

Impacts of environmental law and regulations on agricultural land-use change and urban pressure: The Algarve case

Research Memorandum 2011-40

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Abstract

Land-use change has been an increasing concern in most of Europe. While stakeholder's strategies of coping with land-use change have been constrained mainly due to socio-economic pressures, the natural landscape and fragile ecosystems are often neglected due to infrastructure and urbanization development. However, over the last thirty years, public regulations have become more explicit regarding environmental impacts at a regional level. Spatial assessment of ongoing policies of rural and urban has led in the case of Portugal to concerns inquiries on the consequences of sustainable development and the context of juridical commitment. A good example of this is the agricultural land loss that Portugal has witnessed over the last thirty years, in large part resulting from socio-economic pressures which policymakers have not been able to cope with.

The Reserva Agrícola Nacional (RAN) – translated as National Agricultural Reserve – is an instrument for planning purposes that aims to visualize and protect suitable areas for agricultural activities, due to their morphological, climatic and social characteristics. The RAN has changed its legal status over four times in the last twenty years. These changes have largely been influenced by the policies of sustainable development for the region. However, the ability to defend the interests of agricultural and rural commitments in fragile ecosystems has been largely compromised due to socio-economic interactions brought by pressures of economic growth.

Spatio-temporal analysis of current land loss and geo-statistical analysis are adequate tools to understand the dynamics of change. The spatial properties of data inventories from the RAN and land-covers, allows for an assessment of the changes within the policy context of the Algarve. An integrated assessment of agricultural land loss compared with urban growth parameters and population density unfolds into a rich laboratory of spatio-temporal analysis of carrying capacity of the regional / rural environment.

By adopting a spatial analysis of preemption of agricultural land with an overlay of population and urban data, a focus on the consequences of certain regulations on the dynamics of land-use change becomes possible. This paper aims to further expand on the actual existing decrees which offer support to sustainable development in the region, to

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provide a qualitative assessment of future roles based on ethical values and economic efficiency, and to offer a feasible framework for policy makers regarding the trends of the urban/agricultural dichotomy.

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1. Introduction

Environmental regulation is one of the most fundamental aspects for competitiveness, allowing to reduce cost for industry and business, generate new markets for environmental goods and services, create jobs as well as protect and sustain natural resources from scarcity (Network of Heads of European Environment Protection Agencies, 2005). That said, environmental law which abridges the Environmental law system, may be defined as “an organized way of using all of the laws in our legal system to minimize, prevent, punish, or remedy the consequences of actions which damage or threaten the environment, public health, and safety.(p. 4)” (Steinway and Botts, 2007). However, from a strictly anthropocentric perspective, the very core of legislation of environmental issues is overshadowed by the interests in economic growth. The importance of seeing sustainable development as an interconnected reality, where just distribution of resources should exist and in which irreversible options must be handled with care (Gladwin et al., 1995) is often forgotten. Thus, environmental regulation is often overthrown to economic externalities, making efficient regulation often a disputable topic between the paradigm of growth and sustainability. This has especially been witnessed in the last decades, where environmental deterioration and increasing economic growth have brought scarcity to certain ecological sectors, such as agriculture and have led to increasing asymmetries.

An attempt to “minimize the consequences on environment” (Steinway and Botts, 2007) becomes a very difficult task, calling for regional decrees which legislate and articulate the policies of sustainable development and environmental change, facing the paradigm of socio-economic growth. These decrees however, are often restructured and reorganized to fit the current aspects of environmental degradation, lacking as a consequence a stable and continuous monitoring of sustainability.

Environmental degradation caused by human pressure has been witnessed in different regions of the world. In Europe, where a strong legislation and a good juridical system in general does prevail, urban sprawl has been an inevitable reality. Brought by population increase and socio-economic growth, significant land abandonment especially in regions with a higher demand of tertiary sector activities have been witnessed. Environmental regulation however, has not been able to solve this problem, and, taking as an example

the Algarve in Portugal, such pressures have directly been responsible for the destruction of fragile ecosystems, loss of agricultural land and coastal vulnerability.

Coastal regions share a twofold problem for policy making: their location as socio-economic systems, correspond to highly productive regions which are by far too complex to allow a linear analysis for policy making (EEA, 2006). On the other side, the productive cycle of such areas relies heavily on ecosystems functionality which may become jeopardized with excessive exploration of goods and services. From a historic perspective, coastal areas have been the cradle for a panoply of resources such as agriculture, leading to settling patterns which have encouraged regional prosperity. Their unique landscape combines often moderate temperatures with historico-cultural character which have also led to development of tourist industries in such areas (Vaz and Nijkamp, 2009). However, excessive growth leads to a deterioration of coastal areas, compromising the resilience of such regions. At the long run, ecosystem services of littoral regions must be carefully planned not to jeopardize the fragile ecological habitats in such areas (Costanza et al., 1997).

The issue becomes one of resilience of environmental carrying capacity to support the demand of economic growth. While for example, tourism may be a beneficial activity to some extent (Lacitignola et al., 2007), bringing jobs to certain coastal basins, the counterpart is of rapid land deterioration brought by seasonal population pressure (Kruger, 2005).

The synergistic relation between economic growth and sustainable development is a very complex one, as the effects of socio-economic growth influence the system (or region) in a non-linearly. The dynamics of non-linear complex systems are very difficult to cope with, making necessary legislation to be cross-dimensional. However, such environmental legislation share the less decision-making influence, while narrow focused environmental laws have a larger impact (Ruhl, 1999), as their extend of application is more pragmatic.

2. Spatial Information and Complexity

Spatial analysis has been largely motivated by different scientific backgrounds, such as geography, statistics, economics and mathematics. Complex systems, although still

lacking a consensus regarding its definition, has allowed to create structural analysis of combined factors of economic and social and natural drivers (see Newman, 2005). One of the main advantages of complex systems analysis resides in the possibility of an integrative approach of understanding the global consequences of interactions (Taylor, 2005). The applicability of spatial information and higher spatial resolution georeferenced economic, social and environmental strata, allows a much more coherent approach to integrative analysis: social, economic and environmental phenomena happen in a specific space and time. By combining different factors from heterogeneous variables along a territorial unit over time, it becomes possible to find a coherent explanation of key drivers for environmental change, leading to a better approximation of sustainable development.

The cross-linkage of policy decisions implies direct impact on land-use and on territorial management. Spatial information and complex systems may, if combined correctly create accountable approaches of land-use change and support in identifying key drivers for certain land-use changes. This information permits a much more accurate approach to decision making and of understanding relevant constraints for sustainable development (Nijkamp and Scholten, 1993).

3. The Study Area

Located at the south of Portugal, the region of the Algarve is one of the most well known regions of Portugal for its prosperous and active tourism sector. The region itself shares a unique historico-cultural legacy brought by the Phoenician, Roman and Moorish influence.

The coastal area of the Algarve has a unique ecological landscape, integrated in the continental network of conservation habitats, defined under the European Union directives: 79/409/CEE of the 2nd April and 92/43/CEE.

While the geomorphology of the Algarve may be delimited into three different regions: the Interior, Barrocal and Litoral. The Algarve shows a significant asymmetry between the Interior (located at the northern perimeter of the region) and the Litoral (the coastal regions of the Algarve). It is within the coastal region that areas tend to be more fertile,

and converging ecosystems in the southeast area create the unique Reserva Natural da Ria Formosa, known for many different types of edaphic species.

Figure 1 shows the geographical region of the Algarve, as well as the integration of the NATURA 2000 network. However, the increasing asymmetries between population increase in the south of the Algarve contrary to the northern perimeter, jeopardize the important ecosystems and put at risk the agenda of development of rural areas.



Figure 1 – Location of protected areas in context with municipalities of the Algarve

While agricultural activity has been high in the Barrocal, specializing in carob production, and in the Interior, ranging from ovine production and other agro-pastoral activities (Assunção, 1989) the Litoral has lost largely its agricultural sector for exploration of tourism activities. Since the sixties increase of tourism brought by low-cost flights throughout Europe have been seen as an opportunity of economic growth and prosperity for the region. Creation of amenities and infrastructures to support a massive tourism industry, changed primary sector activities to a tertiary sector, focusing predominantly on the service sector related to tourism.

The development of the tourist industry provided better job opportunities, attracting a massive concentration of population in the Algarve, contributing directly to coastal population increase. Figure 2 represents the population growth tendency since the mid

XVII century. The exponential growth that the Algarve has witnessed, has especially increased during the eighties, and is a reflection of the mass tourism industry.

While the population in the Algarve in 1973 was of 63,682 inhabitants, in 1992, a growth rate of 167,62% was witnessed. The increase in population during the eighteenth century is a direct result of the efficiency of the existent fish industry, which contributed to the existence of jobs and economic prosperity during the eighteenth and nineteenth century. Another important growth rate is registered during the nineties, directly related to a new type of economic growth resulting from the development of low-cost carriers for tourism purposes. Starting in the sixties as mentioned earlier, the nineties witnessed in the Algarve a significant amount of growth in the service sector. A population decrease is witnessed over the last 4 years (Table 1), largely resulting from the economic recession as well as from a loss of revenues in the tourism industry in the Algarve.

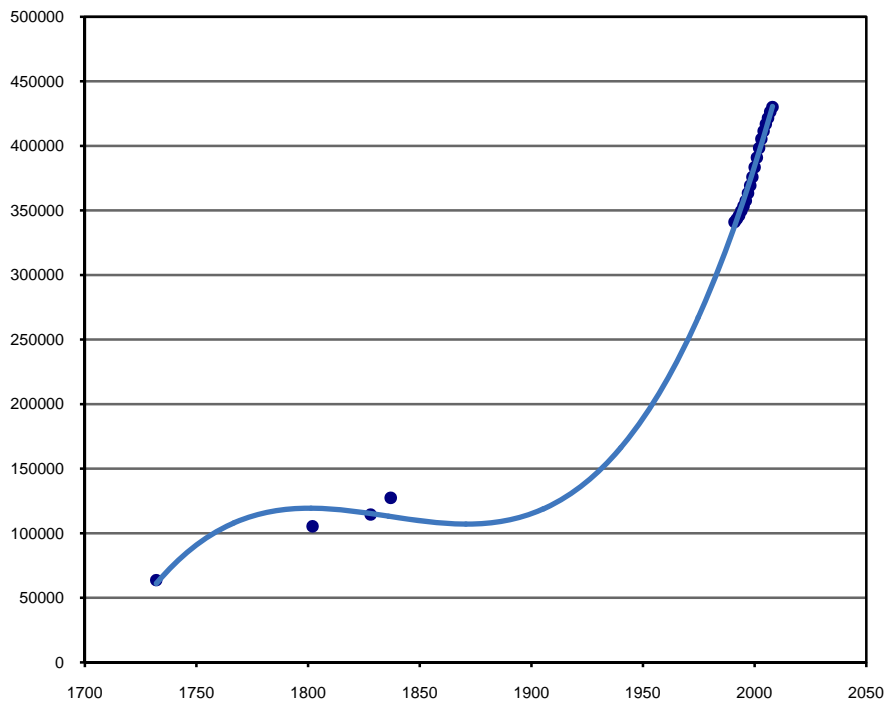


Figure 2 - Population growth in the Algarve since the XVII century

Table 1 - 1991 - 2008 (INE) and 1732-1837 (Lopes, 1841 *in* Tavares, 1989)

Year	Population	Increase	Growth rate
1732	63682	-	-
1802	105412	39.59	65.53
1828	114499	7.94	8.62
1837	127446	10.16	11.31
1991	341075	62.63	167.62
1992	343328	0.66	0.66
1993	345970	0.76	0.77
1994	349658	1.05	1.07
1995	353309	1.03	1.04
1996	357472	1.16	1.18
1997	363387	1.63	1.65
1998	369298	1.60	1.63
1999	375841	1.74	1.77
2000	383399	1.97	2.01
2001	390933	1.93	1.97
2002	398370	1.87	1.90
2003	405380	1.73	1.76
2004	411468	1.48	1.50
2005	416847	1.29	1.31
2006	421528	1.11	1.12
2007	426386	1.14	1.15
2008	430084	0.86	0.87

The construction of the International Airport in the capital district of Faro, as well as the ongoing options on coastal tourism, have allowed the tertiary sector to prosper, while neglecting the primary sector activity contributing for city expansion into fertile regions. As suggested by Wrigley (1985), rise of incomes elasticity for food is less than unit necessarily secondary and tertiary sectors are prone to prosper. The consequence however, may be devastating for ecological coastal regions given the depletion of important resources. Furthermore In 2008, the region of the Algarve showed a density of approximately 80 inhabitants per km². The asymmetry between the coastal area and the northern region of the Algarve, make a much larger variation of density estimates, contributed by the disparity during summer, where the region triples its size of

inhabitants, clustering in the regions of prolific tertiary sector activities. Figure 3 shows the population density per parish, reflecting clearly the cluster pattern on coastal areas and lower intensity in the interior.

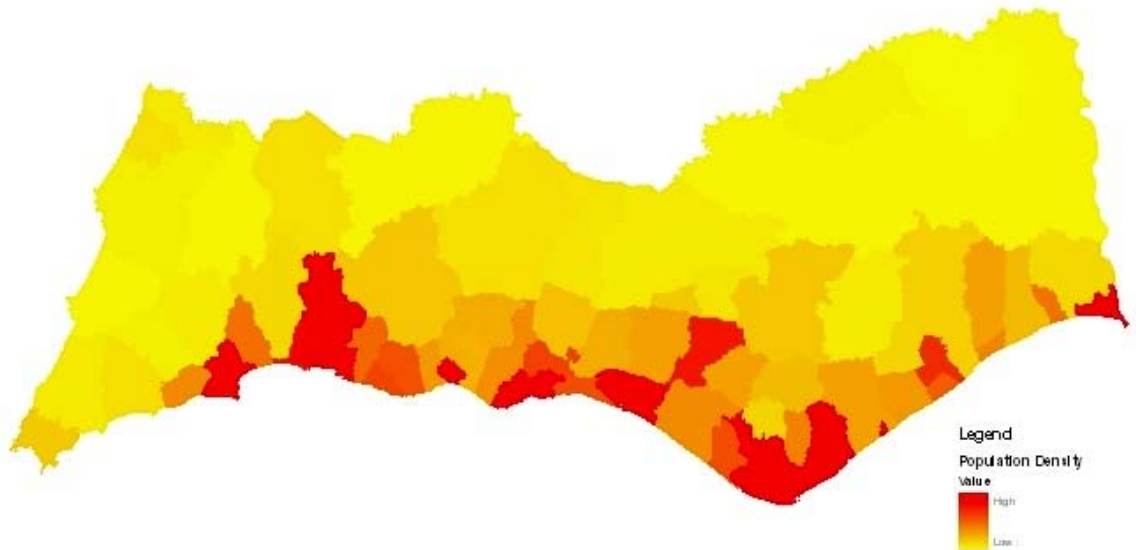


Figure 3 - Population density per parish

A predominant pattern of population density is visible in the surroundings of Faro, the districts capital of the Algarve, as well as in the areas of Albufeira, Portimão and Vila Real de Santo António.

4. Data and Methodology

This study is centered on the changes of Portuguese agricultural land since the end of the nineties until now. The depletion of rural areas that the Algarve has witnessed in the last decades is aggravating and may provoke scarcity in the region. Loss of natural habitats and biodiversity are an increasing concern for regional policymakers as well as widely recognized in the municipal plans of the Algarve.

Methodologically, the main objective of this study is to create comparable spatial datasets derived from land-use maps regarding urban land-use and cross-link with agricultural preemption loss in the municipalities of the Algarve.

Thus, this study proposes a land-use accounting methodology which is shared with population density dynamics and urban growth variations for similar time frames. This

accounting methodology shall allow recognizing the main driver for agricultural land loss - whether urban growth may be considered as a significant driver for loss of rural areas, or, on the other hand, systemic population increase might be a key driver of agricultural land preemption. A multi-temporal analysis for the decades of the nineties and 2000, allows to create variation for urban areas as well as agricultural areas. These dynamics are registered as urban variations and agricultural preemption variations and assessed with the profile of population density. The impact of this analysis (see Figure 4) leads to an assertive characterization of the responsible driver, as well as hypothetical evaluation of future trends regarding agricultural land use and population density for the region of the Algarve. This qualitative analysis combined with the quantitative support from spatial data, permits a better understanding of the dynamics of sustainable development, considering that urban growth is an inevitable reality but sustainable cities must be taken into account also.

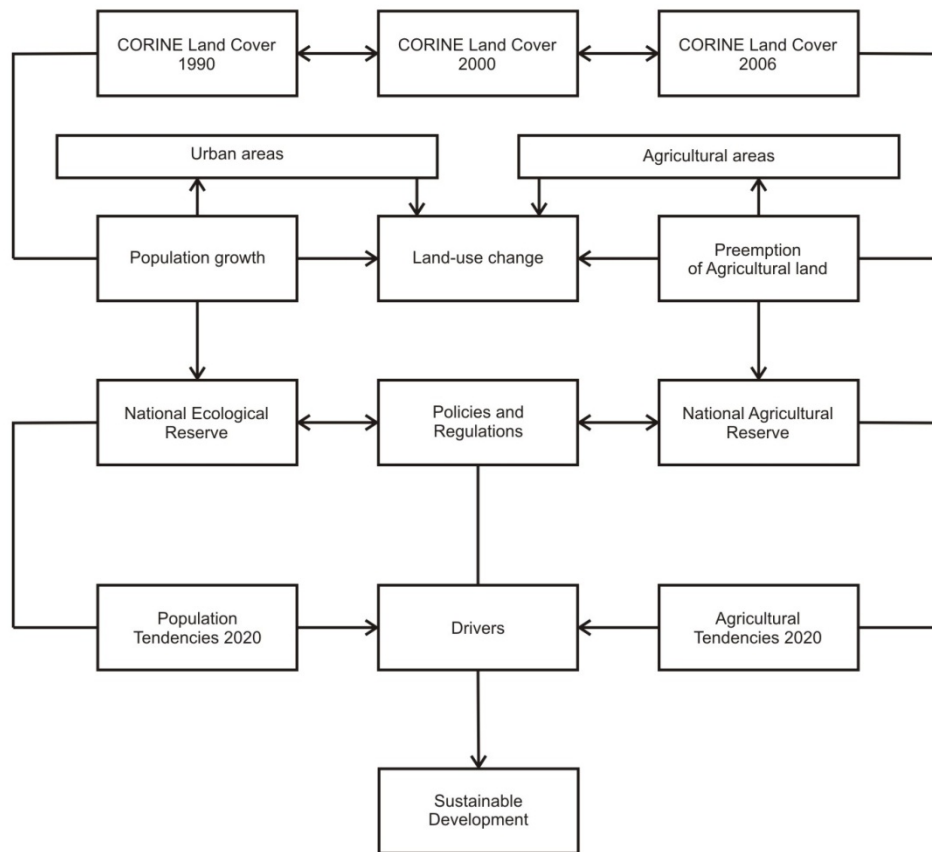


Figure 4 - Flow diagram of research methodology

The comparison of both realities of loss of agricultural land from land loss protocols with urban growth, will allow to establish a regression growth from spatial strata. Figure 4 shows the workflow of the comparison of the CORINE Land Cover period for 90, 2000 and 2006 with the growth agricultural land surveys collected since 1991 to 2008. Given the change analysis of the CLC periods, urban areas and agricultural areas are mutually assessed to examine land-use change. Diagnosis of population growth and preemption of agricultural land are reported within the directives of regulation frameworks between 1989 and 2008. The strategies for the National and Ecological Reserve and for the National Agricultural Reserve are remitted to the existent policies, justifying the available carrying capacity to understand the pressure of population tendencies for 2020 and agricultural tendencies for 2020. These Drivers are tested based on linear regression and forecasted to form the current critic to the endangerment for sustainable development for the region. The multiple time series of population, urban quantification, agricultural quantification and preemption of agricultural land as well as regression correlations allow a comparison of land loss and socio-economic driving forces. The result of this quantification shall mitigate impacts on urban pressure on the coastal region of the Algarve, as well as recognize the ongoing juridic importance of quantitative spatial analysis within the notions of land preemption for urbanization.

The CORINE Land Cover project (CLC) may be considered as a first attempt of deriving spatial information of land-use under the European umbrella.

Starting on the 27th June 1985, as a program that would address the following issues: State of individual environments, Geographical distribution and state of natural areas, Geographical distribution and abundance of wild fauna and flora, Quality and abundance of water resources, Land cover structure and the state of the soil, Quantities of toxic substances discharged into environments and List Natural Hazards (EEA, 1995). In this sense, CLC can be seen as an 'an experimental project for gathering, coordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community' (85/338/EEC, Council Decision 27/6/1985).

The RAN is a Portuguese tool for territorial management, corresponding to the number of areas which, due to their morphologic, climatic and social conditions are adequate and

share the most potential for development of agricultural activities. Essentially, the areas combined within the Reserva Agrícola Nacional are more fertile, and thus, have a larger tendency for creating urban-use patterns. However, local patterns of agricultural activity, typical in the rural areas of the Algarve become depleted from their traditional positive externalities, leading to an augmentation of negative externalities brought by non-systemic production sectors. This led in 1976 to the “Law of Land-use” (Decreto Lei n. 794/76, 5th November), bringing policies of urban control, and prospection of agricultural activity. However, urban and population pressure as well as existent concentration on secondary and tertiary sector lead to further agricultural abandonment, and unavoidable urbanization patterns in Portugal. A especial framework of legislation was conceived in 1982, which shared the concerns of agricultural land loss, creating the RAN (Decreto Lei n. 451/82, 16th November), with the main objective of recovering lost agricultural and abandoned land.

The Reserva Agrícola Nacional is divided in two distinct classes (A and B), based on physical and geographical characteristics (Decreto Lei n. 196/89, 14th June). RAN land is systematically decreasing, while urban areas register a steady increase (Figure 5).

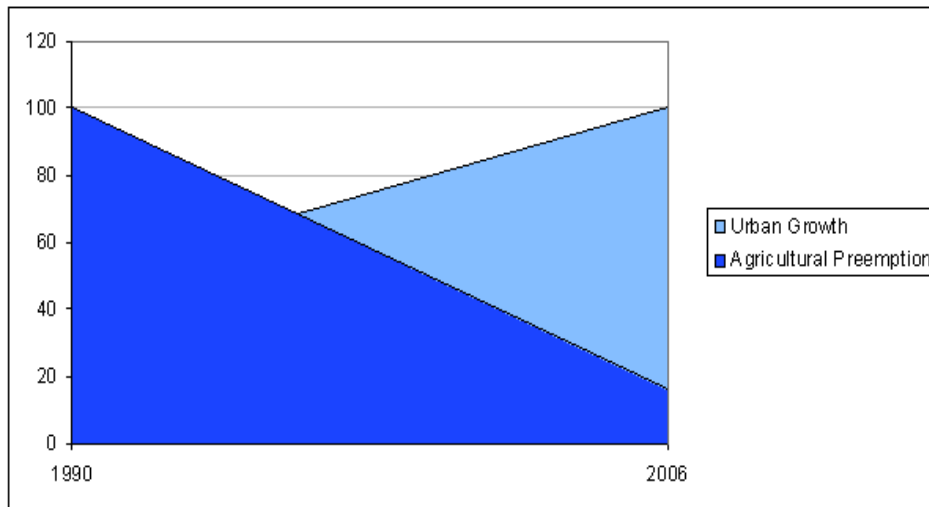


Figure 5 - Comparison of urban growth and RAN land

A closer analysis of land preemption over the last decades shows a fluctuating pattern especially felt since 1996 (Figure 6). Strongly linked to existent land-use policies, the

preemption patterns show an increase since 1994 and in 2005 register the most significant preemption of RAN land, with a total of 3,722,864 m² lost.

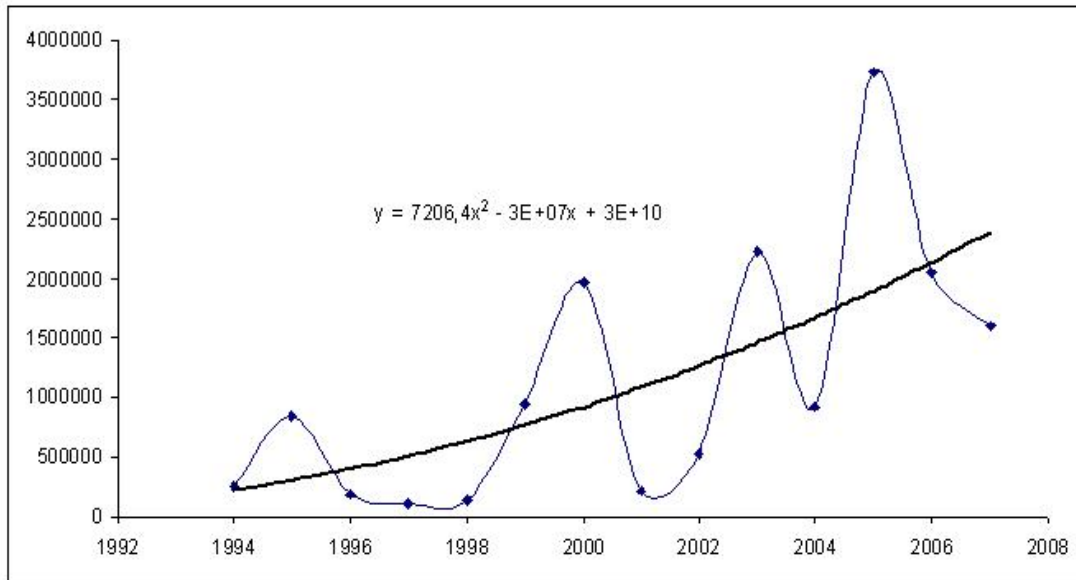


Figure 6 - Evolution of agricultural land preemption

This pattern is of increasing concern, given the fluctuation nature of land preemption and the increasing trend-line of loss of agricultural land. While the peak is for now registered in 2005, it seems to be expected that, with the current trend registered over the last decade and a half, that one might expect a further increase of an equal peak as registered in 2003 for land preemption in 2010. A closer analysis of urban growth tendencies for the Algarve region as analyzed by Vaz and others (2009), show the overburdening tendency of agricultural land loss due to urban pressure.

Analysis of urban growth patterns between the nineties and 2006 demonstrate a continuous growth along all of the Municipalities (Table 1).

Although all municipalities registered significant increase over the 15 years of study, a clear increase in urban sprawl has been verified in Castro Marim, Alcoutim and Silves. Curiously, these areas have had a long tradition regarding the agricultural sector in the Algarve, and have been subjected quite rapidly to urban growth. A further analysis on population density patterns in the Algarve, also reflecting this increase, may be a direct result of competitive prices for construction as well as existing road-networks that allow communication to important cities such as Faro, Portimão and Albufeira.

Table 2 - Ratio of urban variation from CLC 90 to CLC 06 in pixels

Municipality	Urban 90	Urban 06	variation	ratio
Castro Marim	3463	14145	10682	0,76
Alcoutim	506	2032	1526	0,75
Monchique	1304	5068	3764	0,74
Silves	10445	25517	15072	0,59
Vila do Bispo	6128	14510	8382	0,58
Tavira	7775	17942	10167	0,57
São Brás de Alportel	1836	4149	2313	0,56
Vila Real de Santo Antonio	7816	17374	9558	0,55
Loulé	53601	116356	62755	0,54
Lagos	20980	44301	23321	0,53
Albufeira	30404	64128	33724	0,53
Lagoa	22264	45685	23421	0,51
Olhão	11407	21617	10210	0,47
Portimão	31276	53941	22665	0,42
Faro	21748	30750	9002	0,29
Aljezur	10990	14446	3456	0,24

5. Conclusions

5.1. Urban growth and agricultural land loss

A comparative analysis of existing land-use patterns regarding preemption of Agricultural land, allowed to compare the results of urban variation per municipality with variation of loss of RAN. The results were quite intriguing: While population density does not seem to show a direct consequence on urbanization patterns, loss of RAN shares a similar structure of behavior as urban land variation. This information is of utmost interest, as it shows an overall tendency of agricultural land changing to urban areas. This is especially felt in Alcoutim and Silves, where agricultural production has been traditionally high, and current urban growth is following the tendencies of construction among peri-urban areas.

Datasets of RAN were summed to the same timeframes as CLC data and information were cross-linked. the result showed that Alcoutim, Monchique and Silves, on the top of urban growth, also showed explicit loss of agricultural land through preemption of Agricultural regulation of the Reserva Agrícola Nacional. While at local level this information is not evident, a regional quantification of variations of RAN and urban areas share crucial information of land-change patterns for the Algarve.

A larger framework of study for Portugal, using the CORINE Land Cover datasets also allowed to confirm that, in the case of Portuguese land-use change, Agricultural land has a tendency to change to urban areas. While this acknowledgement is quite obvious, the Algarve shows an increasing tendency of land preemption, with an increasing propensity of urban growth along the preempted lands. This pattern seems to be shared with a fluctuating tendency of policies along the areas which allow preemption of agricultural land during certain years (2000, 2003 and 2005), while this preemptions are mainly linked to important regional activities such as, for example, the Euro 2004.

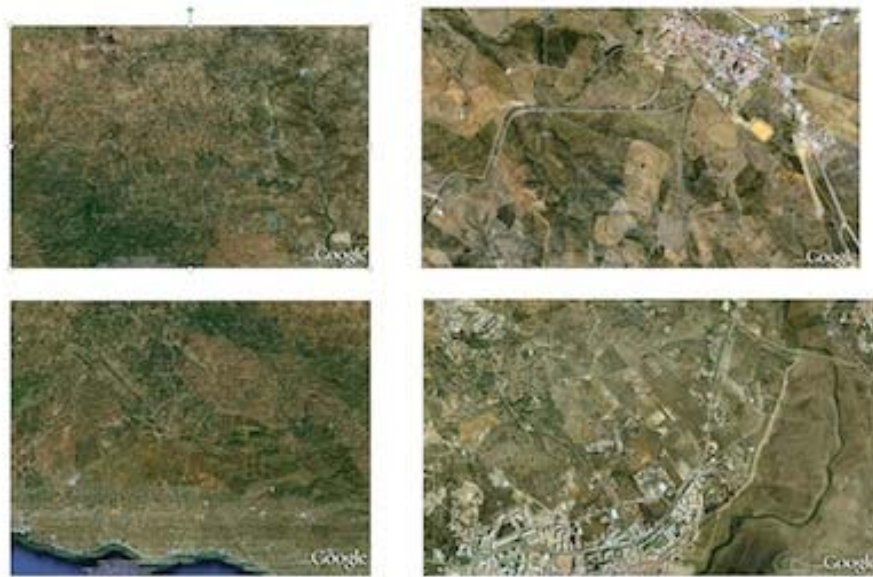


Figure 7 - Examples of urban growth in Alcoutim and Silves

The economic prosperity brought by the Tourist industry, have fomented the strategy of creation of infra-structures within the Algarve. Within the concept that currently promotes the Algarve as a sun and beach district - the “Allgarve” - preemption of agricultural land has led to the an unavoidable land-loss of agricultural territory, especially in peri-urban perimeters. The environmental consequences of this growth are evident: traditional agricultural soils have diminished widely, while new infra-structures seem to boost around certain central areas along the coastal regions.

5.2. The Reserva Agrícola Nacional in the future

On January 29, 2009, a new juridical regime was put in effect, the Reserva Agrícola Nacional, entailing the law 196/1989 of the 4th of June. The objective of this law in particular, to reinforce the juridical nature and the importance of public administration of the RAN. By considering the United Nations definition and nomenclature of territories, methodologically, this classification envisages a better protection of natural resources throughout the country.

For the first time in the regulation history of the Reserva Agrícola Nacional, usage of digital information brought by geo-referenced datasets, will have an important role in the analysis and convergence of crucial information for better management.

While past years have witnessed an imbalanced management brought naturally by economic growth to the usage of Agricultural land, the future within a better integration of information, may lead to better decision making. The Comissão Regional da Reserva Agrícola, might have an important role in reshaping the balance of sustainable development for the Algarve.

Spatial Information might have an important role in creating a synergy within this commission, allowing a more interactive and better assessed decision making.

Acknowledgments:

This paper has been partially supported by the Portuguese Foundation for Science and Technology (FCT).

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