Ecosystem Services: Contribution of Natura 2000 Network in the economy and society of Crete

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Abstract

The aim of this study has been to map the benefits provided by the ecosystems within the Natura 2000 (N2k) network of Crete and assess its importance to the island's society and economy. GIS were utilised to create an integrated platform (Clearing-House Mechanism, CHM) consisting of the most relevant and up to date data for quantitative and qualitative evaluation Ecosystem Services (ES) at regional and/or national scale. Spatial and non-spatial data were merged to provide indicators of provisioning ES. Spatial data produced led to estimates of the contribution of Natura 2000 Network areas in Crete's primary sector, in relation to demography and employment patterns. Maps were further utilised to inform, communicate and raise awareness for the importance of the N2k network to the society and economy of the island.

Keywords

Ecosystem Services, Natura 2000, Clearing-House Mechanism, GIS, Greece, Crete, primary sector, employment, demography

Introduction

Natura 2000 (N2k) Network plays a key role in the conservation of the unique and endangered biodiversity in Europe. Moreover, it aims to protect the provision of benefits from ecosystems to both the society and the economy at local, regional, national and international (EU) level 'via the flow of ecosystem services (provisioning, regulating, cultural and supporting services)' (MAES et al. 2012; TEN BRINK et al., 2011, 2013).

A large number of methodologies, platforms and models have been developed by the scientific community for estimating the benefits and services provided by ecosystems (e.g. InVEST, natural capital project). Despite the availability of data banks (e.g. at European scale) more detailed national surveys and useful datasets are often neglected in ES modelling efforts. Exploration and cataloguing of existing data sources at national scale as well as data integration in a common (GIS) platform is the first step towards the assessment of ES at finer scales. The case of Crete constitutes one of the first attempts in Greece.

The purpose of this study was the implementation of a Clearing-House Mechanism (CHM), a platform consisting of the most common, up-to-date and useful data for quantitative, qualitative evaluation and mapping of ES indicators. The CHM and the associated database for Crete aims to improve efficiency and accuracy of future studies and offer a pilot example of mapping of ES provided by the 53 N2k sites of Crete (NYKTAS 2016). GIS has played a central role as the core of the CHM platform.

Methodology

Both geographical and non-geographical data relevant to the quantification of ES at regional and national level were catalogued and included in a ES CHM-GIS database. Data were made available through various agencies and sources such as the Hellenic Statistical Authority (HSA), the Ministry for the Environment and Energy, the European Environmental Agency (EEA), the Joint Research Centre (JRC) etc. Some of the most relevant data includes the following:
1. Corine Land Cover map (2000).
2. Vegetation type maps at national scales,
3. Land Capability and Land Resources Maps,
4. Soil and geological surveys,
5. Priority species and habitats range and distribution
6. Important areas for birds, as well as auxiliary data e.g. administrative units, waterbodies, road network, cities, towns and villages, monuments etc.

Spatial datasets included the EUNIS Habitat Classification of Crete in 2 levels (10 & 61 classes) from EEA. Supplementary recent high-resolution satellite images (RapidEye, 2016, 5m) were acquired to assist interpretation and future LC/LU assessments.

Important non-spatial data for the assessment of ecosystem services include census data collected by the HSA. The annual special statistical survey on agriculture and livestock farming in each Municipal Community (MC) of Crete (2010 census) was used in the present study. Information on the area covered by several types of crops, the number of fruit trees, agricultural and livestock production, livestock capital, as well as certain data on inshore fishing was the basis for the assessment and comparisons in the present study. Additional valuable information that links ecosystems with society and economy is related to the demography and geographical distribution of the island's population. The data used in this study refers to each MC in Crete and is related to the population, the employment numbers, as well as the workforce allocation per sector (2011 census) (NYKTAS 2016).

Processing of data involved merging of spatial and non-spatial (i.e. census) data, leading to a geographical representation of key provisioning ES, as well as social and economic indicators at MC administrative unit scale. Out of 205 different agricultural and livestock products, 24 were selected to be used as indicators of provisioning ES. Additionally, 6 demographic and employment indicators were included. The geographical dimension gained by linking GIS, demographic and agricultural-livestock census data, enabled various comparisons to be made between the areas of N2k sites in relation to the rest of Crete (NYKTAS 2016).

A methodological choice that had to be addressed in the course of this study is related to the borders of the MCs not coinciding with those of N2k sites. In that respect, the assumption made also for data processing is that ecosystems of N2k Network provide services and benefit communities within their borders, as well as closely neighbouring communities. Therefore, it was decided that all MCs that have at least 1% of their area within a N2k site were included in further processing (NYKTAS 2016). Provisioning ES for MCs intersecting N2k site borders were proportionally included in calculations using MCs mean value. In this way, the results would be more representative of the area designated as a N2k site.

Supplementary information was gained from Level 1 EUNIS Habitat Classification at European scale. Area distribution in each ecosystem type was calculated, as well as the proportion of each type within the island's N2k Network. The GIS software version used in the study was ArcGIS 10.2. Statistical data was merged with the polygons of the MCs and comparisons were performed in spreadsheet (NYKTAS 2016).

Results

Outputs of the present study include:
1. the percentages of the main ecosystem types in Crete and the proportion of each type within N2k Network (Tab. 1),
2. estimates of 24 indicators of provisioning services (Tab. 2) and
3. 6 indicators of population and employment (Tab.3). Comparisons were made between the areas within or close to N2k sites of Crete in relation to the rest of Crete.
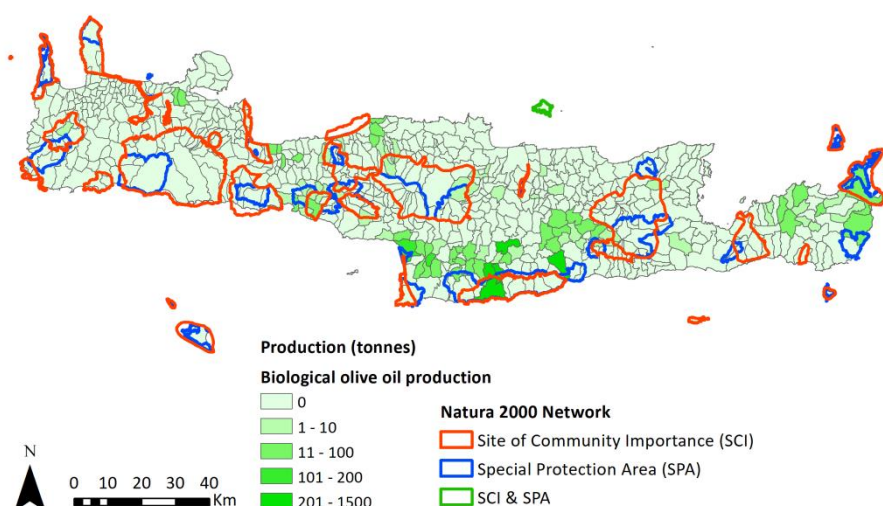
In total, thirty-one (31) maps were created: one map depicting the types of ecosystems in Crete, twenty-four maps of the geography of the primary sector in Crete, two demographic maps and four maps related with employment patterns in each economic sector.
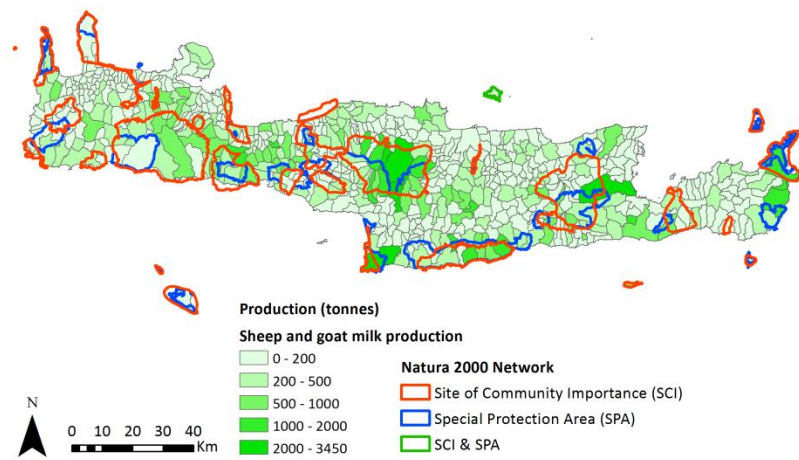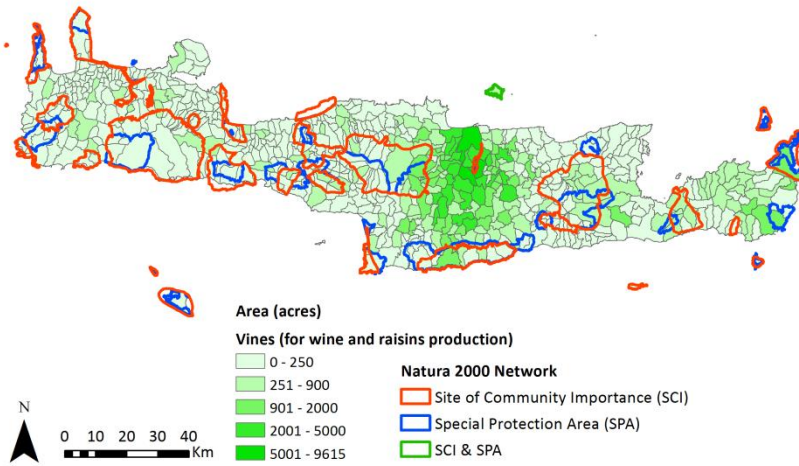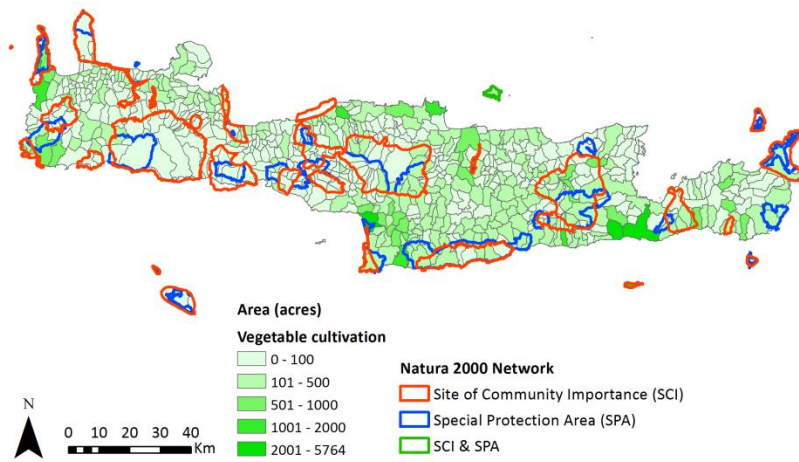
Ecosystem Type	Crete (ha)	% of Crete's area	% of habitat in the Natura 2000 Network
Marine			
Coastal	23707	2.8	46
Fresh water	144	0	44.4
Grassland	216122	26	37.8
Heathland and shrub	211765	25.4	40.1
Woodland and forest	253302	30.4	20.6
Sparsely vegetated land	27199	3.3	78.4
Cropland	88386	10.6	15.2
Urban	11858	1.4	5.2
Total	832483		

Table 1: Ecosystem types of Crete (EUNIS Level 1); proportion of island's total area and within N2k Network.

Indicators of provisioning services provided by agroecosystems	% within the Natura 2000 Network	% outside the Natura 2000 Network
Total area of big scale crops (cereals, legumes, fooder)	24	76
Total area of arable land	23.5	76.5
Total area of vegetable cultivation	23.5	76.5
Olive oil production	19.8	80.2
Tree cultivation area	22.7	77.3
Vines (for wine and raisins production)	16.8	83.2
Local and European beehives	44.3	55.7
Sheep and goat milk production	33.5	66.5
Sheep meat production	32.6	67.4
Goat meat production	34	66
Firewood production	22.2	77.8
Quantity of olive oil produced in the oil factories	16.7	83.3
Quantity of biological olive oil produced in the oil factories	27.8	72.2
Cheese and dairy production	40.9	59.1
Sheep wool production	36.4	63.6
Goat hairs production	49.5	50.5
Honey production	47.4	52.6
Wax production	55.2	44.8
Hides and skins from small animals	21	79
Hides and skins from large animals	3.8	96.2
Fisheries	19.1	80.9

Table 2: Geographical distribution of agricultural & livestock production in Crete (Source: HSA, 2010).

Area (acres)

Vegetable cultivation
- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 2000
- 2001 - 5764

Natura 2000 Network
- Site of Community Importance (SCI)
- Special Protection Area (SPA)
- SCI & SPA

N

0 10 20 30 40
Km

Area (acres)

Vines (for wine and raisins production)
- 0 - 250
- 251 - 900
- 901 - 2000
- 2001 - 5000
- 5001 - 9615

Natura 2000 Network
- Site of Community Importance (SCI)
- Special Protection Area (SPA)
- SCI & SPA

N

0 10 20 30 40
Km

Production (tonnes)

Sheep and goat milk production
- 0 - 200
- 200 - 500
- 500 - 1000
- 1000 - 2000
- 2000 - 3450

Natura 2000 Network
- Site of Community Importance (SCI)
- Special Protection Area (SPA)
- SCI & SPA

N

0 10 20 30 40
Km

Figures 1-4: Four examples of provisioning ES depicted in map form: 1) biological olive oil production, 2) vegetable cultivation, 3) vine crops & 4) sheep & goat milk production (Source: HSA, 2010).

Indicators of population and employment	within the Natura 2000 Network	outside the Natura 2000 Network
Distribution of population	7%	93%
Population density (hab/ha)	16.8%	103.8%
% of economically active population (% of economically inactive population)	37% (63%)	44% (56%)
% of economically active population in primary sector (% of economically inactive population in primary sector)	35.7% (64.3%)	10.8% (89.2%)
% of economically active population in secondary sector (% of economically inactive population in secondary sector)	9.7% (90.3%)	12.5% (87.5%)
% of economically active population in tertiary sector (% of economically inactive population in tertiary sector)	46.9% (53.1%)	60.9% (39.1%)

Table 3: Geographical distribution of population & employment in Crete (Source: HSA, 2011).
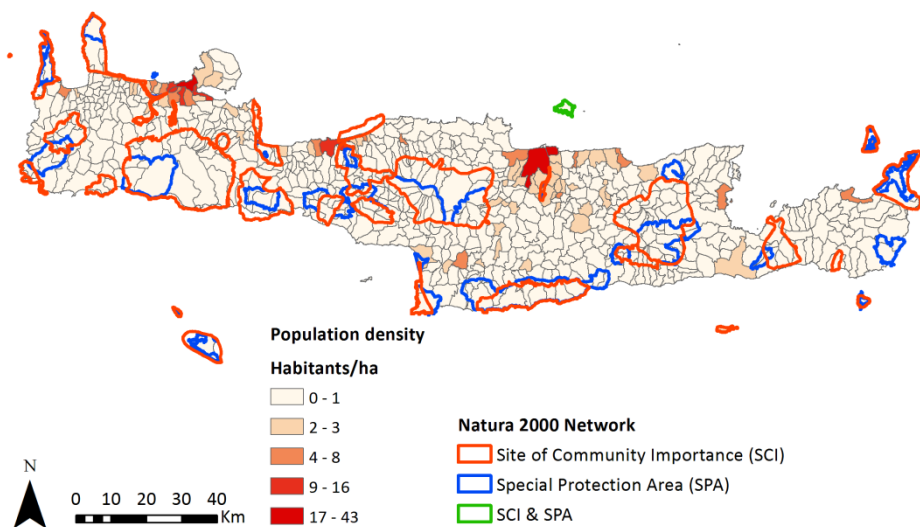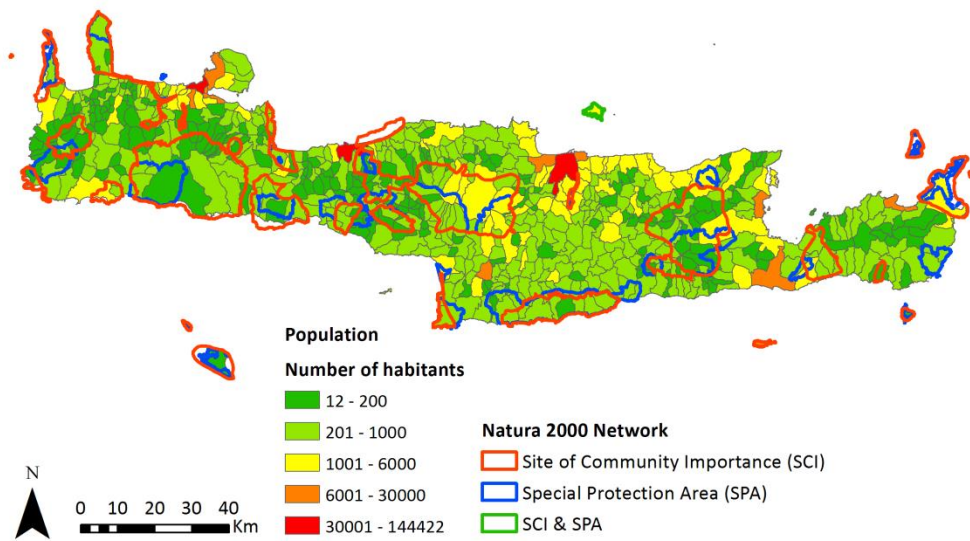
Figures 5-6: Geographical distribution of population & population density in the MCs of Crete.

Conclusions

The terrestrial part of N2k network covers 31.8% of the total area of Crete, while the mountainous areas represent 50.1% of N2k sites area. The allocation of ecosystems within N2k is balanced with regards to natural habitats, whereas cropland and urban areas are underrepresented as expected. Even though sparsely vegetated areas occupy only 3.3% of Crete, a high proportion of them (78.4%) are included in the N2k network (Tab. 1). Protection of mountainous areas reflects the importance of these habitats for many endemic and rare species, as well as the key role of those areas in Crete's water resources management.

The results of agricultural and livestock production demonstrate a notable production derived from the primary sector within or close to N2k sites. Livestock production in particular stands out. Despite that only 7% of the population of Crete lives within the protected areas (Tab. 3), sheep and goat milk production *(Map 4)*, as well as cheese and other dairy production ranges from ~33% to ~41% in N2k sites. Similarly, sheep and goat meat production in N2k sites represents about 33% of the island's total production (Tab. 2). Crop fields (excluding tree crops) cover 10.6% of Cretan land, while 15.2% of them is found within the N2k Network (Tab. 1).

Basic agricultural products such as cereals, vegetables, fruits and grapes, support Cretan economy and are produced in significant quantities within protected areas (24%, 23.5%, 22.7% & 16.8% respectively). Organic and conventional olive oil production within N2k Network is 60.5% και 35.3% respectively *(*Fig. 1-3, Tab. 2*)*. These numbers are noteworthy given the importance of olive oil production and export to Crete's economy.

More than 20% (120 out of 578) of MCs have at least part of their land within N2k Network. Population numbers and density within N2k sites (Fig. 5-6, Tab. 3) are low especially when compared to the production of the primary sector in those areas. With regards to the employment, the economically active population in the areas outside of N2k Network of Crete is the 44% of the total population as opposed to 37% of the population of the rural areas of N2k Network, most possibly related to the aging of the population in those areas. The population within or close to N2k sites that works in the primary sector is 35.7% of the total active population as opposed to 10.8% outside of the protected areas (Tab. 3). All the above emphasize the threat from further depopulation of rural areas of Crete and its detrimental effects in Crete's primary sector and overall economy.

Discussion

The preliminary findings of the present study for the island of Crete highlight the importance of a CHM and GIS for the evaluation and monitoring of the ES provided by N2k Network. GIS is an essential tool for collating and visualizing various indicators depicting the significance of N2k Network to the society and the economy of the region. Spatially explicit outcomes of this study could provide policy directions for the sustainable management of the areas within and outside N2k Network. Furthermore, outcomes have been an indispensable input for the production of educational and instructive material raising public awareness regarding the importance of the N2k network in Crete.

Acknowledgements

References

BURKHARD, B. & MAES, J. (eds.) 2017. Mapping Ecosystem Services. Pensoft Publishers, Sofia, 374 pp.

MAES, J. et al. 2012. Mapping ecosystem services for policy support and decision making in the European Union. Ecosyst. Serv. 1: 31-39.

NYKTAS, P. 2016. Action B1: Information update and establishment of a Clearing-House Mechanism for the NATURA 2000 Network in Crete. Evaluation report of the current ecological, social and economic situation of the Natura 2000 sites in Crete and a framework for linking ecology and economics. Produced in the framework of the LIFE Natura2000 Value Crete (LIFE13 INF/GR/000188).

TEN BRINK, P. et al. 2011. Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network. Final Report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy (IEEP), GHK, Ecologic Institut, Brussels.

TEN BRINK, P. et al. 2013. The Economic benefits of the Natura 2000 Network. Synthesis Report. Institute for European Environmental Policy (IEEP), GHK, Ecologic Institut, Metroeconomica, EFTEC, Luxembourg.

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