

Land use evaluation and planning for integrated rural development (the case of a Hellenic region)

O. Christopoulou¹ & G. Arabatzis²

¹*Department of Department of Planning and Regional Development, University of Thessaly, Greece*

²*Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, Greece*

Abstract

Proper land use and management of natural resources are considered as subjects of high importance for the achievement of fundamental socio-economic objectives. Lack of competent management and inappropriate use of land, concerning both current and future needs, will result in the continual degradation of these valuable resources. This paper examines the potential for three alternative land uses (agriculture, forestry and range management) and reforestations in the county of Pella. It was established that land usage cannot be changed from agriculture to forestry and/or range management; while on the contrary, the transition from range management to forestry can be successfully achieved.

Keywords: land use, land evaluation, land capability, rural development.

1 Introduction

The surface of our planet is a mosaic of different foliage and geophysical features. Its characteristics are defined by many different factors such as: permanent and temporary changes in the atmosphere, land type and usage, geological factors, the availability of water and the different plants and animals that are found both above and below its surface. It is at the same time a terrain of both physical and socioeconomic activity, it is the area where human activity takes place and where human needs are met, and it is the foundation on which



socioeconomic policies are built [1, 2]. In addition to this, the earth's surface is divided into geopolitical regions that make up the many different nations of our world. It is immovable, permanent; it varies from region to region and is the main source of food and fibres. Each and every activity of man that utilises this terrain is referred to as 'land use' [3, 4].

Current land usage is the product of different factors, some of which are directly connected to the availability of natural resources, while others are the result of the political, social and economic circumstances of the past. Often the selected land use does not take future needs into consideration and this is why land use should be examined regularly. In this way alternative land uses may be considered which continue to meet human needs, but at the same time ensure that the harmony and balance of the natural environment is not compromised [5].

The planning process, and more particularly the development of a strategy for land use, is a means by which specific, objective targets can be identified and effective policies can be devised [6].

The problem of land use planning is widespread. Over the years many attempts have been made to resolve land use issues using various methods. To date, most of these attempts have been either legislative (e.g. the establishment of zones for specific land uses) or economic (e.g. widespread fiscal incentives) measures, and have concentrated on preserving the valuable agricultural land surrounding many large urban developments [7, 8].

A study of current land use must be carried out prior to the development of an alternative plan because this offers a valuable source of data, collected over an extensive period of time, and under specific socioeconomic and political conditions [9]. A successful long-term plan should be a broad-based one, which takes forestry, agriculture, and range management into consideration. Moreover agro-economic development strategies must take the form of clearly defined policies [10].

Most European countries, especially those of Western Europe, have established planning mechanisms, which designate land use within their borders. In such countries land use programs form an integral part of government policy [11–15].

2 Methodology

The evaluation of land into regions legally designated for forestry, agriculture and range management is based on the biophysical characteristics of the land which must enable it to produce agricultural and/or forestry products without the utilization of artificial means.

The assessment of the potential of land for various uses in one map unit is based on the class of land capability and amount of each type of land within the unit. Each map unit consists of between one and ten land types.

Information such as the division of land into ecological areas, areas containing basic raw materials, land classified according to soil depth and soil erosion, land slope, and the amount of horizontal land are used in planning future alternative land uses, and help policymakers to decide such things as which trees



to select for forestry, the productive capacity of agricultural land, the danger from soil erosion, the need for watershed protection, and to reach a decision on the best possible means of reforestation, etc.

The land use map for the county of Pella consists of twelve 1:50,000 sheets (the sheets for Promachoi, Armissa, Edessa are completely within the county boundaries, and the remainder nine sheets belong to neighboring counties). The evaluation of land for various alternative uses in the area is based on map units.

The analysis cards, developed by the Institute of Mediterranean Forest Ecosystems and Forestry Product Technology (map unit) as part of a land classification programme, were used to place the land in the region into appropriate categories. Quality assessment was carried out on each unit to establish its capability for forestry, agriculture, range management and the possible cultivation of forest productive trees. Each of the units surveyed was classified according to the ratio of land belonging to each of the five categories of possible alternative land use. The analysis of this data was carried out using the computer program EXCEL, version 7.0.

3 Research area

An arc shaped mountain range defines the natural boundaries of the county of Pellas. Stretching from east to west, this range is made up of mount Paiko (height 1,458m), mount Tzena (2,182m), mount Pinovo (2,154 m), northern Kaimaktsalan (2,524m) and Vermio (2,027).

A plain forms 40.64% of the county, 14.01% of the area is semi-mountainous, and 45.35% mountainous. The relatively high proportion of lowland in Pella is reflected in the land use of the area. Agriculture accounts for 94,09 ha, 37.55% of the total area of the county. A proportion of 75% of the agricultural area is in lowland areas whilst 9.4% are in semi-mountainous territory with a further 15.5% in mountainous regions. Grazing lands form 29.75% of the total area of the county and consist of 74,520 ha [16]). A percentage of 50.1% of the public grazing lands of the area, and 64.2% of private grazing lands are located in mountainous areas. An area of 588.7 thousand stremmata is covered by forests, some 23.5% of the total area of the county. The largest proportion of forests is located in the county's mountainous regions.

4 Results

4.1 Biotic and abiotic factors

The county of Pella, according to above mentioned land classification programme, covers an area of 250,771 ha and excluding the Lake Vegoritida 247,032.6 ha.

The natural vegetation of an area develops according to the climate, soil conditions and biological factors that determine its existence, composition and evolution. In order to classify areas of land where natural vegetation has not



been significantly disturbed by human impact, the term ‘ecological areas’ is used to describe ‘major natural vegetation zones’ [4].

In the county of Pellas there are three ‘ecological areas’: the deciduous oaks zone (sub-Mediterranean zone), the fir zone (mountainous zone) and the pseudo-alpine zone (mountainous zone) (comprised of treeless peaks in the region’s highest mountains). The deciduous oaks zone makes up 78.9% of the area of the county 55.6% of which is cultivated, whilst grasslands form 20.7% of the area. The fir zone, in which trees such as beech (*Fagus moesiaca*, *F. orientalis*, *F. sylvatica*) and black pine (*Pinus nigra*) are cultivated, covers some 19.55% of the county. The sub-alpine zone covers 1.55 of the county’s area, in which human intervention is minimal [17].

The soil in the county is mainly alluvial (29.92%), limestone (21.22%), topsoil (17.74%) and shale (12.31%). A large proportion of the alluvial and topsoil is deep, of differing textures and, as a rule, fertile. Nowadays most intensive crop cultivation takes place in areas where this type of soil is prevalent. In contrast limestone and shale are covered with natural vegetation.

The depth of soil in hilly and mountainous areas depends on the type of soil (geology), the degree to which natural vegetation has been affected by human intervention, plus other factors such as position, aspect and slope. When natural vegetation is destroyed the land on mountain slopes loses its natural protection from shifting and soil erosion and becomes shallow.

The majority of ground in the county is covered by deep soil (75.29%), whilst areas with shallow ground account for 19.16% of the total area. The subsoil consists mainly of alluvial soil, whereas the top soil is mainly colloidal in nature and a large proportion of the edaphic area is made up of flysch shale and peridotites, which, left uncultivated, develop into woodland which in turn protects against erosion. The areas of shallow ground are mainly found in mountainous and hilly areas of limestone, flysch, shale and peridotites. Natural vegetation has been badly affected in these areas and, in some cases, completely destroyed. A small part of the land in the county consists of rocky ground, which mainly takes the form of limestone escarpments where woodlands have either been totally destroyed or seriously damaged.

Erosion of land is being caused by human intervention and leads to the degradation of the land, a marked reduction in fertility and the devastation of a natural resource which is of extreme importance to mankind, a resource which cannot be replaced or regenerated. Most of the land (90.62%) in the region is not affected by erosion. All levels of alluvial and rocky ground fall into this category, particularly the limestone escarpments and land on mountainsides, a resource permanently covered with a protective layer of natural vegetation. Because no form of organized trade or settlement has taken place in such areas this natural vegetation has remained undamaged. There is only a small portion of land in the area (0.52%) that suffers from severe erosion in the county.

The slope of the land influences surface irrigation, water absorption, drainage, soil erosion and the amount of sunlight the land receives and as a consequence land temperatures, topsoil loss and the development of the ground – all of which in turn determine the way in which the land can be exploited in a particular



region. In the county of Pella most of the gradients (71.6%) are fairly shallow (<40%) whilst only 2.94% are very sharp.

The majority of the land in the area, some 31.2% is south – north facing (24%) and south – north-facing land makes up 16.15% of land in the county.

4.2 Land evaluation for forestry, agriculture and range management

As can be seen from Tables 1, 2 and 3, 84.61% of the land is suitable for forestry (capability classes 1, 2 and 3), 38.31% is suitable for agriculture (capability classes 1, 2 and 3) (approx. the amount of land currently farmed today), and only 0.93% of land in the county is considered suitable for range management (capability classes 1, 2 and 3). The fact that the amount of land in the county which is considered suitable for cultivation is already being cultivated reveals that this sector has not been overlooked.

Table 1: Distribution of land in Pella according to capability classes for forestry.

Classes	Area (Ha)	%
1	48,051.97	19.45
2	133,722.36	54.13
3	27,240.68	11.03
4	34,351.92	13.90
5	3,665.64	1.49
Total	247,032.57	100.00

Source: [17]

Table 2: Distribution of land in Pella according to capability classes for agriculture.

Classes	Area (Ha)	%
2	75.726,93	30,65
3	18.921,7	7,66
4	56.925,86	23,04
5	95.458,08	38,64
Total	247032,57	100,00

Source: [17]

The areas suitable for forestry – with the exception of those found in this study to be ideal for agriculture, and which should remain as farmland because of the greater economic returns by this activity – make up about 46.4% of the total land in the county.

As is evident from Table 4, shows land that is in capability class 2 for agriculture is also in capability class 2 for forestry. In other words, land that is suitable for agriculture is also suitable for forestry. These lands, however, are

located within the deciduous oaks ecological zone and are currently used for agriculture. Most of this land has alluvial soil and topsoil deposits and is located on plains. Obviously, a change in land use is not indicated here.

Table 3: Distribution of land in Pella according to capability classes for range management.

Classes	Area (Ha)	%
1	1,062.63	0.43
2	1,230.59	0.50
4	221,785.68	89.78
5	22,953.67	9.29
Total	247,032.57	100.00

Source: [17]

Table 4: Classification of land in the region according to potential for both agriculture and forestry.

Capability classes for agriculture	Capability classes for forestry					Total Area (Ha)
	1	2	3	4	5	
2	0	75,726.93	0	0	0	75,726.93
3	6,113.52	12,026.1	703.16	0	78.92	18,921.7
4	10,194.42	27,745.51	10,161.41	8,824.52	0	56,925.86
5	31,744.03	18,223.82	16,376.11	25,527.4	3,586.72	95,458.08
Total Area (Ha)	48,051.97	133,722.36	27,240.68	34,351.92	3,665.64	247,032.57

Source: [17]

Table 5: Classification according to potential for both forestry and range management.

Capability classes for forestry	Capability classes for range management				Total Area (Ha)
	1	2	4	5	
1	895.51	0	47,156.46	0	48,051.97
2	0	0	133,192.62	529.74	133,722.36
3	0	0	25,340.6	1,900.08	27,240.68
4	0	0	14,480.68	19,871.24	34,351.92
5	167.12	1,230.59	1,615.32	652.61	3,665.64
Total Area (Ha)	1,062.63	1,230.59	221,785.68	22,953.67	247,032.57

Source: [17]

An important part of the area, i.e. 114,445.3 ha (46.33%), is considered to have serious limitations (marginal land) and as such cannot be considered for agriculture. These regions are considered to have high (capability classes 1 and 2) suitability for forestry (capability class 3). They are currently used for forestry and the main types of trees are beech, black pine and fir. Productive forestry in the county is carried out on lands with high and low productive potential. In addition to this a small section of land, i.e. 37,938.64 ha (15.36%), in the county is land with high potential for both agriculture and forestry. The land in question consists mainly of limestone and is currently covered with shrubs. Table 5 reveals that 205,689.08 ha (82.24%) of the land in the county falls into land capability class 4 for range management, and has high to medium potential for forestry. Despite this, a change of land use is impossible since the land is currently used for agriculture and forestry.

4.3 Biotic and abiotic factors in areas suitable for reforestation

The ecological zones of the region which were found by this study to be suitable for the establishment of reforestations are within the boundaries of the ecological deciduous oaks and fir zones. The largest section (88.9%) of the areas found suitable for reforestations is in the deciduous oaks zone. Grasslands make up 78.6% of the zone and the remainder of the zone consists of sparse and open scrubland. 11.1% of this area, which was found to be suitable for reforestations, is located in the fir zone while 58.6% is in grasslands.

A percentage of 43.8% of the land which is suitable for reforestation is made up of topsoil deposits, 20.4% are peridotite - gabbro and 16.1% shale.

A percentage of 77.7% of the land that was found to be suitable for reforestation contains deep soil. A percentage of 50.5% are not affected by any form of erosion whereas in 49.5% we have a medium level of erosion.

Most of the gradients in this area (84.7%) are shallow. Of the areas found suitable for sustainable forestry south-north facing land makes up 49.5% of the total, and north facing land 15.2%.

4.4 Land evaluation in the county for reforestation

Areas of land in the region which are suitable for reforestations have the following characteristics: a) they contain all types of natural vegetation – with the exception of those which contain mainly alluvial deposits (as a result of arable farming), limestone, riverbeds and river valleys – and the prerequisite is that the soil is deep b) the gradient is <70% and they are not located in pseudo-alpine zones. Sixty four land units in the region, i.e. a total area of 30,471.67Ha, some 12.35% of the total land area of the county of Pella, present the above characteristics, making them suitable for sustainable forestry. It should be mentioned that their suitability for reforestation was based on ecological criteria, without taking into consideration the ownership of the land in question, or its possible current use (e.g. as grazing land, timber felling etc.). Furthermore, the fact that such areas must consist of units of at least 1,000-5,000 ha was not taken into consideration.



As can be seen from Table 6 some 98.4% of the above mentioned land (capability classes 1, 2 and 3) was found to be suitable for forestry. In addition, as is revealed by Table 7, 98.5% of these are areas (capability classes 4 and 5) where development of agriculture would be subject to major limitations. A percentage of 100% of the land that falls into capability class 4 is land with serious limitations for the development of range management (Table 8). The majority of this land is in areas of range management although there are areas of sparse and open scrubland.

Table 6: Distribution of land in Pella evaluated to be suitable for reforestation based on capability classes for forestry.

Classes	Area (Ha)	%
1	745.4	2.4
2	20,137.2	66.1
3	9,100.3	29.9
4	488.8	1.6
Total	30,471.7	100.0

Source: [17]

Table 7: Distribution of land in Pella evaluated to be suitable for reforestation based on capability classes for agriculture.

Classes	Area (Ha)	%
3	444.6	1.5
4	21,848.1	71.7
5	8,179.0	26.8
Total	30,471.7	100.0

Source: [17]

Table 8: Distribution of land in Pella evaluated to be suitable for reforestation based on capability classes for range management.

Classes	Area (Ha)	%
4	30,471.7	100.0
Total	30,471.7	100.0

Source: [17]

It can be seen from the above that the land recommended for reforestation would not be suitable for either agriculture or range management. More specifically, the land that belongs in land use classification 1 for forestry is land that belongs to capability classes 4 and 5 for agriculture. The land that has been given capability class 2 for forestry is land that is in capability classes 4 and 5 for agriculture (Table 9). In other words this land is unsuitable for agriculture and

indeed it is not currently used for agriculture. The land which has capability classes 1, 2 and 3 for forestry is land which has capability class 4 for range management (Table 10). From the above it becomes obvious that all of the land found suitable for reforestation has severe limitations for the development of range management. All of the above enables us to recommend that a section of this land be devoted to forestry – although factors such as socioeconomic conditions in the area and the traditional conflicts between those who earn their living from range management and those who earn their living from forestry, which is a consequence of the historical development of land use from ancient times to today, must be taken into consideration.

Table 9: Distribution of land in Pella evaluated to be suitable for reforestation based on capability classes for both agriculture and forestry.

Capability classes for agriculture	Capability classes for forestry				Total Area (Ha)
	1	2	3	4	
3	0	444.6	0	0	444.6
4	294.6	16,926.7	4,626.8	0	21,848.1
5	450.8	2,765.9	44,473.6	488.75	8,179.0
Total Area (Ha)	745.4	20,137.2	9,100.4	488.75	30,471.7

Source: [17]

Table 10: Distribution of land in Pella evaluated for reforestation based on capability classes for both forestry and range management.

Capability classes for forestry	Capability classes for range management	
	4	Total Area (Ha)
1	745.4	745.4
2	20,137.2	20,137.2
3	9,100.4	9,100.4
4	488.7	488.7
Total Area (Ha)	30,471.7	30,471.67

Source: [17]

5 Conclusions

As we have already seen from the evaluation of the land, there is no indication that agricultural land is being under-exploited. Additionally, there are no techniques (based on ecological criteria) by which farming land can be transformed into forestry and/or range management. In addition, during the evaluation it was discovered that, technically speaking, range management can



be transformed into forestry however, any attempts to make such a transformation in the county of Pella would face serious problems.

In the mountainous areas of the county (approximately 1/3 of the total area of the county), the three main land uses i.e. forestry, range management and agriculture, have never existed nor are they evident today. The boundaries of such areas are not clearly defined and they are constantly shifting over time.

An analysis of the historical development of social structure and land use reveals that the system of land use on which the foundations of agriculture, range management and forestry are built have been through important changes. These are linked to general changes within the economy of the county. In general terms, the use of land for grazing is rather arbitrary and is decided according to its cost-effectiveness within the economic circumstances of each historical period. It does not, however, exhibit the same rate of change as agriculture or forestry during the same periods and under the same economic circumstances. The fact that there was an increase in the number of herding animals at the end of the twentieth century, making it inefficient to transform land use from grazing to forestry, offers one explanation for this slower rate of change.

The classification and evaluation of land in the county of Pella is based on the biophysical characteristics of the land, however, in order to increase land use efficiency in the area a detailed plan of land use is required. Such a plan must take into consideration a wide range of factors such as techniques, socioeconomic and political data, and, in addition to these, collaboration between the policy-makers and the administrators of the natural resources; it is often the case that policymakers who allocate the division of such resources are not the people who will administer those resources. In this way, an increase in the productive capacity of the area and at the same time the greatest protection of the environment will be achieved, as well as the social and political values of the county.

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