ENVIRONMENTAL SUSTAINABILITY OF SMALL GRAZING ANIMALS IN THE MEDITERRANEAN AREA

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Introduction

The total number of small ruminants in 1993 was about 1.7 billion of heads, 65% of which was sheep and 35% goats. About 42% of the total number is in Asia, 22% in Africa, 11% in Australia, 8% in Europe and 7% in South America.
During the last twenty years, the worldwide goat and sheep populations have increased by 10%,with peaks up to 19% in Africa.
In the Mediterranean basin, the area subjected to our analysis, the small ruminants breeding has evolved homogeneously compared to the world trend. The current situation is summarised in the table 1.
The data in table 1 highlight that the southern area of the basin (from the Straits of Gibraltar to the Bosporus) the number of goats and sheep is about 127.5 million of heads, whereas in the northern shore (from the Bosporus to the Straits of Gibraltar) the total number is about 60 million of heads (about half of the southern area).
The globalisation of the world economy imposes that the world is viewed into macro areas, and the Mediterranean basin is one of them in all respects, with the peculiarity of being an important meeting point for the northern and southern world.
The pastoral activity characterises both shores of the Mediterranean basin and the related environmental issues are a relevant factor to reflect upon to better understand the future development of the integration policies between the rich and poor economies of the globe.
In the last two decades the breeding sector has significantly evolved with an increase in the number of animals both in absolute values and in relation to the population, with an increase in meat and milk production, particularly in the most developed Countries.
As already highlighted, the number of goats and sheep is increasing, for example:

- in Italy where, after the relevant 50% decrease due to the industrial boom between the '50s and '70s due, the number of heads is now gradually increasing up to the current 11.7 million heads, 1.3 million of whom are goats and 10.4 million are sheep. During the last years, a qualitative improvement of herds and their productions has been recorded; in the Italian regions where pastoralism is the main economic activity, a continuously growing trend has been recorded, as is the case in Sardinia where the total number of sheep has increased from 845,000 in 1881 up to 4,297,000 in 1994 (table 3);
- in Spain, where in the last decades a positive trend has been recorded with a peak at the end of the '80s up to the current 23 million heads (table 2);
- in Algeria, where a trend similar to the other Mediterranean countries can be highlighted with a halving of the sheep population during the '60s, mainly due to the war of independence, followed by a steady increase up to the current 21 million (tables 1 and 4).

Although the pastoral activity is common to both shores of the Mediterranean, differences can be observed in the productive sector: in the southern area meat production prevails, whereas in the northern shore dairy production is more relevant, as shown by the data on milk reported in table 5: the total goat and sheep milk production in the Maghreb Countries and in the Middle East is about 2.5 million tons, whereas in the European Mediterranean Countries it averages 3.6 million tons, although the total number of animals is about half of the southern shore.

Market trend in Europe

In the Mediterranean basin, the market trend of the products from dairy sheep and dairy goats has deeply influenced the development of this sector. In the last two decades, the increasing demand for milk and cheese has resulted in a significant increase in their price. As a consequence, farmers increased production mainly through the enlargement of the existing farms by adopting highly productive techniques.
In the European Mediterranean Countries the increased demand for products from goat and sheep breeding mainly involves milk and cheese, although meat also has a positive trend.
With particular reference to the Countries in the southern shore of the Mediterranean basin, mainly the Maghreb area, the increase in small ruminants meat demand is strictly linked to the population increase and to the increased demand in the urban areas.
In relation to meat consumption in EU, a relevant role has been played by the medical emergencies, the BSE epidemic in particular, that have affected cattle over the last decades and that made consumers to turn to alternative meats. Furthermore, the massive emigration from north Africa and the Middle East (where goat and sheep meat is traditionally consumed) to Europe has increased the demand for these products.
A main reason behind the renewed interest in milk and cheese in the last decades is linked to changes in feeding habits, to the growing consumers' demand for typical and niche products and to the increasing number of food allergies, and in particular the allergies caused by cow milk and cheese. Such allergies mainly concern children and goat and sheep products are an important and valuable alternative.
With reference to goats, in Europe, this favourable market trend has resulted in a productive system able to produce 17% of the world goat milk with only 3% of the total world goat population. Four Countries in particular, Greece, France, Italy and Spain, produce about 86% of the EU goat milk (table 5).

Agricultural policies and goat and sheep breeding.

The development of goat and sheep farming has been highly influenced by the agricultural policies adopted in the European Union in the last twenty years (fig 1 and 2) and by the north African Countries in the years following the colonial period.
In the '70s and '80s the EU Agricultural Policy aimed at increasing the agricultural production in all sectors in order to reduce importation of products, meat in particular, to satisfy its own needs from non-EU Countries.
For this reason, great importance and therefore a relevant economic support was given to increase productivity, to exploit the agricultural lands intensively and to cultivate all areas available.
This policy has caused, on one hand, an increase in the available forage resources and, on the other, the adoption of forage integration also in goat and sheep breeding, with a related increase in the numbers of animals. Furthermore, the price maintenance guaranteed to the community products resulted in a "safe income" to the farmers, and it was linked more to the quantity than to the quality of the production and to the real market trends.

Although the most recent legislation gives more attention to the environment and to the quality of products through incentives to pasture improvement and grants for the late slaughtering of lambs, an increase in stocking rates has been recorded,
Similarly, in the Maghreb Countries the agricultural policies adopted by the national governments after their independence aimed at increasing agricultural productivity to satisfy the Country's own needs as well as the exportation of products that guarantee a precious income in hard currency.
Although small ruminants breeding is by tradition the most widespread agricultural activity, greater attention has often been given to cropping, and fruit production in particular, and in some cases (e.g. in Tunisia) with a quite higher support compared to breeding in general, and to pasture improvement in particular.
In addition, the excessive boost towards innovation that often characterises the developing Countries, resulted in the adoption and support of new breeding techniques, mainly intensive breeding, based on permanent herds and on the large use of forage and foodstuff integration.
Furthermore, in the years following the colonial period Governments started up a process of land privatisation into small pieces of land that were given to the farmers; this new property layout clashed with the traditional transhumance, also over long distances, and nomadic breeding systems; wide areas previously subjected to pasture turned into unusable cultivated lands, and even crossing them was more difficult.
Finally, it is worth highlighting that pastures were regulated by non-written laws enforced by traditional institutions (such as the jmaa-s in Morocco) that ruled the life and the economic activities in the rural areas much more successfully that the central Governments ever could. Their loss of authority caused a sort of anarchy in the pasture land utilisation that, together with the reduction of the available lands and the decreased productivity caused by drought of the remaining ones, resulted in a severe crisis of the breeding sector in the Maghreb area.

Cultural traditions
Cultural traditions have always had, and still have, a significant influence on the evolution of the small ruminant breeding
In the northern shore of the Mediterranean basin the development of this sector is mainly linked to its taste whereas in the southern shore the need to guarantee animal protein food to the increasing population is the main factor. It is worth remembering, for example, that in the north African Countries, particularly in the rural areas, animal breeding is not only an important source of food and income, but also a factor that determines the family social status within society. Very often families or clans purchase goods or reach agreements by exchanging animals, the most common way of payment.
Also, sheep meat consumption is often linked to religious traditions both for Christians and Muslims.

Goat and Sheep breeding systems in the Mediterranean basin.
The goat and sheep breeding systems in the Mediterranean basin vary according to the different climatic, environmental, socio-economic and cultural conditions of the areas concerned. With particular reference to the climate (fig 3), for example, the breeding system can be nomadic in the desert and sub-arid areas, and intensive in the humid and/or irrigated areas (table 6).

Transhumant breeding system.
"Parcours" of the Maghreb steppe
This is currently the most common breeding system in the southern Mediterranean Countries. By "parcours" it is meant grazing land with spontaneous vegetation that is exploited extensively to feed sheep. These areas are grazed by both transhumant herds that during the year move from their habitual place searching for available forage, and by animals of the nomadic tribes that move continuously from one place to another.
These lands are usually located in areas characterised by scarce and irregular rainfall that prevents more profitable agricultural activities. The floristic composition varies depending on the environment and, as a consequence, also productivity varies significantly. These pastures are characterised by perennial shrub and herbaceous species and by annual herbaceous species with a relevant forage production although only for a short period (from February until May).
From a legal point of view and according to the "pastoral code", the "parcours" belong to the State except for the "....lands that have been constantly improved". In recent years, this unclear provision has caused severe problems to the breeding sector and violent conflicts among farmers as some of them have in fact cultivated wide areas of the "parcours" taking actual possession of these lands thus forbidding the animals to graze and to pass through.
This situation has had several direct and indirect consequences, and in particular:

- an increase in cultivated lands to the detriment of the grazing ones and the related increase in stocking rates, with degradation of the vegetation cover and a decrease in productivity;
- an increase in sedentary herds caused by the privatisation "de facto" of wide areas belonging to the State;
- an increase in poverty and unemployment worsened by the increasing social differences both among areas and farmers: only farmers with technical and financial means can utilise the grazing areas available or purchase forage and cereals for the animals;
- an increase in the so called "no lands" breeding

"Dehesas" system in the wooded areas of the Iberian peninsula.
This goat and sheep breeding system was largely used in the XIX century in the Iberian peninsula in its most traditional form, based on the integrated management of all resources available on the land.
It is typical of a socio-economic context characterised by i) high prices of both breeding-derived products and wood productions; ii) scarce availability of wealth and pasture lands that could only be productive by carrying out relevant interventions both in terms of the arable lands and the wooded areas management and for the control and care of the animals.
By grazing the wooded areas, a very high productivity could be obtained if compared with the technical tools utilised and the limited extension of areas concerned.
Apart from providing a relevant forage production in areas where pasture land is scarce, this system enhances wood fertility by providing organic matter and by contributing to the renewal of vegetation and the underwood clearance through the bites of the animals.
Although keeping its peculiarity (grazing in wooded areas), the most modern version of this breeding system has undergone deep changes by enlarging to wider areas without any control on the herds and above all without preserving the wood.
As a consequence, these areas are progressively more degraded and severe soil erosion phenomena are taking place because of the deterioration of the vegetation cover caused by the excessive stocking rates and by the lack of any control (fig 4).

Long distance transhumance in Italy

In Italy, the long distance transhumance was carried out with a large number of animals (from 300 to 2000 heads) that during the year were taken from the planes to the mountain grazing areas and *viceversa*, without any shelter for both men and animals. Nowadays, this breeding systems has almost disappeared as a consequence of i) the improvement of the socio-economic context that reduced available labour, ii) the problems related to transhumance and iii) the social marginalization of the breeder as a profession.

This breeding systems was once quite widespread all over the nation, but it is now utilised only in few areas: in the Lombardy region, involving about 10 thousands animals that every year, during winter, are taken from the mountains of the province of Bergamo to the plane areas, and then back in the following summer; and the Puglia region, where the animals were taken up to the Apennines along the so-called "tratturi".

Extensive breeding systems

The extensive breeding system constitutes an evolution of the nomadic and transhumant systems, a first attempt to create a permanent farm structure in a given area. Within this structure, man could find a compromise with the most ancient breeding systems so that his stability is counterbalanced by a relative freedom of the animals that can graze in a wide but limited area, also in terms of natural resources.

This system is usually adopted in those countries with hot climate (Maghreb, southern Italian regions). The animals are kept outdoors all year round and graze on pastures with little forage integration. These animals are meanly meant for meat production, because outdoor grazing makes milking quite difficult.

In general, autochthonous breeds are utilised in this systems without any selection, so that safeguard is incidental or non-existent.

Semi-extensive and semi-intensive breeding systems.

They are hybrid breeding systems that combine stall-rearing and the exploitation of the available natural resources with a strong and rational breeding/environment interaction.

This breeding system is typical of the most advanced and productive areas, and is usually carried out in the European Mediterranean Countries.

With reference to its utilisation, there are differences in the time span and in the period of the year. Both the length of the grazing period and the time of the year are influenced by the climatic conditions; in the hottest regions, grazing occurs in the autumn, when water resources make pastures richer, whereas in the most temperate areas (such as the Alps) grazing is carried out in the spring-summer period, the well known mountain pasture, by moving the animals to high altitude pastures.

With particular reference to Italy, the southern regions adopt the semi-extensive system, whereas to the north the semi-intensive systems is widespread also favoured by the better conditions of the pabulum.

The rational land exploitation favours the control of costs to feed animals. In the period of stall-rearing, animals are fed on forage and fodder.

The main product from semi-intensive breeding is milk and its treatment occurs all year round, whereas meat (mainly lamb and kid) becomes a "secondary" product. On the contrary, the main product from the semi-extensive system is meat, and milk production is limited to a short period during which important niche products are made.

In order to maximise the income from meat production and to minimise the accidental death rate of the youngest animals during grazing, lambings and kiddings are concentrated in the period in which they are kept in stalls and, above all, before Easter and Christmas when the consumers' demand is very high.

The autochthonous breeds are mainly used in the semi-extensive breeding systems, although there exist important cases in which the selected breeds are also utilised; in this context, interventions to improve the autochthonous breeds can be adopted.

Intensive system

It represents the point of arrival of the evolution of the goat and sheep breeding, which is the antithesis of nomadism.

During the whole year herds are taken in sheepfold, grazing is not used and the animals are mainly fed on dry food (hay and concentrates).

This system is typical of agropastoral activities developed in areas where climate and agricultural practices allow a good forage production, purchase of equipment and appropriate stalling structures. Land availability is the limiting factor as a consequence of the urban growth and the industrial activities.

This system that could be completely independent from the land availability even in the so-called "no lands" breeding

The production is mainly represented by milk and derived products, and meat is additional. The lamb weaning is based on the utilisation of milk replacer.

The breeds of the intensive system are the cosmopolite and the selected ones.

The environmental sustainability of goat and sheep breeding

In the Mediterranean area goat and sheep breeding has historically represented one of the most widespread economic activities.

In its traditional form it represented a land use activity able to guarantee a perfect balance between environment and man.

The utilisation through grazing guaranteed land treatment, vegetation renewal and soil fertilisation (through animal dejection).

Unfortunately in the last decades the situation has deeply changed and the relationship between natural resources and animal breeding is greatly unbalanced, thus resulting in sheep farming to cause negative effects on the environment (soil degradation with erosion and nutrient reduction, high water consumption, water pollution, and reduction of biodiversity).

The main reason is not due to the sheep farming, but to the inadequacy of the methods applied by the man, who is not able to evaluate the impact of the increasing productions on the environment and on the natural resources.

The negative impacts on environment

Sheep farming causes identical direct impacts on the whole Mediterranean area. The increase in small ruminants in this area and the parallel decrease in grazing areas has determined an important increase in the stocking rates, that causes overgrazing phenomena (fig 5).

Overgrazing effects on soil and vegetation

A rational grazing strategy should maintain pasture productivity by: keeping plants in a vegetative forage producing state, maintaining optimum leaf area index, improving the nutritive value of available forage, reducing excessive accumulations of standing vegetation and

mulch. On the other side, an excessive grazing pressure can seriously reduce, damage, or completely remove vegetation cover and cause soil compaction and degradation, thus starting or intensifying erosive processes.
The negative effects of grazing on the soil are both direct, through trampling, and indirect, through the reduction in vegetation cover and removal of organic matter.
Trampling may cause soil compaction, surface disruption, reduction of infiltration, creation of terracing on steep slopes, development of animal trails.
Soil compaction by hooves causes a reduction in soil porosity which reduces water infiltration and percolation in the soil. This leads to an increase in water runoff and erosion on sloping terrain, and a tendency to hydromorphism or to stagnation in flat terrain. Soil compaction depends both on the characteristics of the animals ' behaviour, such as their tendency to walk, run or jump or to graze in groups, and on agropastoral activities, such as the presence of concentration areas (shade of trees, areas protected from predominant winds, drinking and artificial feeding places, etc.). Compaction depends not only on stocking rate but also on the specific pressure of the hooves per square centimetre. For instance, a calculation based on hoof area and body weight of various animals has estimated an average pressure per unit area of 0.47 kg/cm2 for sheep, 0.98 kg/cm2 for cattle and 1.01 kg/cm2 for donkeys. Trampling has more destructive effects on wet and clay textured soils, and where vegetation cover is poor.
The creation of terracing on sloping terrain, and of trails on flat areas, is a result of the routes chosen by animals during grazing and being transferred from one pasture to another. Trails are created in direct proportion to stocking rates and in inverse proportion to the availability of forage. At times these trails may cover a high proportion of the total pasture area, especially at waiting points near gates and near drinking places. These areas may suffer from significant wind erosion during the dry season.
Overgrazing reduces the vegetation cover, thus increasing raindrop impact, favouring soil surface crusting, decreasing soil organic matter content and soil aggregate stability, reducing water infiltration rates. All these effects may cause increased water runoff, reduced soil water content, and increased erosion. Soil organic matter is also an important component of soil fertility and essential for the maintenance of good soil structure, which can counteract the erosive action of water and wind.
Other practices related to the agropastoral activities, such as the use of fire and machinery to keep pastures clean from shrubs, in certain cases, particularly in hilly landscapes, can be very impacting.

Impact of fires
Agropastoral activities are a major cause of fires in the Mediterranean environment. Fire has been considered as important practical and economical tool to clear lands for grazing. A detailed analysis on the causes of forest fires in Sardinia shows that more than 90% of the total number of fires are deliberately caused by men; in other regions of the Mediterranean basin the situation is not much different. Land fragmentation and the heterogeneity of land cover, typical of Mediterranean environment, have in many cases favoured fire propagation from grasslands to shrublands and wooded areas, thus compromising forested ecosystems.
Although in the Mediterranean basin fire has always been present in the ecosystem, favoured by long dry seasons and by the characteristics of high inflammability of the Mediterranean vegetation, in the last 50 years its occurrence has dramatically increased, and it is now a major factor of desertification. The destruction of the vegetation cover and the effects on the underlying soil turn out in an increased erosion risk.
In my region (Sardinia), between 1982 and 1996, an area of 689,432 ha of land was swept by fire. The mean annual area affected by fire amounts to about 46,000 ha, about 72 % of which are pastures. With particular reference to woodlands, between 1989 and 1993 about 1.6% of the total area was annually swept by fire; when compared to the European Mediterranean average (1%), this datum shows the significant incidence of this phenomenon in Sardinia.
Degradation phenomena determined by interaction between fire of wood land and grazing land have been repeatedly point out in Greece and in Spain too.
Plants dominating Mediterranean -type ecosystems are equipped with adaptive strategies enabling their post fire recovery. A great number of herbs too, mainly legumes and grasses, reappear during the first year after the fire due to the activation of germination of the soil seed bank. Shepherds are aware of the abundance of legume species the first year after the fire, which are also an excellent fodder. Moreover fires are used by stock-farmers as a means of fighting against *Sarcopoterium spinosum,* a Mediterranean dwarf shrub, dominant in desertified Mediterranean ecosystems, as is not an animal fodder.
Overgrazing that follows wildfire has a destructive impact on land productivity, since the supply of nitrogen to the system is cut off. Due to the low productivity of the Mediterranean rangelands, which is not enough to cover the dietary needs of livestock in the islands, shepherds are forced to supplement their diet with fodder. In order to increase productivity and to reduce the production costs of dairy products the cycle of fires and overgrazing continues every year. With increasing grazing pressure (there is trend to increase the number of grazing animals in the islands) the ecosystems are degraded and led to desertification, where the dominant species is *Asphodelus microcarpus,* a plant well adapted to dry and grazing conditions. Alternative management practices such as dizonic system: one year grazing and two years set aside must be adapted.

Improper agronomic practices
In order to meet the higher feeding requirements of animals, some regional or national government promoted policies aiming at increasing forage production also providing subsidies for the improvement of pastures to create new ones. The use of modern mechanised practices was also favoured. Actually, such policies were not accompanied by the necessary guidelines for their implementation. Artificial pastures in marginal areas are created to the detriment of forestry vegetation and in particular of the typical Mediterranean maquis. The agronomic practices used to create or improve pastures involve brush and stone removal, deep tillage (executed, in many cases, on steep slopes along the maximum gradient) and sowing of forage species. These actions were carried out on several areas, regardless their specific morphologic and pedologic conditions, resulting in a severe impact on the land: the substitution of wide areas of Mediterranean maquis with artificial pastures, obtained by using fire and heavy machinery on steep slopes, is a representative example of the negative consequences of the regional regulations: these practices are often very expensive and do not allow in an increase in pasture productivity. They can be carried out just because they are supported by regional subsidies.
A relevant element to avoid the environment degradation caused by the grazing is the evaluation of land that must be suitable for this use. The model (fig 6 and table 7) was developed according to the methodology proposed by FAO (1976), adapted to the peculiarities of agropastoral systems and implemented in the GIS in the course of a three years research financed by the European Community (Enne *et al,* 1999). The model yields five land suitability classes: suitable (S1), moderately suitable (S2), marginally suitable (S3), currently unsuitable (Nl), permanently unsuitable (N2).

Considering Sardinia, only a small part (8%) of the current artificial pastures was classified as unsuitable and can be considered "fragile area " (N1) or "critical area " (N2), but about 48% of these areas were classified as S3, so it has been considered "potential sensitive area" and severely threatened by land degradation if the current agronomic practices (brush removal and mechanical tillages along the maximum gradient) will be repeated over time.
In the southern part of the Mediterranean area, in addition to the over mentioned factors, there are others more specifically connected to specific natural phenomena, to the population dynamics and to the agricultural policies of different governments.
The degradation of the "Parcours" of the North African steppe is essentially due to natural phenomena further expanded by the population increase and by the excessive animal stocking rates that lie on the ecosystem.
The population increase together with deforestation and the increase in cultivated areas and wells are index of land degradation that has broken the ecosystem equilibrium that in the steppe area existed in the first half of the 20th century.

Evolution of the population
The steppe population is composed by shepherds that practise the nomadism and the transhumance, the most suitable social forms in the arid habitat and that permit to safeguard the environmental equilibrium and to face periods of drought. These breeding systems consist of a rational management of space and time through two basic steps: the "Achaba" that consists in the flock grazing of cereal stubbles for 3-4 months, during summer, and the "Azzaba", in winter months, during which the animals graze in northern piedmont areas.
These two steps permit the best utilisation of the steppe area, 3-4 months in spring, during the greatest forage production, mainly connected with the annual species (rain-fed crops), that with their high nutritive level, make up for the low level of the perennial species.
This traditional and intelligent breeding system permits to optimise the utilisation of natural resources, because the "parcours" are exploited only for 1/3 of the year and the unused period allow the grass soil regeneration.
Actually the pastoralism is undergoing a period of social and economic transformation.
A relevant population increase has been recorded in the second half of the century (the steppe population in Algeria grew from 900.000 in 1954 up to 4 million in 1999) concerning the sedentary people more than the nomads.
There is a relevant reduction in nomadism, practised by the 5% of population; the remaining people is not completely sedentary, but they only move 10-15 km .
The shepherds have changed their production system joining the cereal cultivation to breeding.
The small ruminant population in Algeria (80% of which are sheep) is growing from 5,6 million of animals in 1968 to 15 million in 1996, similarly to the Maghreb area; herds are mainly small and medium size (more then 70% of sheepherds have less then 100 animals).
The huge increase in sheep breeding has resulted in overgrazing of the "parcours", from 1 eq.ov/1.9 ha in 1968, to 1 eq.ov/0.78 ha in 1996, and the consequent degradation of the grazing lands, due to the prolonged persistence of the herds, that results in the grass utilisation higher than the annual production; the output of the "parcours" has undergone a 1/3 decrease.

The increase of cultivated areas
The steppe breeders have always cultivated their lands with cereals both to supply their food demands and to provide food integration to sheep.
This cultivation has been practised in the semi-arid and southern area, in the river bed of Sahara and in the piedemont area.
The relevant flock growth and the increase of the forage deficiency have induced the breeders to increase the cereal cultivation, taking up a large amount of grazing lands, that are not suitable to this activity (7% of these areas are cultivated with barley for animals).
The extension of ploughed areas and the introduction of agricultural mechanisation are two factors that have brought about environmental degradation as well as overgrazing.
The processing techniques utilised have an erosive action, destroy the land surface and make the land infertile, that is not reversible.
The wood species have been destroyed and replaced with adventitious species that support the wind erosion.
In these areas there salinisation phenomena have also been detected. Furthermore the low productivity of cereal cultivation (5 q/ha) do not even compensate for the loss of fertility.

Wood species weeding
The wood species, in the past utilised as food for the herds, have been totally weeded out and utilised by the sheep breeders to get warm and to cook.
Deforestation is the only phenomenon connected to the environmental degradation that in the last years is reverting due to the nomadism reduction and to a greater utilisation of gas cylinders.
The over mentioned factors greatly affect the natural resources degradation; in the last 30 years the steppe ecosystem has been greatly disturbed both in the structure and in the primary production.
The degradation factors have emphasised the desertification actions, as the sanding and the creation of a dune system.
The reduction of the vegetation and the variation of the grass composition are typical elements of the regression of the steppe.
The population increase also brings about a higher meat demand together with the development of the "no lands" breeding, that form a disturbing element of the fragile environmental balance of these lands.
In fact the great forage and cereal demand for animal nutrition have induced the cultivation of all the available areas, even in fragile environments of great value, that are storage of biodiversity , and the utilisation of great amounts of chemical fertilisers and pesticides have caused water pollution.
Finally, especially in Maghreb area, the numerical increase of the herds, together with the need of a higher amount of grazing areas, correspond to the development of the agricultural activity connected to the vegetable cultivation and the extension of urban areas. The consequent removal of grazing areas has caused conflicts between breeders and farmers for the land and water utilization and has heavily destabilised the ancient social structure, based on herd property as the most important element for the definition of the social scale.
Furthermore in these areas sedentary breeding can only be followed by farmers that have the financial resources necessary to buy the production equipment (machines, foodstuffs, fertilisers, etc.), whereas the sheep farmers, that traditionally practised the "parcours" grazing and whose unique wealth are the animals (also utilised as exchange of goods), face severe problems due to the impossibility to continue the activity.

Conclusions
The highlighted factors can be extended to the Mediterranean marginal areas and allow the suggestion of some recommendations useful for the mitigation of the effects of agropastoral activities on the environment.

1. The drawing up of zonal plans highlighting agropastoral development priorities is essential. All the executive actions must be realised within these plans in order to avoid the fragmentation and the overlap of competencies which have often led to irrational and contingent interventions (works of land improvement, productive reforestation, etc.).
2. Actions of land improvement must be preceded by land evaluation which is the main effective tool for prevention of land degradation phenomena. Land evaluation for a specific agricultural utilization must take into account the socio-economic context; with particular reference to land evaluation for grazing, further efforts must be made to produce a scheme suitable for Mediterranean environments taking into account physical (geolithology, pedology and morphology) and biological (pasture productivity and quality) aspects related to the socio-economic context.
3. Grazing in Mediterranean wooded areas cannot be avoided as it is the main economic activity in marginal areas. Therefore, a rational utilisation of forest resources should be recommended by introducing suitable agroforestry systems. The dehesa silvopastoral model particularly widespread in Spain, allows a balance between pastoral activities and forestry. Here the definition of sustainable stocking rates and of grazing seasons according to the different silvicultural systems constitute a quite interesting subject to be explored.
4. Land abandonment of marginal areas is another factor leading to land degradation. In this case, low input and multiple-use silvopastoral production system can contribute to assure the human presence, to preserve lands and to economically sustain the rural communities. Moreover, such production systems can effectively contribute to the reduction of wildfire risk.
5. Land degradation is mainly due to human activities. Detrimental effects of regional agricultural policies which have not taken into account land planning, have been shown. A stronger interaction between research institutions and decision makers involved in land planning and management is therefore needed. It is also necessary that all the results obtained from research activities are immediately disseminated to political bodies in the form of simple and easy to understand guidelines.
6. Studies on the outcome of the implementation of the environmental friendly policies are needed and strategies should be set up to restrict their application in case they damage the environment.

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Table 1 - Total number of goats and sheep in the Mediterranean basin Countries.

	Goats	Sheep	Total	Source
Morocco	5.000	16.500	21.500	(1)
Algeria	3.400	18.200	21.600	(1)
Tunisia	1.300	6.600	7.900	(1)
Libya	2.200	6.400	8.600	(2)
Egypt	2.878	3.672	6.550	(1)
Israel	73	340	413	(2)
Palestinian Authority	340	660	1.000	(1)
Lebanon	400	350	750	(1)
Syria	1.082	13.119	14.201	(1)
Turkey	8.376	30.328	38.704	(1)
Cyprus	3.786	2.460	6.246	(3)
Goat and sheep total number in the southern shore			**127.464**	
Greece (cumulative data)			12.330	(4)
Greece	2.975	5.107		(4)
Albania	-	-	-	
Montenegro	-	-	-	
Bosnia and herzegovina	60	554	614	(5)
Croatia	17	63	80	(6)
Italy	1.368	10.439	11.807	(7)
France	1.187	10.556	11.743	(8)
Spain	2.605	21.323	23.928	(9)
Goat and sheep total number in the northern shore			**60.502**	
Goat and sheep total number in the Mediterranean basin			**187.966**	

Rounded data from different sources in thousands of heads (000)
(1) e (2) RADISCON e FAO stat. Database in www.fao.org (2002); (3) CYSTAT in www pio.gov.cy; (4) www.minagric.gr; (5) Ministry of Agriculture and Forestry, Federation of Bosnia and Herzegovina ; (6) OV-KO mlijecni proizvodi. Lipnia, 2000; (7) ISTAT data; (8) INRA data in www.inapg.inra.fr; (9) Ministerio de agricoltura, pesca y alimentacion in www.ine.es

Table 2 Spain – Variation of goat and sheep stocks (heads * 000)

Year	Goats	Sheep
1985	2.584	16.954
1986	2.850	17.641
1987	3.663	24.037
1988	4.417	23.064
1989	4.574	22.739
1990	3.663	24.037
1991	2.972	23.371
1992	2.837	24.615
1993	2.947	23.872
1994	3.157	23.058
1995	2.605	21.323

* Ministerio de agricoltura, pesca y alimentacion in www.ine.es

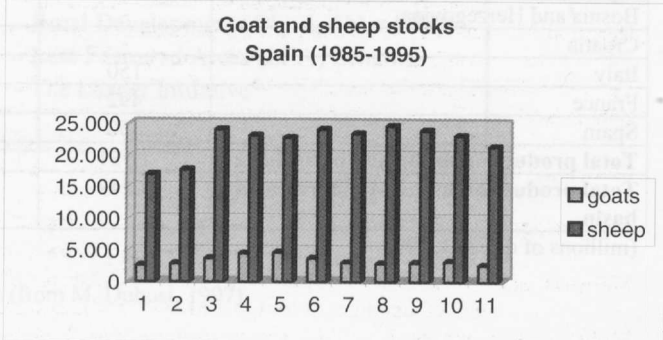


Table 3 Italy– Variation of goat and sheep stocks (heads * 000)
ISTAT

Year	Goats	Sheep
1881	2.016	8.863
1908	2.715	11.426
1930	1.893	10.268
1950	2.491	10.295
1970	1.019	7.948
1980	1.009	9.277
1985	1.089	11.451
1990	1.297	10.847
1992	1.321	10.439

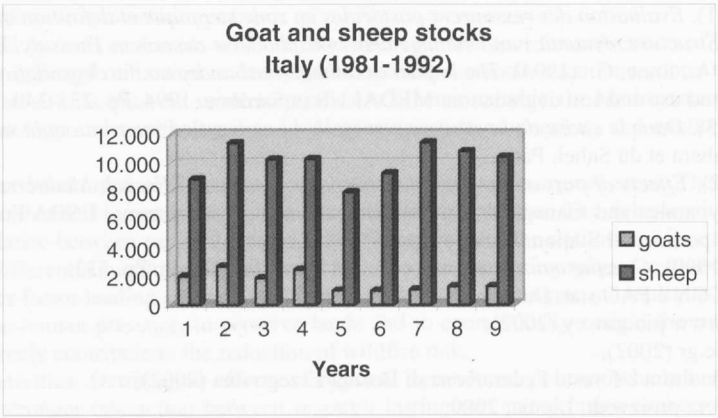
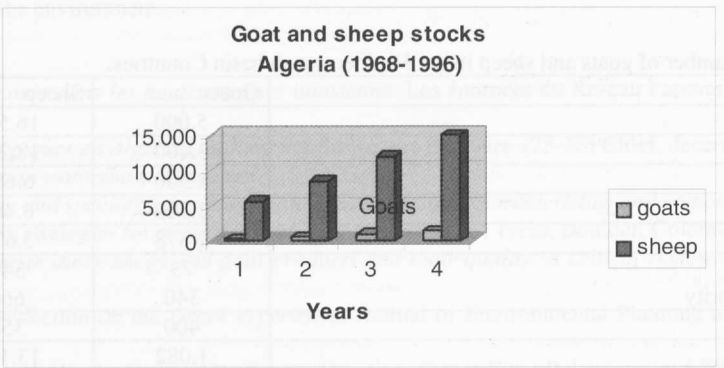


Table 4 Algeria – Variation of goat and sheep stocks (heads * 000)

Year	Goats	Sheep
1968	300	5.600
1978	560	8.500
1988	1.000	12.000
1996	1.400	15.000



– Office National des Statistiques

Table 5 - Milk production in the Mediterranean basin

	Goat milk	Sheep milk	Total milk production	Cow milk
Morocco	35	27		1.010
Algeria	145	180		984
Tunisia	12	17		670
Libya	15	40		100
Egypt	15	93		1.350
Israel	14	19		1.093
Lebanon	37	34		200
Syria	80	580		1.118
Turkey	249	826		9.000
Cyprus	26	20		136
Total production in the southern shore	**628**	**1.836**	**2.464**	**15.661**
Greece	460	670		750
Albania	69	70		721
Montenegro	-	-		
Bosnia and Herzegovina	-	-		
Croatia	-	-		285
Italy	150	759		10.876
France	492	243		24.500
Spain	350	300		6.100
Total production in the northern shore	1.521	2.042		43.232
Total production in the Mediterranean basin	**2.149**	**3.878**	**6.027**	**58.893**

(millions of q) FAO, 1999

Table 6 Small ruminants breeding systems in the Mediterranean basin (modified from A. Nardone, 2000)

Climate	Breedying system	Specie and genetic type		Production
Desert	Nomadic herding	Goat	Autochtonous	Milk, hair, hide
Sub-arid	Nomadic herding	Goat Sheep	Autochtonous fat tail	Milk, meat, hair, hide Meat, milk, wool, hide
Arid	Transhumance Forage oasis	Goat Sheep	Autochtonous Autochtonous	Milk, meat, hair, hide Meat, milk, wool, hide
Semiarid	Extensive pasture (grain farming) Transhumance	Goat Sheep	Autochtonous Autochtonous	Milk, meat, hide, hair Meat, milk, wool, hide
Sub-Humid	Stationary pasture (or short migratory) (grain farming)	Goat Sheep	Autochtonous selec. Autochtonous selec.	Milk, meat Milk, meat, wool
Humid	Stationary Forest	Goat Sheep	Autochtonous selec. Autochtonous selec.	Milk, meat Milk, meat, wool
Irrigated	Semiestensive Intensive	Goat Sheep	Select. Select.	Milk, meat Milk, meat

Table 7 - Matching of current artificial pasture and suitability classes for the creation of artificial pasture (from G: Enne, F. Previtali, C. Zucca, 2000):

Suitability class	Explantation
Highly/Moderate suitable (S1-S2)	Not threatened by land degradation: current land use can be carried out over tome without causing land degradation
Marginally suitable (S3)	Potentially sesitive areas: threatened by land degradation if the current agronomic pratice are repeted over time
Currently not suitable (N1)	Fragile areas: areas undergoing land degradation process in the short period
Permanently not suitable (N2)	Critical areas: areas quickly undergoing severe land degradation processes (areas already characterised by low biological potentiali)

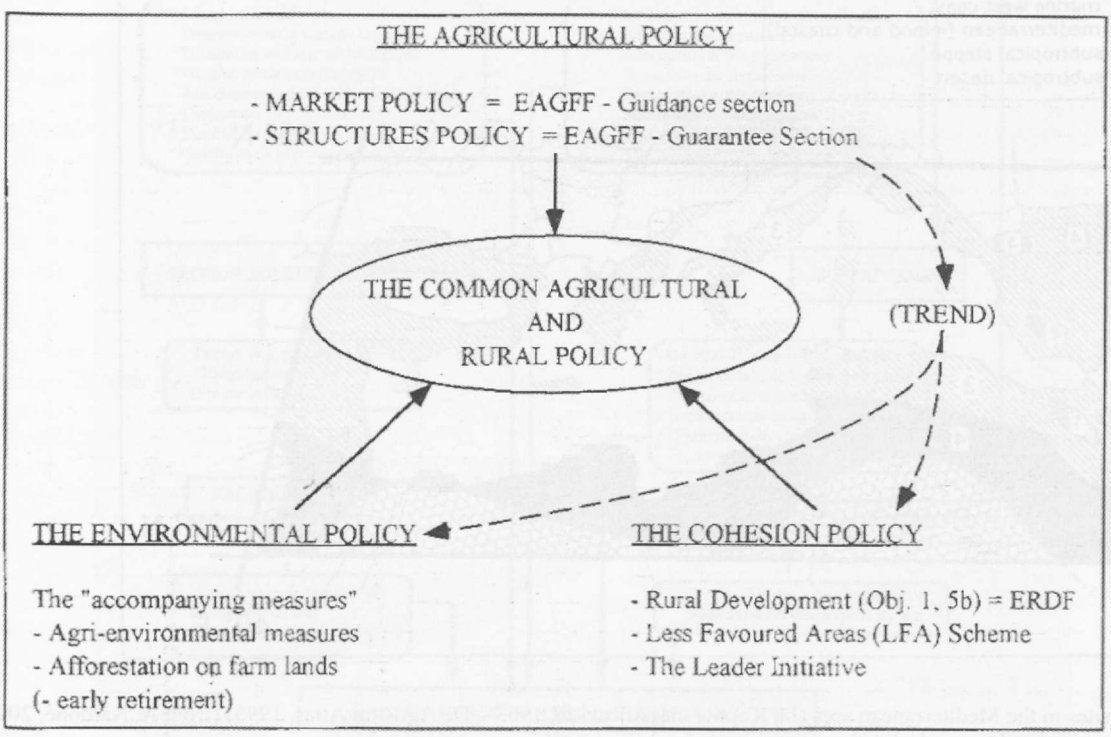


Figure 1: The common agricultural and rural policy. The three basic concepts (from M. Dubost, 1997)

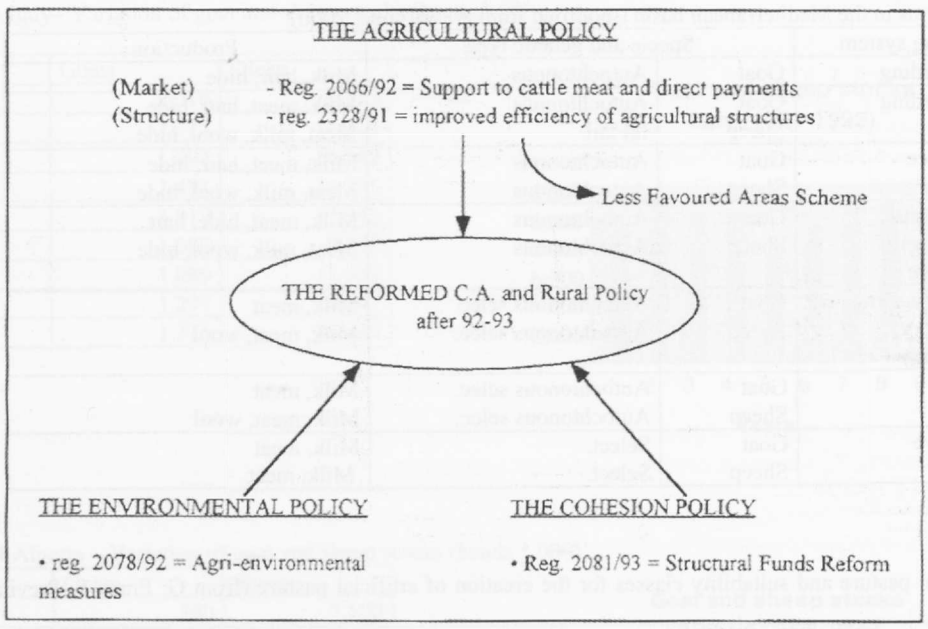


Figure 2 – The CAP reform, 1992. Major change in the common and rural policy from 92-93 (from M. Dubost, 1997).

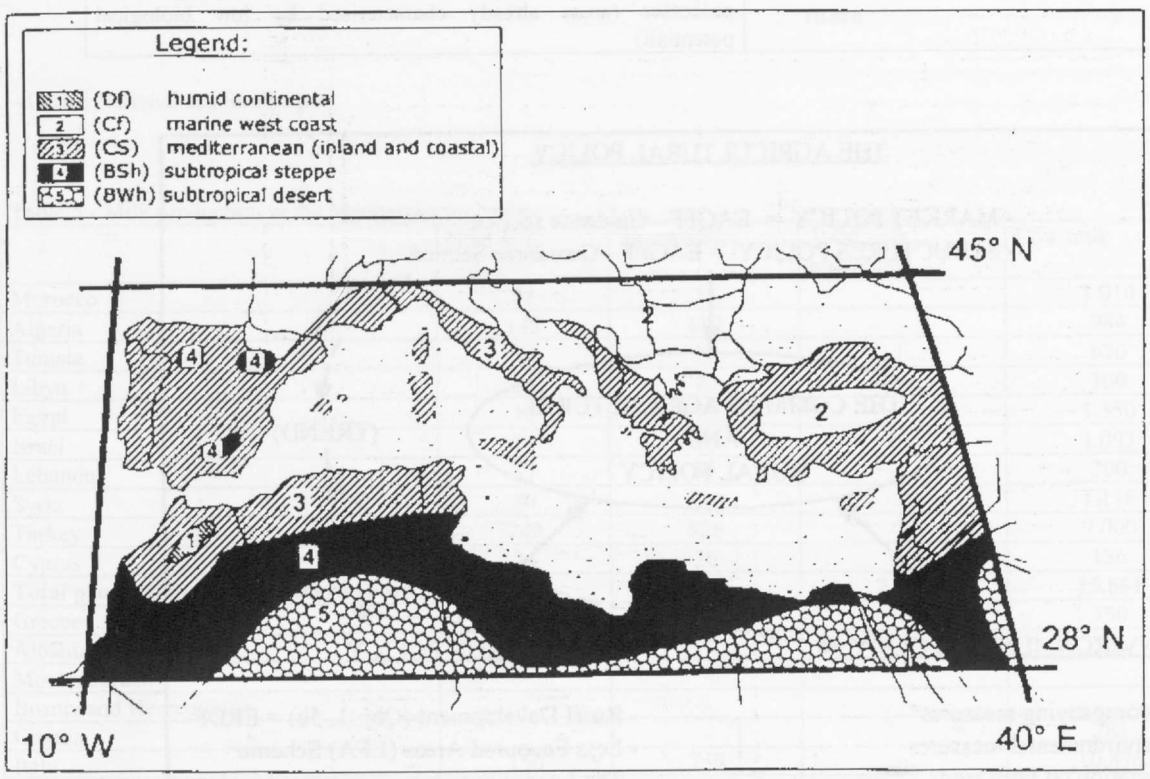


Figure 3: Climates in the Mediterranean area (bu Kopper classificazion, 1963 – De Agostini Atlas, 1995) (from A. Nardone, 2000)

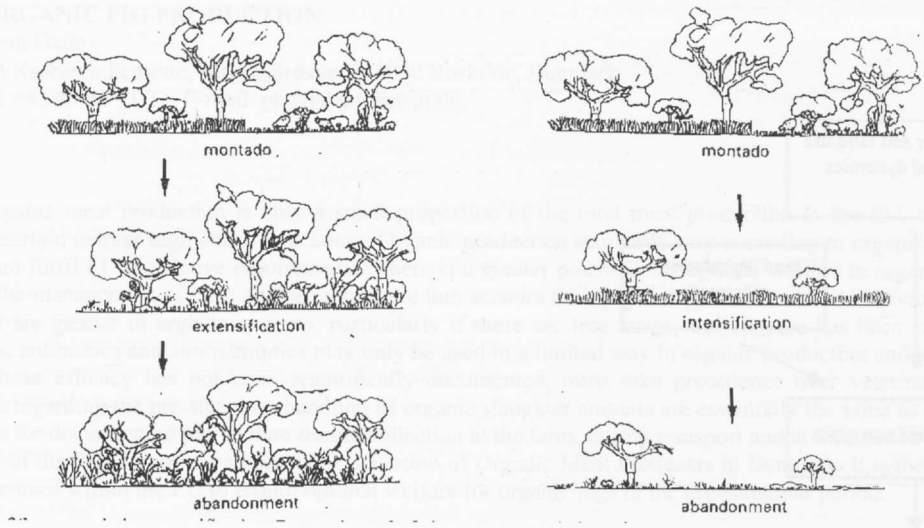


Figure 4: Changes in Portuguese "Montado" (from B.H. Green, 1997)

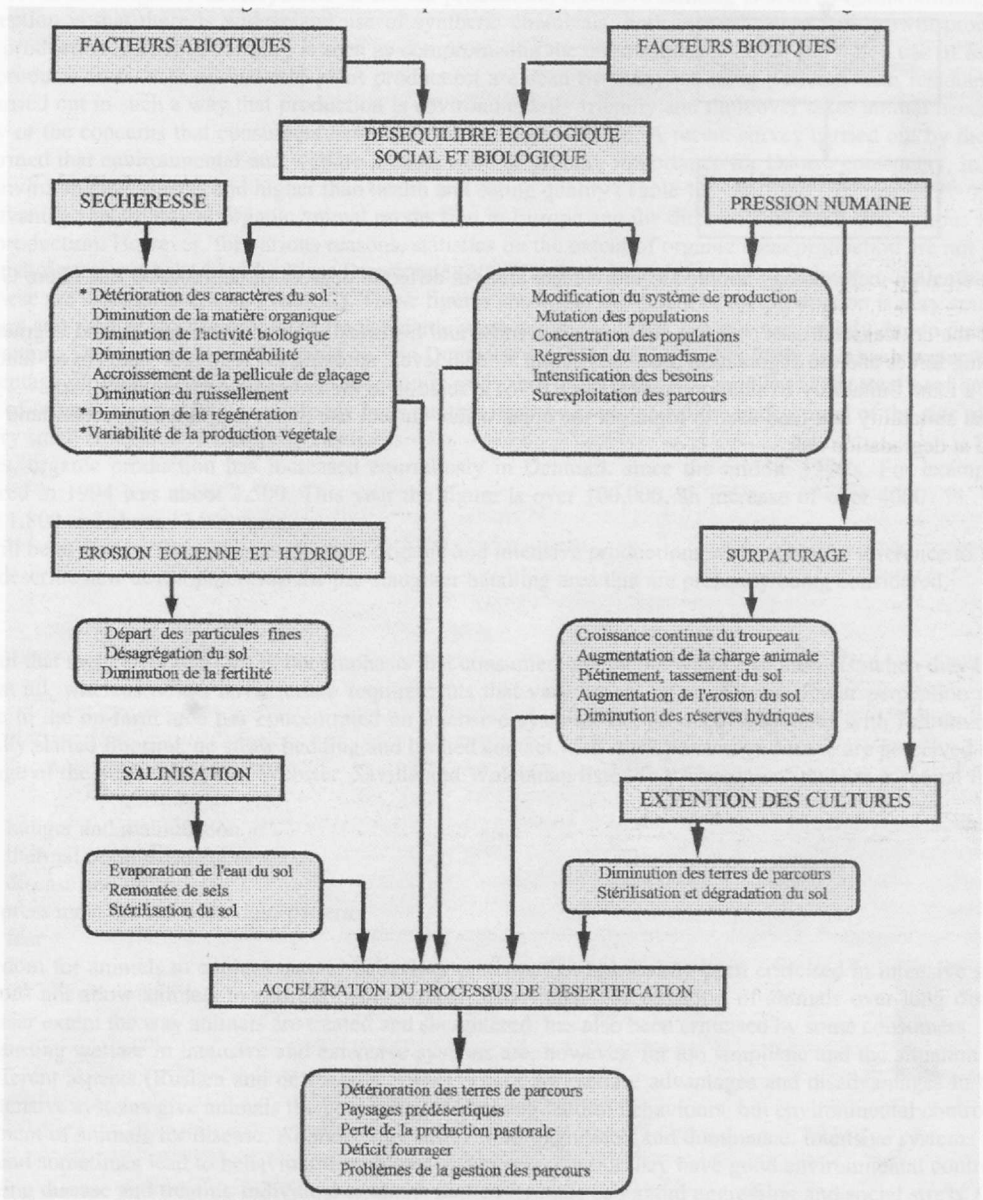


Fig. 5 – Degradation factors and impact indicator (from D. Nedjraoui, 2001)

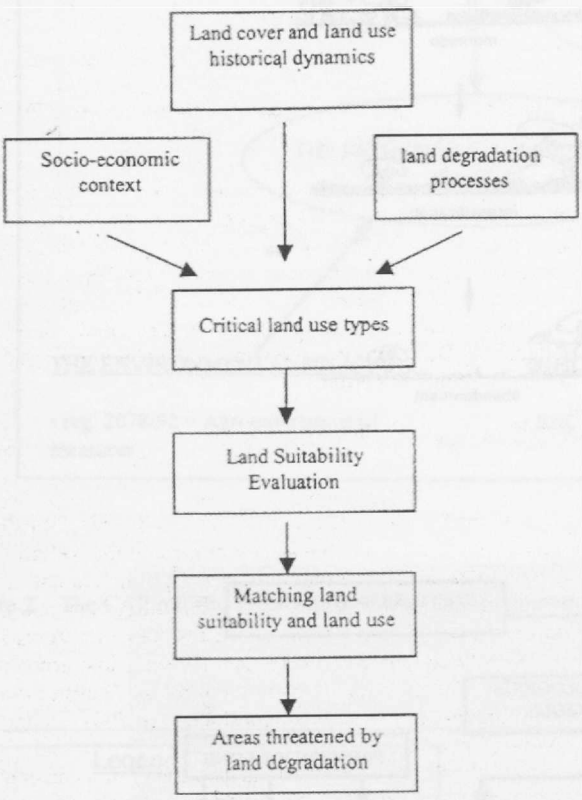


Figure 6 - Land evaluation methodology adopted to individuate areas at different degrees of degradation risk (from G: Enne, F. Previtali, C. Zucca, 2000):
1. identification of the critical land uses / human activities (currently, and historically, directly related to land degradation phenomena), by: analysing the driving forces and the degradation processes acting at local level , studying the temporal land cover -land use dynamics;
2. development of a Land Suitability Evaluation model (FAO 1976) in relation to the critical use (uses) identified;
3. matching of land suitability and land use, to highlight the areas where current use is not supported by actual land potential, and that can thus be considered at degradation risk.