THE IMPLEMENTATION OF A GIS AS AN EFFECTIVE TOOL FOR THE VALORIZATION OF TYPICAL FOOD PRODUCTS FROM MARGINAL AREAS

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Abstract
The economy of marginal areas is frequently compromised by the inadequacy of the transport system, lack of co-operation between farms, and insufficient distribution of their typical products, whose valorization may be an important factor for exploiting rural tourism. In those areas, the problem that more frequently arises is the difficulty in planning land development, due to the lacking or poor knowledge and classification of every information, together with the inadequate capability to get new information and to simultaneously analyze several different data. In this paper, a GIS method has been employed for an application in land use planning with reference to an internal area of Basilicata Region (Southern Italy), well known for its typical food products (sheep and goat cheese). This GIS has been implemented, so as to match information of geographical level (terrain height, gradient, slope orientation, soil utilization, structures and infra-structures, *etc.*) with pasture characteristics (pasture aromatic herbs, grass percent coverage, nutritional values, *etc*.). It has revealed a very useful tool, allowing to individuate new areas that may be devoted to pasture, with the best characteristic and highest potential performance, able to contribute for an increase of quantity and a standardization of quality in production of "*Pecorino"* cheese.

Key words: Internal areas; Built heritage; Traditional foods; Rural tourism; Landscape protection.

Introduction

Sheep and goat breeding occupies an important place in animal husbandry conducted in internal areas, not only because of the economic weight of its production, but also because of the social aspects connected with this activity (Picuno C.A. et al., 2017; Statuto & Picuno, 2017; Picuno C. et al., 2020). Products derived from sheep and goat milk have very different characteristics, often original, whose diversity is closely linked to the peculiarities of the breeding areas and production techniques, often connected to ancient and consolidated traditions. In some Italian internal regions, most of farms are located in mountainous areas (Statuto et al., 2017; Picuno C. et al., 2019), which further accentuates marketing problems, while at the same time it highlights the different characteristics of the production area. The present paper aims, through a GIS approach, at the identification of the main characteristics of the pasture sites used by sheep and goat farms producing "*Pecorino*" cheese, within a study area delimited on the basis of homogeneity characteristics of this cheese production (Statuto et al., 2013).

Material and methods

The study area, located in Basilicata Region (Southern Italy - figure 1), comprises 31 municipalities, which are currently included in the specification for the production of *'Pecorino di Filiano*' cheese.

In this area, agriculture has always been one of the main livelihood factors for the resident population (Statuto et al., 2019). Aim of the present work has been to inventory, integrate and correlate, by means of spatial superimposition, all the information useful for the creation of a decision support system. This result was obtained by dividing the operations into the following phases:
A) identification and filing of the following basic information layers:
- administrative limits;
- inhabited centres;
- road network;
- hydrological data;
- sheep and goat farm locations.
- geo-lithological data;
- altimetric data;
- vegetation data;
- thermo-pluviometric data;

B) inventory and update all information useful for the creation of the relevant data-base (Table 1).

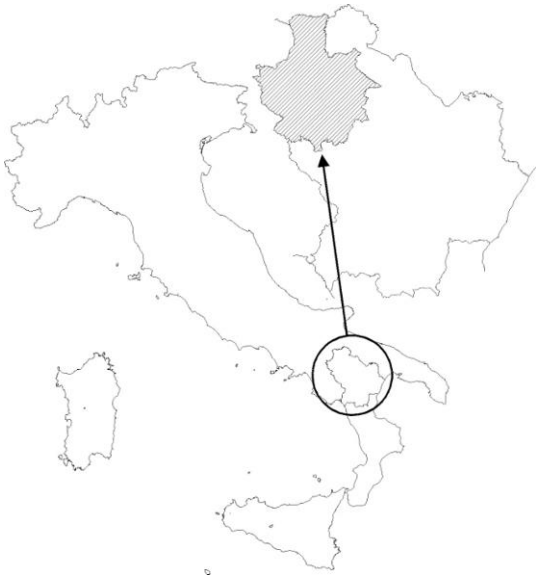

Fig.1: Basilicata Region and study area (in grey color).

Tab. 1: Homogenization and integration of the basic information layers

LAYER	QUALITY
Elevation belts (DEM - Digital Elevation Model)	MORPHOLOGICAL
Slope	
Exposure	
Permeability	CLIMATIC
Temperature-rainfall	
Phyto-climatic belts	
Land use	VEGETATIONAL
Map of areas currently used for grazing	
Farm buildings distribution	ANIMAL HUSBANDRY

In order to evaluate the productive potential of the pastures used by the flocks in this area, a specific Geographical Information System has been implemented. Once the archiving, homogenization and integration of the data has been completed, the layers have been set up, through appropriate processing, then grouped into distinct "quality" classes, which proved particularly useful in subsequent resampling operations. After the first processing, the data were re-sampled, attributing a different degree of importance (operation of "*weighing*" the information layers) both to each class of the single theme and to the different thematic levels obtained, in order to characterize the areas with greater production potential. In order to assign the weights, the influence of the single factors was first identified, and then the weights were assigned to the different information levels and quantified according to the estimated forage productivity. After resampling, the themes were processed using multiplicative algorithms. The result of the simultaneous processing of the information levels is a summary map called the “Grazing Potential Map” (Figure 2).

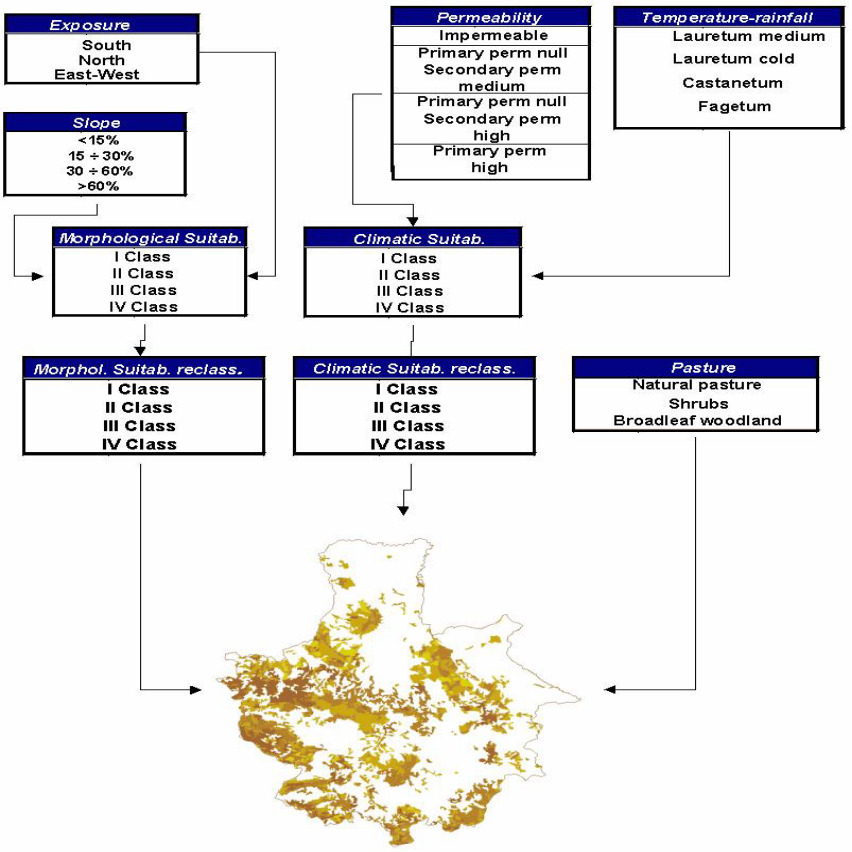

Fig. 2: Grazing potential map

Then, considering that the characteristics of greater or lesser value of pastures can be identified through agronomic and nutritional parameters, some of these parameters were measured on a sample of farms in the study area. These data, concerning both sheep and goat farms, as well as the pastures they use, were grouped in five classes (Table 2) in order to show the relationship between the types of supplements and the classes of grazing potential, making them comparable with the previous elaborations, so as to be superimposed on the grazing potential map.

Tab. 2: Pasture classes, grouped depending on supplied food supplements

	V CLASS	IV CLASS	III CLASS	II CLASS	I CLASS	TOT
Oat	6	6	0	5	0	17
Oat, barley, maize, broad beans	7	3	1	1	1	13
Oat, barley	4	1	1	3	3	12
Barley, maize, broad bean	0	4	0	3	0	7
Oat, barley, broad bean	0	2	1	0	0	3
Maize, barley	1	2	0	0	0	3
No food supplement	1	2	0	0	0	3
Oat, maize	0	0	0	2	0	2
Oat, maize, barley	1	0	0	1	0	2
Barley	2	0	0	0	0	2
TOT	22	20	3	15	4	**64**

Results

A first verification of the reliability of the new information level obtained was carried out by overlaying the location of the sheep and goat farms on the grazing potential map reported in figure 2. This overlay operation highlighted how, while the greatest number of small farms falls in areas belonging to lower grazing potential classes, farms with a greater number of animals are located in portions of the territory identified by a higher value of grazing potential (fig. 3/a).

Then, the "propensity to graze" of the areas used for cereal production has been finally assessed by superimposing the agronomic and nutritional parameters (tab. 2) on the grazing potential map (fig. 2).

This, allowed to highlight the classes of potential, proving that most of the area shows a strong vocation for grazing (fig. 3/b).

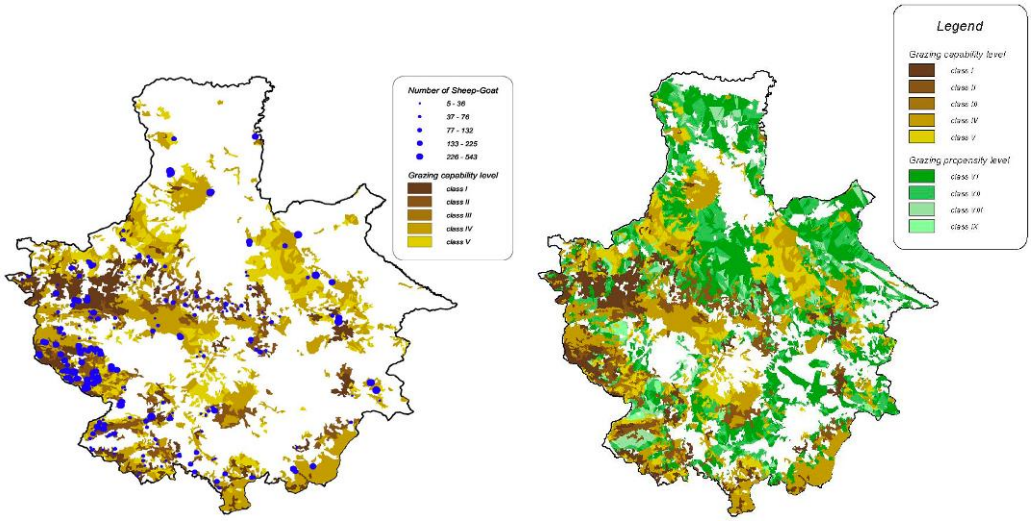

Fig. 3: a/Grazing potential crosse with position of sheep-goat raising farms (left);
b/Grazing propensity map (right)

Discussion

The obtained results show how they are strongly dependent on the possibility that large areas of agricultural land - currently used for cereal cultivation, since they benefit from economic subsidies provided by the European Union – may change their use, since these subsidies would cease in the near future. This, may relaunch pasture areas, boosting production of *pecorino* cheese as well.

The spatial overlay highlighted also how the values of energy contained in the milk produced from the ingestion of 1 kg of standard barley has increased in correspondence to classes with higher potential, thus confirming the better predisposition to grazing of areas identified with higher pasture potential. This elaboration, carried out considering the distribution of some qualitative parameters (*e.g.*: Dry Matter - DM; Rough Proteins - RP; Rough Fibers - RF) showed that, as for DM, the classes with the highest potential coincide with the highest values, while this result was not obtained for the other two parameters (RP, RF). This discrepancy is probably justified by the variability of the species present in the pasture turf and, in particular, in the associations of legumes and grasses. The greater use of oat as a supplement is due to the greater availability of this foodstuff on small farms with fewer animals, while on farms with a larger number of animals the combinations of oats and barley, and oats, barley, maize and broad beans are more widely diffused.

Conclusion

The elaborations carried out in the present research allowed to create a synthesis informative GIS tool, in which the vocation of pastures towards fodder production is reported. A further refinement of this study can be sought, both by further integration of the qualitative/quantitative data of the pastures and by processing other agronomic parameters.

At the same time, further analysis of the area's road network should be implemented, with special attention on rural tracks/paths, so as to assess the possibility of optimizing the infrastructure network serving the farms, given the extremely important role it plays in the marketing of the produced goods.

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Souhrn
Hospodářství okrajových oblastí je často ohroženo nedostatečným dopravním systémem, nedostatečnou spoluprací mezi zemědělskými podniky a nedostatečnou distribucí jejich typických produktů, jejichž zhodnocení může být faktorem růstu pro země, které se kvůli orografickým a geografickým znevýhodněním často opožďují ve svém hospodářském rozvoji. V těchto oblastech se častěji objevuje problém s obtížemi při plánování rozvoje půdy, který je způsoben nedostatečnou nebo špatnou znalostí a klasifikací všech možných informací spolu s nedostatečnou schopností získávat nové informace a možností analyzovat současně mnoho různých údajů. Z tohoto pohledu se jeví jako velmi užitečný nástroj využití geografického informačního systému (GIS), protože umožňuje porovnat informace geografické úrovně (výška terénu, sklon, orientace svahu, využití půdy, struktury a infrastruktury atd.) s charakteristikami pastvin (aromatické byliny na pastvinách, procentuální pokrytí travou, nutriční hodnoty atd.) V tomto článku byla použita metoda GIS a zpracování obrazu pro aplikaci v územním plánování s ohledem na vnitřní oblast regionu Basilicata (jižní Itálie), známou svými typickými potravinářskými produkty (ovčí a kozí sýry). Cílem tohoto výzkumu bylo zjistit nové oblasti, které mohou být věnovány pastvinám s nejlepšími vlastnostmi a nejvyšším potenciálem, které mohou přispět ke zvýšení množství a standardizaci kvality při výrobě sýra "Pecorino". Zavedený GIS umožnil díky křížení mnoha informačních úrovní získat tematické mapy se specifickým využitím, které zvýraznily oblasti určené k pastvě. Poté byl podle vah přiřazen různý stupeň důležitosti agronomickým a výživovým parametrům, přičemž zvláštní pozornost byla věnována pastvinám a kapacitě ekologické zátěže různých oblastí. Opětovný výběr těchto informačních úrovní vedl k vytvoření konečné tematické mapy - nazvané "mapa náchylnosti k pastvě" - kde jsou zobrazeny oblasti s vyšším produkčním potenciálem a nejlepšími botanickými vlastnostmi. Závěrem lze říci, že tento přístup GIS se tak ukázal jako velmi užitečný nástroj pro zhodnocování potravinářských produktů vnitřních oblastí, a tím i posílení agroturistiky při současné ochraně venkovské krajiny.

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