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Landscape development in a Spanish Mediterranean farm: A mountain farm case.

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1 Description of the area

The Mediterranean environment

The Mediterranean climates are characterized by summer drought and winter rainfall. The minimum daily temperatures usually do not descend below zero degrees. The rainy season prolongs for a period of four to nine months. The dry period is usually related with the total precipitation. There are areas with dry periods longer than the rainy season, others with a rainy season of equal length to the dry season and a third type with a short dry season.

During the rainy season, the ground remains normally wet due to the frequency of precipitation and the low evapotranspiration rates, which occur during the coldest part of the year. Since precipitation is not regular, and the rainy days concentrate on short and spaced periods, the water holding capacity of the soil is important. The deep flat soils of medium texture and moderate drainage are the best. Because of the slope the infiltration rate is larger, thus reducing the run-off.

There are several varieties of Mediterranean climates in Spain, as well as in the other countries of the Mediterranean basin. The differences arise mainly in the total precipitation, the length of the rainy season and the summer temperatures. Each variety is referred to as an Eco-region Province. There are basically four different major environmental situations in the Spanish Mediterranean: the *sierras* (mountains), the central plateau, the irrigated valleys and the coastal areas.

In a Mediterranean environment with a long period of summer drought, it is convenient and often necessary to integrate the irrigated valleys and meadows with the dry lands. Water is an important element in landscape design in Mediterranean areas, and thus, rivers and dams should be considered as a primary element for design, both on a large or small scale.

The climax sclerophytus broadleaf forest densely covers the ground and remains green year-round. It protects the soil from erosion, and allows water infiltration and soil development. It is an attractive landscape component for human life, but it does not add large amounts of saleable products such as the traditional agriculture which produces crops, animal products and lumber. The original forest, mostly of *Quercus ilex* or *Q. suber* has been or could be transformed into a *dehesa*-type vegetation dominated by an open upper tree layer and a lower dense layer of annual ephemeral plants which spontaneously grow during the winter months and remain dry during the summer.

2 Criteria used

The most useful criteria for this farm analysis were the socio-economic and biotic environmental criteria. Socio-economical factors such as the land tenancy have induced all the agriculture history in the area.

3 Farm analysis

Present situation at the study site

This paper analyses the farm "las Monteras" which is located in the Sierra Morena in the northern section of Cordoba province in Andalusia, Spain. The average altitude of the farm is 550 m above sea level. It is predominately hill country intermixed with a small proportion of meadows and other non-depressional fairly flat lands. The average precipitation is about 550 mm, concentrated mainly during the fall and spring months, with a hot, dry summer period which extends from May to October.

It covers an area of 7337 ha represented by the following geo forms (figure 1):

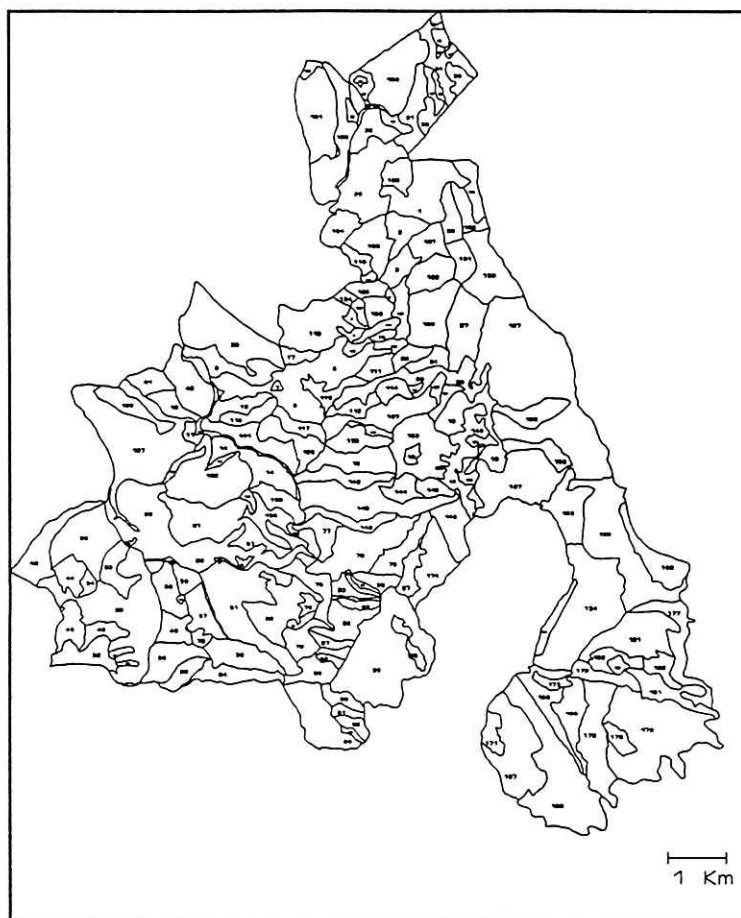
SLOPE	ha
Bottomlands (<0.0%)	39
Plains (0.0%-10.4%)	433
Rolling hills (10.5%-34.4%)	1226
Hills (34.5%-64.4%)	5481
Mountains (>=64.5%)	4

The vegetation cover is the following:

VEGETATION	ha
Annual crops for wildlife feed	58
Cultivated forests	2438
Dehesa	1743
Chaparral	2216
Shrubby steppe	623
Pasture	7
Rangeland	252

It is clear that most of the area is hill country with shallow soils, highly erodible and with a high proportion of rocks and stoniness. A 5.9% are plains of medium depth soils, with a larger potential productivity for range and even crops. The area covered by brush lands is small.

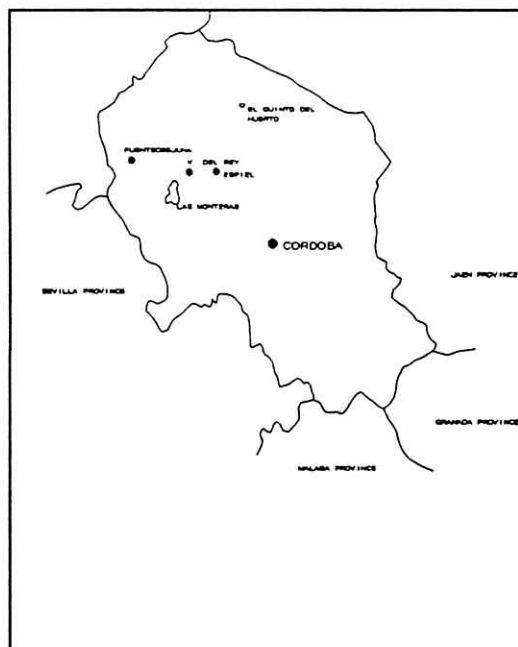
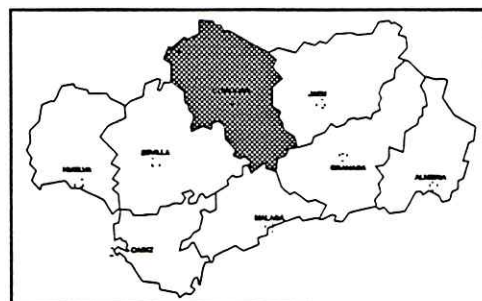
Figure 1.
Biogeostruc-
tural units on
Las Monteras
farm.



The potential productivity varies according to the District and Site. It has been estimated as follows:

District	Fire and pulpwood	Lumber	Pinyon nuts	Animal live weight gains kg*/ha ¹ year ¹	Cereal yield
Mountain	300	-	-	-	-
Hill	600	-	1.0	-	-
Rolling hill	2000	1.0	10.0	3	400
Plains	4000	2.0	50.0	6	800
Bottomlands	7000	3.0	100.0	-	1200

Figure 2 Location of Las Monteras farm and counties in Cordoba Province, Andalucia.



Presently on the farm there are 10 people working, organized as a cooperative. It has a deer population of 2742 heads, distributed as follows:

Class of age	%
Young deer	7
Adult male deer	33
Adult female deer	60

The farm technostruture is as follows:

- a) The headquarters, composed of an office, an apartment for visiting specialists, a dining area for the workers, a patio, a storage room and a cover for machinery.
- b) A house for a forest guard.
- c) Two old abandoned headquarters, in good shape.
- d) One old abandoned headquarters, in poor shape.
- e) Facilities for partridge raising.
- f) Facilities for rabbit raising.
- g) Two meter tall 80 km fence for deer surrounding the farm.
- h) 12 km of dirt roads for cars and trucks in excellent condition.

Presently no family lives permanently on the farm. There is only one forest guard that lives permanently there. The rest of the workers come during the morning to fulfil their duties, while some of them remain during the afternoon. On holidays there are some occasional guards. The people that work on the farm live with their families in the surrounding towns or villages according to their origin.

The main purpose of the farm is large game hunting. The farm is divided into 6 *manchas* (areas) for hunting. On different days every *mancha* is hunted on alternate years, with a hunting style called *monterfa*. There is a total of 270 *puestos* (hunting spots).

The farm is organized as a wildlife ranch since it is all fenced and the deer are regularly given supplementary feed during the summer months. The population is selectively controlled, and the habitats are managed.

Figure 3 Farm map of the original division of the land in Las Monteras around 1960, before consolidation.

Figure 4 Land size frequencies of the original farms

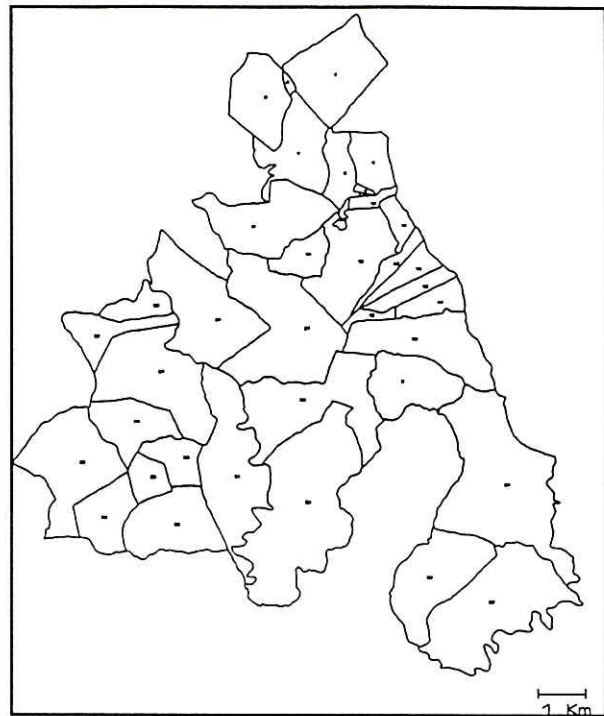
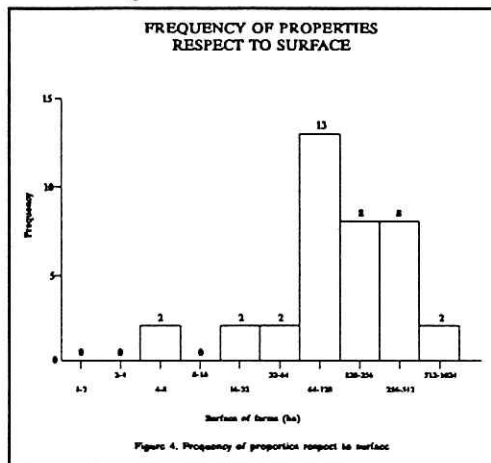
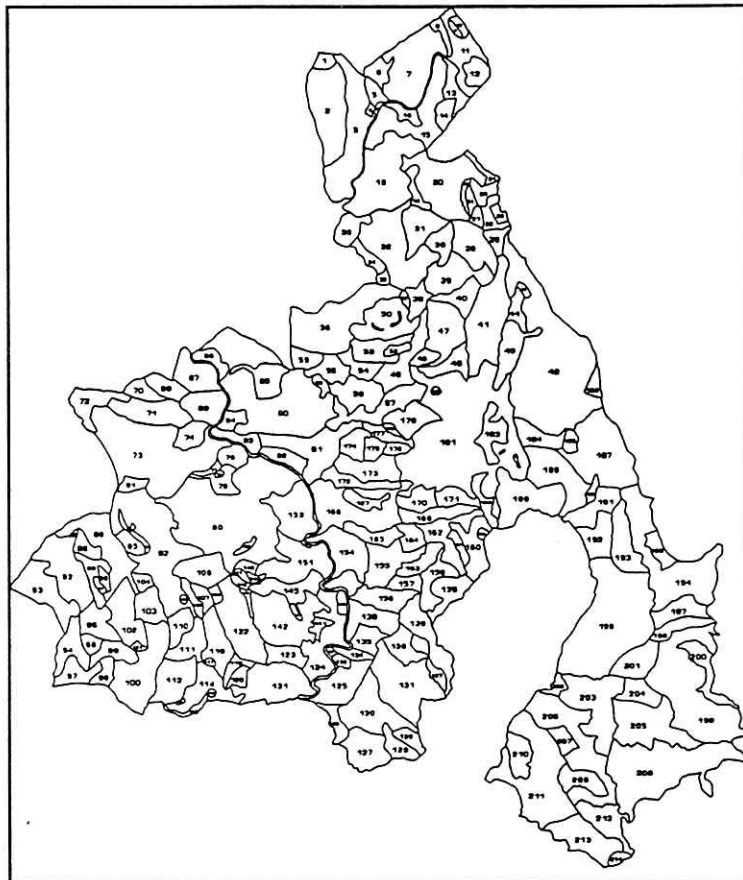


Figure 5 Plant cover map of the consolidated farm area at Las Monteras.



Future landscape and use

The transformation from a crop and small mammals minifundio to a large wildlife ranch has been positive. It has meant an increase in scale and reduction in intensity. This development has been caused by a drastic reduction of the human population in the area. The rural population migrated to labour markets, mostly in the rest of Europe and recently, to the industrialized areas of Spain.

The receptivity of technology by the ecosystem is low so it could not resist an intensification of crop technology, such as fertilizers, pesticides, improved varieties, and conservative cultivation; besides it would not have increased the yield enough to support the increasing population.

The present situation evolved towards a multiple use landscape, predominately a wildlife ranch, complemented with cultivated forest for protection and watershed management for water yield. However, the landscape is not fully organized for this. It requires more technostucture as well as an improvement in the ground cover for multiple use.

Because of the proximity to several large cities and villages the recreational use will have to be developed in some way. The area has good wilderness conditions but it is not well organized for the handling of visitors. The coolest months of fall, winter and spring have fairly favourable weather conditions for the visitors to enjoy vegetation and wildlife. The summer months are too hot and also have to compete with the coastal areas for recreation. However, during the hot periods, it is easier to see the large wildlife.

For recreational purposes, it would be necessary to develop some water facilities, both for

drinking and enjoyment in strategic places on the farm. Routes need to be developed for walking, horseback riding, and bicycle riding.

Some of the old houses and cortijos could be developed as housing for rural tourism. For this, water facilities and gardens would be necessary. These old constructions are strategically located where routes could be developed. The river that crosses the ranch is also an important element for planning multiple use. The functional farm development should be complemented with ecological and aesthetical purposes.

Finally the farm would have to be integrated in some way with the nearby towns and villages to be globally successful, since it is not large enough and does not have the facilities to attract by itself visitors from faraway cities.

Space shape and size

A natural landscape is the resultant of the action of climatic forces on the geological surface over a long period of time. The combination of water, temperature, wind and gravity erodes and weathers the upper and most vulnerable elements while depositing the sediments on the lowlands. Over long periods the land finally reaches a state of equilibrium of all the components.

The available habitats and resources generate conditions for the development of a plant and animal cover, which in turn modifies the environment already generated. An example of this is the watershed. Each part of the watershed is different from the other in its components and attributes. The land parts or parches are connected with each other through corridors and both of them are related on a space matrix.

The landscape system has a definite organization necessary to reach a degree of stability and function. The human activities through agriculture and urbanization affects this organization of the landscape, generating different results according to the circumstances.

The natural ecological landscape structure differs from the administrative human organization of the space. The intensification of use through an increment of fences located without ecological constraints and limitations, necessary for the normal ecosystem functioning, are represented by the location, size and shape of the administrative spaces, built for any specific purpose of management or development. Frequently the landscape is subdivided in excess in order to accomplish certain agricultural activities or processes. Many large wild mammals which require a certain minimum area of resources and habitat to survive, are not capable of crossing the fences. Therefore there should be harmony between the ecological and the administrative spaces.

Functions

Ecological, aesthetical and structural organization.

The example analyzed is based on an historical evolution of the landscape. The traditional elements incorporated into the constructed landscape are the basis for land management. They are kept and improved according to the farm or the farmers needs. Eventually, if these elements are not needed they are abandoned and left on the farm as they were. In this historical context, the land ownership is a basic argument for landscaping, both related with size and shape of the property, as well as the owners' rationality.

The historical influence of the farmers on the landscape is reduced or eliminated when the land is consolidated into a larger property after being bought by the state or by a neighbour. This does not happen when the land is divided, then the remaining structures are used according to tradition.

The ecological functions of the landscape are hardly understood or developed by the farmers. There is small evidence that the ecological rationality receives any consideration in farm

landscaping. As a matter of fact, it is considered as an expensive obstacle for farm development. It is believed that agriculture is one thing, ecology another. Ecology applies only to the natural protected areas on public lands.

There is no interest to incorporate the ecological dimension into the agricultural practices and landscape design. Also the way to relate agriculture and ecology is not clear to the technicians nor the farmers. The schools of agriculture and forestry have not included this subjects and point of view into their curricula.

The ecological dimensions related with the structure and function of landscape is based on its inherent heterogeneity and the maintenance of its biotic diversity has been ignored. The tendency has been towards the search of a larger homogeneity. The differences in the distribution of species, matter and energy between patches and corridors should be increased, maintained or reduced, according to the circumstances.

The agricultural activities have an effect on the nutrient distribution of the farm patches according to the circumstances and intensity of the activities. It also affects the energy flux.

The agricultural effects on the landscape are moderate, the heterogeneity increases.

The main attention has been placed in the productive structure of the farm, such as fences, roads, water facilities and buildings. There is not a priority in landscaping activities to solve specific problems when they occur, and there is no global planning of the activities.

In relation to the aesthetical development of the farm, there is also no global planning. There are some activities related with the subject, such as painting the buildings or cleaning the farm yards, which is regularly done. In many cases, the aesthetical activities could be carried out without impairment of the productivity and ecology, while in many cases, it could be complementary and synergetic.

Original state of the farm

Until the end of the fifties the area was divided into 37 different properties of various sizes (figure 3-4). Considering the potential productivity of the land, the area was insufficient to support the human population and to provide a life quality according to the present standards. Most of the people lived on the farm with their families in modest houses or cottages without the necessary facilities for modern life. A few, however, lived with their families in the nearby villages; while the landlords lived in cities farther away.

There were four kinds of landuse styles:

- a) **rotational croplands**, one-fourth cultivated and three-fourths resting. The cereal crops cultivated, (mainly wheat, barley or rye), were low input, with no fertilization and no improved varieties of seeds. They produced only around four hundred kilograms per hectare. The remaining area was utilized by goats to produce milk and off-spring. Some firewood was also harvested.
- b) **vineyards**. They were small pieces of lands with marginal productivity. Farmers, who lived in nearby villages, made sporadic trips to this areas during harvest and land cultivation.
- c) **olive orchards**. They were located on hill country and rolling hills of medium soil depth. They were typical Sierra orchards with marginal productivity, where the farmers lived and worked. There was also one almazara (olive factory).
- d) **sheep husbandry**. The sheep were raised on rangelands belonging to landlords and managed by shepherds. Sometimes part of the land was rented to be used as rotational crop land.

The main kind of activities were:

Cereal crops. They were cultivated under marginal dry land conditions. Land preparation was

carried out by mules or horses. One-fourth of the area was cultivated and the remaining three-fourths left resting. It was a low input system. The grain yield was used for family consumption, while the straw was used to feed the livestock (figure 5).

Burning. Burning was carried out every year after August 15th, as a previous step for soil preparation. There was no problem with wildfires. It was a normal and ancestral agricultural activity.

Goat herding. Herd size was usually between 20 and 100 goats. Every day the goats were taken to browse freely or under the care of a shepherd, usually a young person of the family. They were always associated with people living on the farm. The goats produced milk for cheese consumption which was sold in the nearby towns. Young goats were sold when they were well developed and their weight reached about 12-14 kilograms at 3 months. They were not supplementary fed with grains, hay or concentrated feed in general. The manure was used in the orchards or on cereal crops.

Sheep herding. This was an activity of the landlords who usually hired a shepherd. The sheep grazed on the rangelands of the farm. Their main products were wool and lambs. There were no fences on the land and management was only with shepherds and dogs.

Pig raising. There were some herds of 20 to 50 pigs. Normally they were associated with acorn production in those lands with good dehesas. Those farms without dehesa owned two to three pigs per family for consumption. In this case they were butchered and prepared as ham and sausages at the farm.

Horses and mules. Normally on every farm where people lived, there were one or two horses and mules for labour.

Cattle husbandry. There was no cattle grazing on the farm. The only exception were some oxen or cows for labour.

Garden and orchards. On every farm where people lived, there was a garden and orchard to produce vegetables and fruit, mainly figs, almonds and grapes for self consumption. The gardens were located in any place where the environmental conditions of soil and climate, together with water supply for irrigation, were adequate.

Small game. There was an abundant amount of partridges and rabbits for hunting. Rabbits were a basic ingredient of the food ration; it was included as an everyday meal. It has been mentioned by some of the older dwellers that they ate rabbit at least once or twice a day.

Large game. The population was insignificant. Occasionally one deer was hunted. Wild pigs were also hunted once in a while.

Cultivated forest. There were no cultivated forests on the farm. Plantations were made after the farms were sold or traded.

Firewood. This was a necessary product for dwellers. It came from land clearings as well as from harvesting the native "chaparral" or oak pruning.

Vineyards. They were small and marginal. They belonged to outside owners.

Chickens and Turkeys. Every dweller had some chickens; mostly for meat and egg production. Eggs were also sold for income. Occasionally some turkeys were raised.

Housing and other farm constructions. Houses were fairly modest. There were three cortijos of a better quality, but the rest were only cottages, all of them without the necessary facilities of running water, gas, electricity and adequate space.

Fences. There were no fences on any of the farms.

Roads and trails. There was no road on the farm. There were only trails for horses and wagons.

4 Discussion

The farm change

The process of change was very rapid. It occurred mainly during a period of 15 years, from 1960 to 1975. At that time better opportunities for work expanded in the European countries, especially in Germany, France and Switzerland, where most of the country workers migrated in search of work. Also better labour opportunities were developed mainly in Bilbao, Cataluña and Madrid, and a large migratory current took place and left the country side almost empty. Simultaneously, the economic situation in the country abruptly deteriorated because of lower prices of products, over-population, small farms, and soil and vegetation degradation. The technological receptivity of the lands was insufficient to support the population and satisfy their demands. At the same time the Spanish government started afforestation programmes in order to increase the wood production. For that purpose they bought big surfaces of land. It was a good opportunity for the land owners to sell their patrimony a fairly good price and move away. During the first years, the consolidated land was planted with several species of pines: *Pinus pinaster*, *P. pinea*, and *P. halepensis*. The area as a whole did not have a clear destiny until recently. About 1985 it was fenced and transformed into a wildlife ranch (see table 1).

Elements for planning

The planning is accomplished mainly in a subjective way or as a consequence of economic analyses, not directly related with landscape. The most solid elements for planning are not considered for this purpose.

The data base related with the different Sites represented in the general area and identified on the farm is not well developed. There is vague knowledge of the empirical results generated by the experiment stations and the regular activities of the farmers. There is no extension service to condense this information and generalize it according to the Site types which are present in each region and to advice on the kind and amount of technological inputs to be applied.

The farms are not represented in a spatial model such as maps in an appropriate scale where one can refer to the activities and information. There is enough technological supply in relation to maps, images and aerial photographs to be able to make a convenient image of the phenomenon. There are also GPS instruments to establish a relationship between the farm as a phenomenon and its image or model.

Table 1 Average landuse of the original property from 1960-1975 and the consolidated farm in 1994. The information on the original farms in many cases is approximate, since it is based on incomplete information from old settlers, forest guards and estimations.

Subject	Item	Original farm	Consolidated
General statistics	Number of properties	37	1
	Area (ha)	7300	7300
	Average farm area (ha)	198	7300
	Population (number)	230	40
	Workers (number)	70	10
Cover	Cereal crops (ha)	1100	58
	Vegetables (ha)	Few	0
	Olive orchards (ha)	80	0
	Vineyards (ha)	Few	0
	Rangelands (ha)	1000	252
	Brush lands (ha)	3000	2800
	Cultivated forest (ha)	0	2400
	Native forest (ha)	1700	1700
Livestock	Goats (heads)	200	0
	Sheep (heads)	No data	0
	Horses, mules (heads)	No data	4
	Wild pigs (heads)	Few (30)	1000
	Pigs (heads)	200	0
	Cattle (heads)	200	0
	Deer (heads)	0	2700
	Partridges (heads)	Many (2000)	Few (300)
	Rabbits (heads)	Many (2000)	Few (100)
Water yield	Water yield (m ³ /ha*year)	Medium	Low

Laboratory technologists, who describe and analyze soils, water and vegetation, could also help in this respect. The computer technology of GIS, as well as the available software to digitize the farms, could help in solving this problem.

Styles of agriculture

Agriculture, in any place and time, always includes the resource mobilization in order to transform them into a specific value. The dryland farming characteristics of the crop-grazing farm intensely mobilizes the resources, while the hunting farm doesn't. The farming style also implies the way a farmer organizes the farm space and activities.

In the dryland crop-grazing farm, the space is organized in fixed paddocks, divided by permanent fences. At fixed intervals, the soil is ploughed, seeded and harvested and then the land is left idle, allowing the spontaneous grow of annual plants. Every four years the accumulated resources are liberated when a new rotation cycle starts. The field size and location are arranged according to the functional operation of the farm rather than to a strict ecological or aesthetical rationality. A great improvement could take place in this respect.

On the wildlife ranch, there are no internal fenced paddocks to organize the territory. The space is divided in a different way. The forest plantation covers one section of the farm, thus eliminating or reducing the wildlife utilization. The wildlife is supplementary fed during the summer months, thus concentrating the population in the areas where the feed is distributed. During the hunting season the *manchas*, *armadas* and *traviesas* subdivide the space according to their purpose. The complementary activities for hunting are located in definite spaces, such as parking and dining areas, areas to concentrate the animals hunted, and roads to reach the *puestos*.

The relationship with markets is well established for the traditional crops which are sold in a conventional way and receive a price support from EU. This is not the case with wildlife, recreation, water yield, aesthetics, conservation and other products which do not have a given price and where there is not an established market.

The technologies for the ecological development of the farm are not well known and applied. For instance, it is well known how to plant a tree but it is not known how and where to plant a tree for recreation, wildlife management, aesthetics or water yield. Also it is not known how to design a farm space, how to characterize the ambit from an ecological, aesthetical and functional perspective, and how to organize the space in order to make a better use of the land and to improve the life quality.

Available technologies

There are several agricultural technologies to improve the ecosystem and make it productive. The olive orchards are well adapted to the environment but their productivity is marginal compared to the *campiña* and irrigated valleys. The same happens with the vineyards which have been marginal for a long time. There is only one small plot to produce wine for self-consumption. The olive orchards have been commercial and large enough to sustain workers. Because of their marginality, they have finally been abandoned or sold and transformed into wildlife ranches.

The cereal crops have been used for a long time under marginal conditions in the sierra land. The main purpose has been self-support for the families. This activity is normally associated with small mammal husbandry, such as goats and sheep. The shepherds need to live on the farm to take care of the goats or sheep and at the same time, they need the cereals to survive. The basic combination is the crop and livestock, which also consumes the stubble. The marginal environment associated with small scale operations finally made it non-competitive and so it disappeared.

In the flatlands and larger areas, growing cereals could be commercial. The yields under dryland conditions, however, are too low to be competitive with other cereal areas of the EU, where yields are three times as large or even more. The vegetation normally is fertilized, but in dry years, the productivity may be nil. Because the farms are larger, cereals are combined with sheep to graze the stubble as well as some marginal lands which can not be cultivated. The system is based on crop rotation and sheep herds. Fences are insufficient and poorly located for livestock and range management.

Dehesas are a well adapted range technology for livestock grazing under Mediterranean dryland conditions. In the cereal producing areas, the forests and the woody species in general were eliminated in order to facilitate cropping, and thus are now bare land. In the sierra, where the land has been marginal for cereal production over a long period of time, the *dehesas* have been kept and taken care of, but have been rationally cultivated.

Forest trees have been planted in the originally marginal lands for dryland crops. Their growth, because of climatic limitations, has been low and non-competitive for wood production. The climate is too marginal for afforestation to produce commercial yields, even under good soil conditions. Pines are the main group of species selected for this purpose. They are well planted considering the land preparation and establishment technology but they are poorly planted when taken into

account where to plant them and for what purpose.

There is much to do in this respect. The landscape needs to be improved by increasing the phytomass and remodelling the shape of the space.

Rangeland improvement through seeding annual clover and grasses could be a solution for the best Sites, originally with cereal crops. There is little done in this respect. The regeneration of native rangelands through proper management is a necessity, however there is no tradition in this respect. Also some perennial grasses could be established under dryland conditions in the deeper soils. Oak planting spaced as a dehesa is a complementary action to regenerate rangelands.

The modern techniques of wildlife management and improvement are not widely used. There is a combination of tradition and technology. Hunting regulations are observed carefully and there is intensive care of large wildlife. The modern ecological principles for management are not well known and applied. There is a large field for improvement of habitat conditions, such as hedges and woody vegetation protection, especially in the cereal flatlands.

Technologies for leisure and sports could be introduced into the area. There is, however, little done in this respect. The markets for these products are not developed and it is not clear how far it could develop.

Fences are not well developed. There is a long way to go in organizing the space for other uses and fencing it, especially for wildlife management, forest protection and water yield.