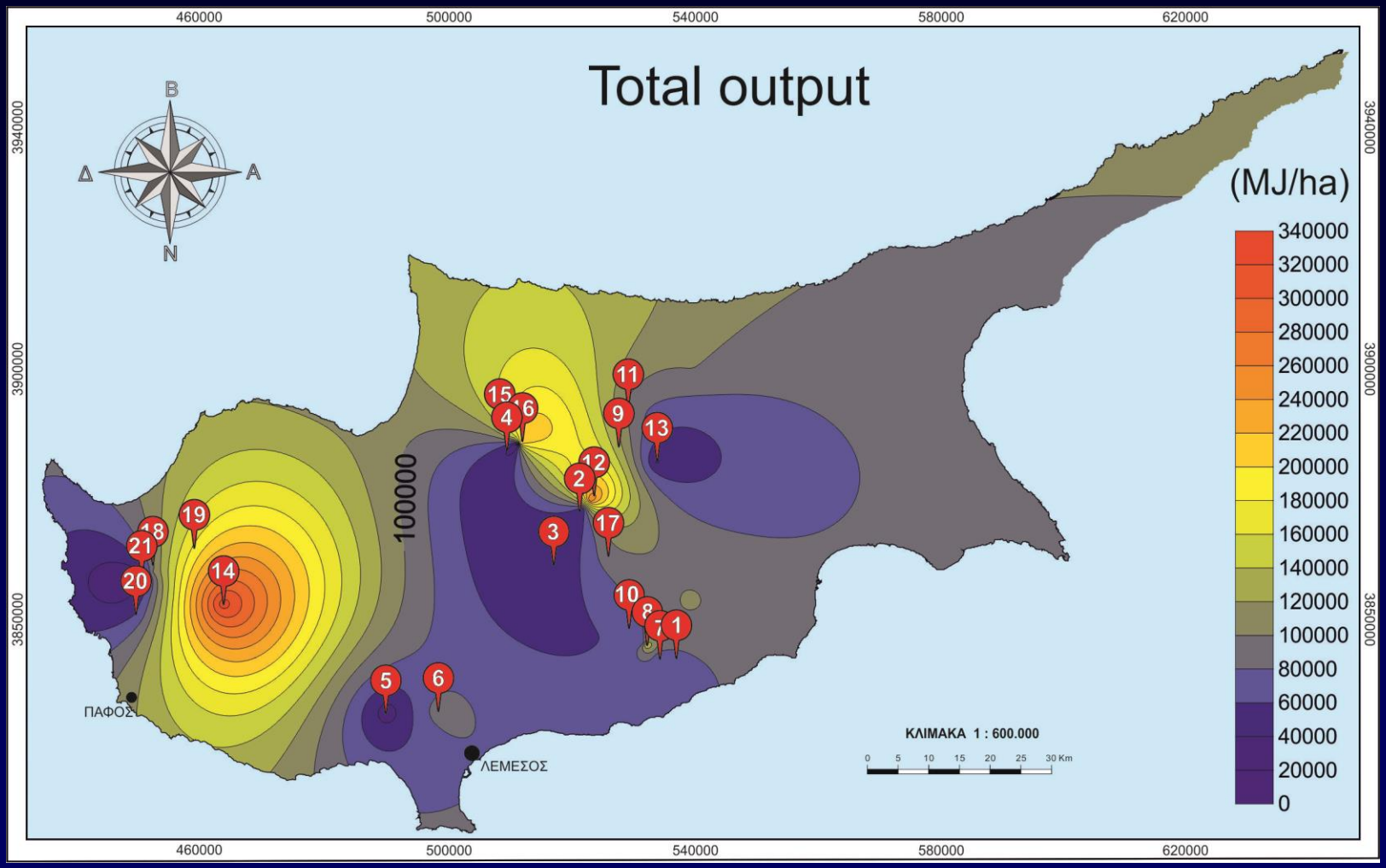
In a Geographical Information System (G.I.S.), interpolation with the form of a contour map was used showing the expected spatial distribution of the:

- total energy inputs (MJ ha^{-1}),
- total energy outputs (MJ ha^{-1}),
- energy efficiency for olive groves (Total energy outputs/total energy inputs),
- and impacts of greenhouse gas emissions (CO_2 kg ha^{-1}, CH_4 g ha^{-1}, N_2O g ha^{-1}, and CO_2 equivalent kg kg^{-1} olives).

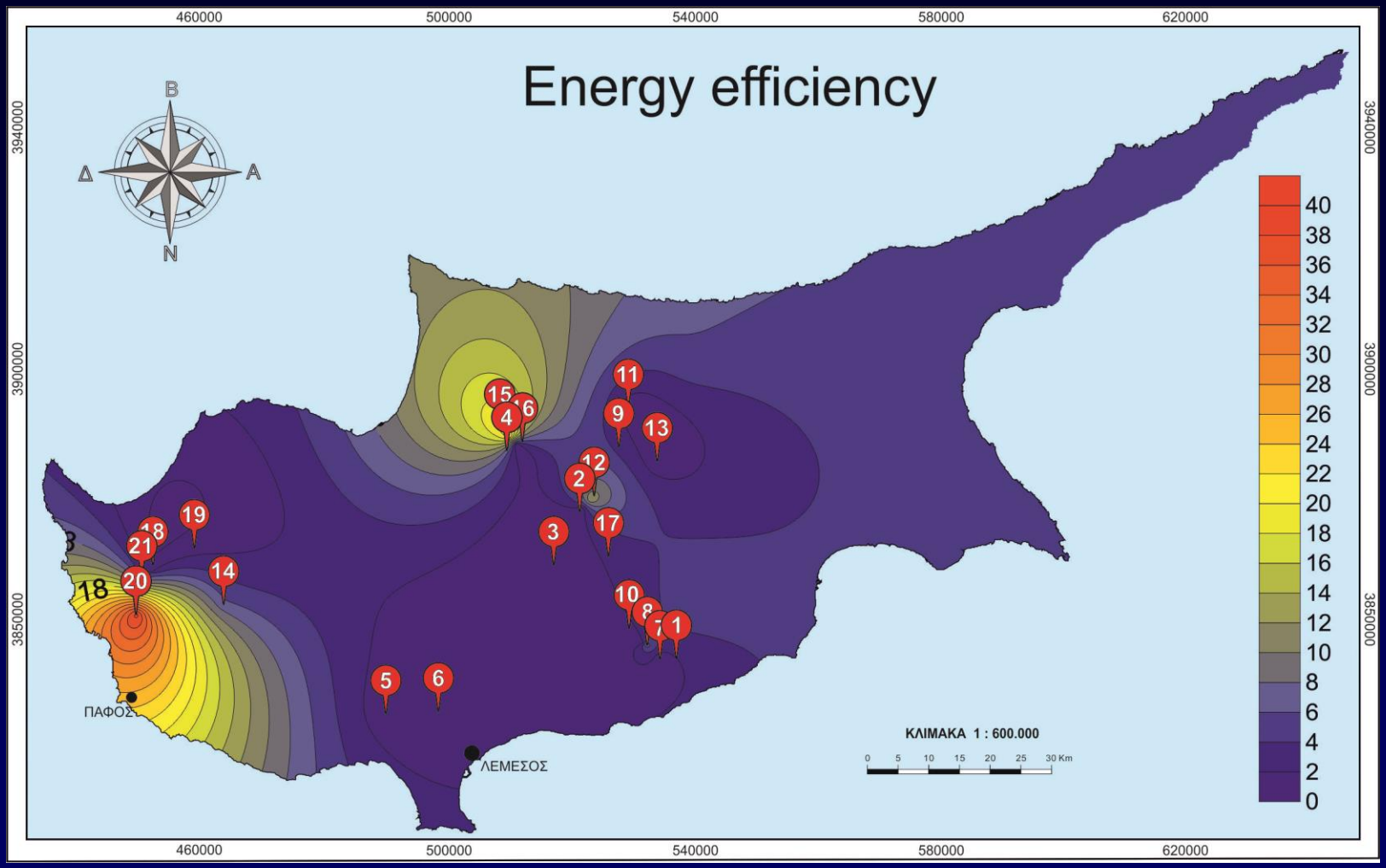
Results


Total Input
(MJ/ha)
115000
110000
105000
100000
95000
90000
85000
80000
75000
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
460000
500000
540000
580000
620000
3940000
3900000
3850000
B
Δ
A
N
45000
45000
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000
0 5 10 15 20 25 30 Km

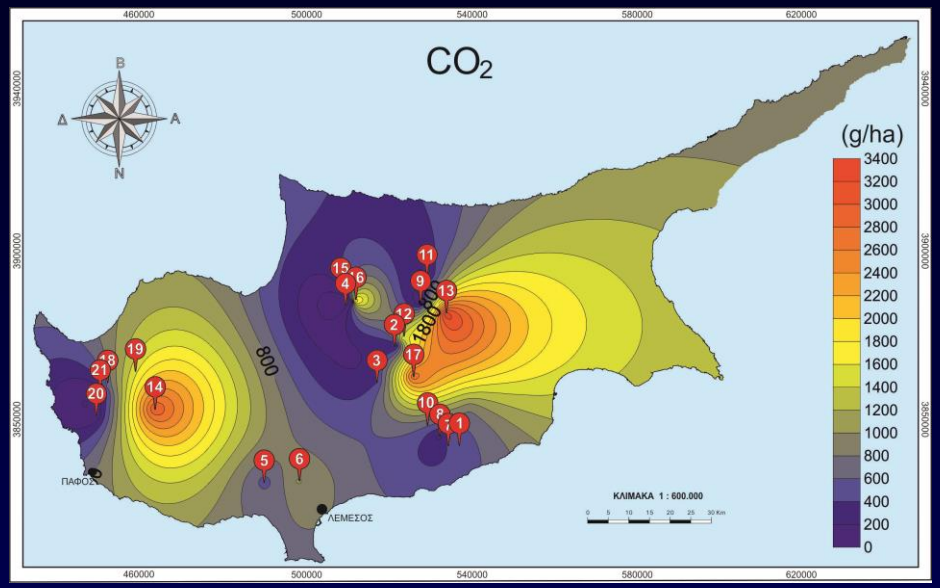
Results

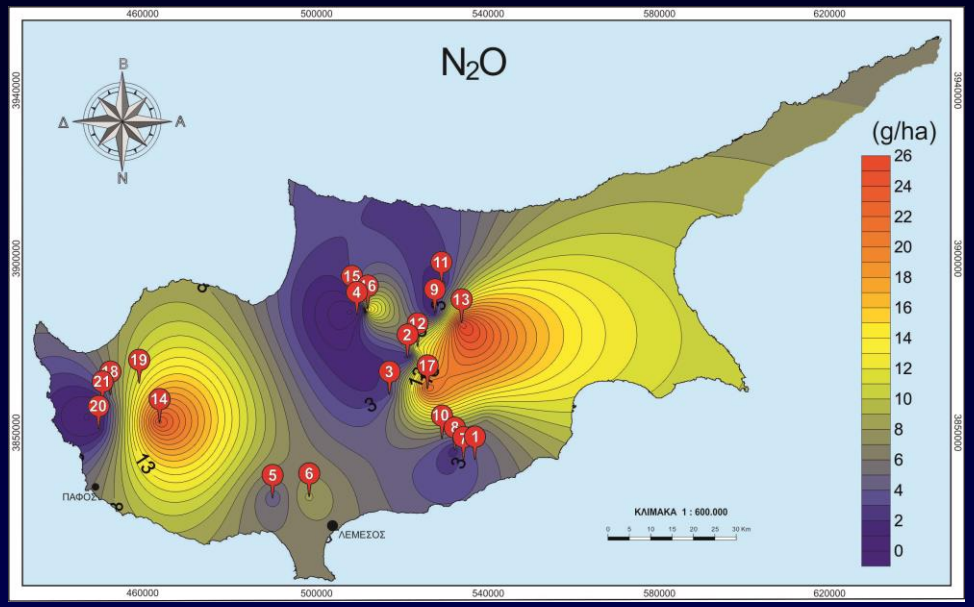

Total output
(MJ/ha)
340000
320000
300000
280000
260000
240000
220000
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
460000
500000
540000
580000
620000
3940000
3900000
3850000
B
Δ
A
N
100000
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000
0 5 10 15 20 25 30 Km

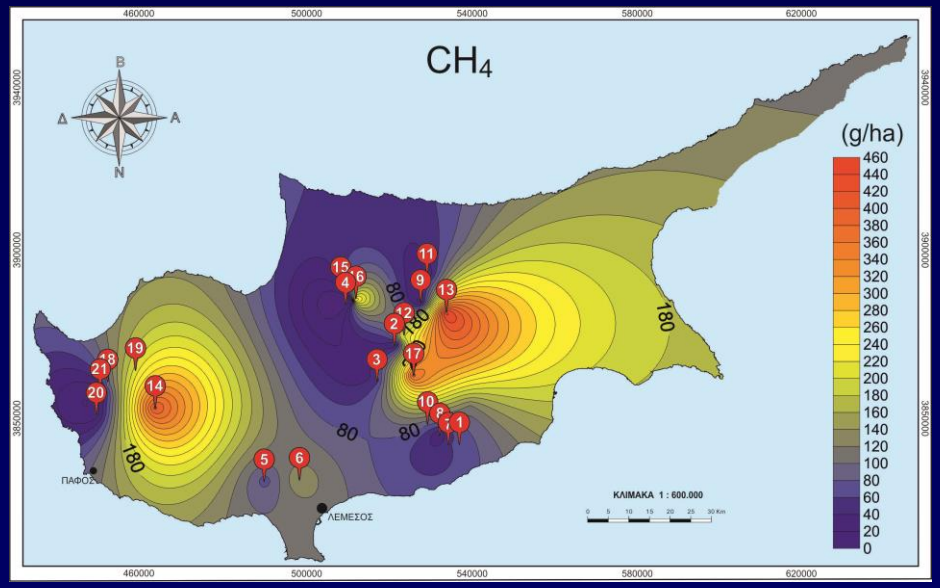
Results

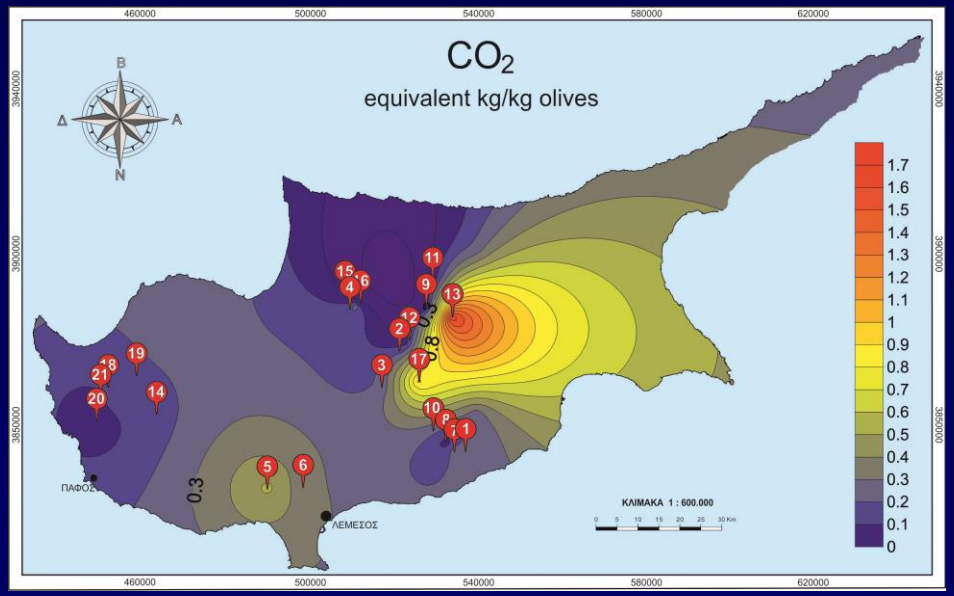

Energy efficiency
460000
500000
540000
580000
620000
3940000
3900000
3850000
B
Δ
A
N
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000
0 5 10 15 20 25 30 Km
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0

Results


CO_2
(g/ha)
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000


N_2O
(g/ha)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000


CH_4
(g/ha)
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000


CO_2
equivalent kg/kg olives
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
ΠΑΦΟΣ
ΛΕΜΕΣΟΣ
ΚΛΙΜΑΚΑ 1 : 600.000

Carbon labels for Cypriot olives and olive oil?

CARBON LABEL

Conclusions

- High and low energy inputs areas in the Island.
- High input does not necessarily mean high output and better economic results for the producer and the sector.
- Employing GIS in our analysis allows for better evaluation (and enables visualization) of the results and more appropriate management of the olive orchards.
- Appropriate inputs management means environmental protection and all this could be highlighted in the marketing strategy for the olive sector.

Future research

- Local VS imported olive varieties and energy budget and GHG emissions.

- Holistic approach for GHG emissions from the agricultural sector, using the appropriate IPCC models and the GIS technology.

Thank you for the opportunity and for your attention!