SOIL SEALING: THE PERMANENT LOSS OF SOIL AND ITS IMPACTS ON LAND USE

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Introduction

The increasing awareness in the world for the environment and natural resource conditions against inappropriate exploitation of land is still rampant. Yassoglou and Kosmas (2000) state that the sequential land use changes leading to soil degradation in the Mediterranean context (the case of the islands) are induced by the destruction of the indigenous plant species, land abandonment due to economical hardships, and overgrazing resulting in irreversible physical desertification. Moreover, the cultivation of rain-fed cereals throughout the Mediterranean Basin especially in the West Asian and North African regions is intensifying the delivery to the ultimate end –desertification (Yassoglou, 1998; Kosmas et al. 1999; Kapur and Akça, 2001). The prevention of the ultimate end can only be attained by the development of sustainable land management (SLM) plans, which initially requires reliable local data, obtained on country basis. Unfortunately, the absence of reliable databases on resource use, management and conditions in most countries is responsible for the difficulty in establishing an SLM. Turkey is one of the few countries having acceptable data revealing the drastic changes on land caused by the population pressure. The national inventory prepared by the General Directorate of Rural Affairs, in 1978 which has been updated in 1996 puts forward the misuse of natural resources particularly soils of the country. The increasing proportions of resource consumption via infra and superstructure occupation is much higher on better quality lands resulting to indirect hazards on the remaining prime soils, with higher inputs of agricultural chemicals. The occupation of marginal lands, to be

devoted to biodiversity and forestry, to meet the increasing food demand is also threatening the vulnerable ecosystem, particularly the coastal regions of the Mediterranean Basin.

Key words: Soil sealing, resource consumption, land degradation, rural-urban development project, solidarity fund

SOIL SEALING

The relation between the increase in population and soil sealing are complex (EEA, European Environment Agency, 2000). The process of sealing generally follows trends of increasing demands due to the population pressure (Kapur and Akça, 2001). This trend reveals itself by the increasing consumption of prime land via extensive construction of infra and superstructures. UN (2000) reported that globally, approximately 2 billion hectares of land are affected by human-induced degradation of soils. Each year an additional 20 million hectares of agricultural land are also degraded for crop production, or are lost to urban sprawl (EEA, 2000). Soil sealing in Europe is reported to be one of the main land degradation types. EEA (2000) documents loss of soils by sealing through growth in urbanisation and transport infrastructure, which are high and similar in several EU countries, such as the Benelux, Germany, and Switzerland. Furthermore, urbanization, particularly with investments on tourism, in the Mediterranean basin has accelerated soil sealing in the coastal zones of southern Spain, the Mediterranean islands, southern France, Italy, Greece, Turkey, Egypt, Tunisia, Algeria, Israel and Lebanon (Kapur et al. 1999). These pressures are likely to remain or increase in the coming years provided a sustainable land management program with high implementation probabilities is not developed for the region (Belloti et al. 1997; Kosmas et al. 1999).

Soil sealing in Turkey has started in the 1950s and accelerated by the 1960s due to the unplanned industrial sprawl/ordeal upon agriculture and the natural environment, which was an absolute outcome of the implementations of the shortsighted profit based policies that also induced mass immigration from rural areas. The proportion of the urban population to the total of the country in 1950 was 25%. This increased to 44% in 1980 and to 59% in 1990 (Ministry of Agriculture and Rural Affairs, 2001). The second

rush of immigration of the 1980s to relatively developed areas, namely urban and sub-urban regions of southern, western and central parts of the country, has had more drastic impacts on the environment and soils around the towns with adverse resilient effects on the abandoned soils by secondary natural succession of the natural vegetation (Billings, 1964; Akça et al, 2000).

Cangir et al. (2000) have determined the immense increase of soil sealing due to the creation of new suburban settlement areas ie overhousing along with industrial sites. The total occupied areas of prime soils in Turkey by permanent structures from 1978 to 1996 increased from 171.992ha to 356.841ha, which is equivalent to a 200% increase (GDRS, 1997; Cangir et al. 2000).

The three examples located in southern Turkey, the Adana, Mersin and K.Maras towns (Figure 1), illustrate the catastrophe facing the future of food security by loss of prime land to sealing (Figure 2).

Figure 1. The study area

These towns being the leading agricultural and industrial provinces of Turkey since the 1960s have had a long tradition of cotton cultivation and other cash crops such as olives and citrus, together with agro-based industries, which date back to the mid 19th century. The economy of these provinces was at its climax during the first half of the 1980s (except K.Maras) with decreasing trends in the second half being mainly due to the unsuccessful conversion of capital from agriculture to related industries, increasing internal migration from southeast Anatolia, and most of all to sealing of productive soils (Figure 3). Cadastral and field studies coupled with data obtained from geographic information systems (GIS) have illustrated the loss of prime rural land, suitable for the

cultivation of cash crops, to sealing in the towns mentioned above (Figure 4, 5, 6, 7, 8). The decrease of land devoted to cash and indigenous crops such as citrus, grapes and olives along with cotton, maize, soybean, cereals, and vegetables has led the ever increasing population to exploit the remaining soils at a highly intensive mode with higher inputs, i.e higher risks for land degradation.

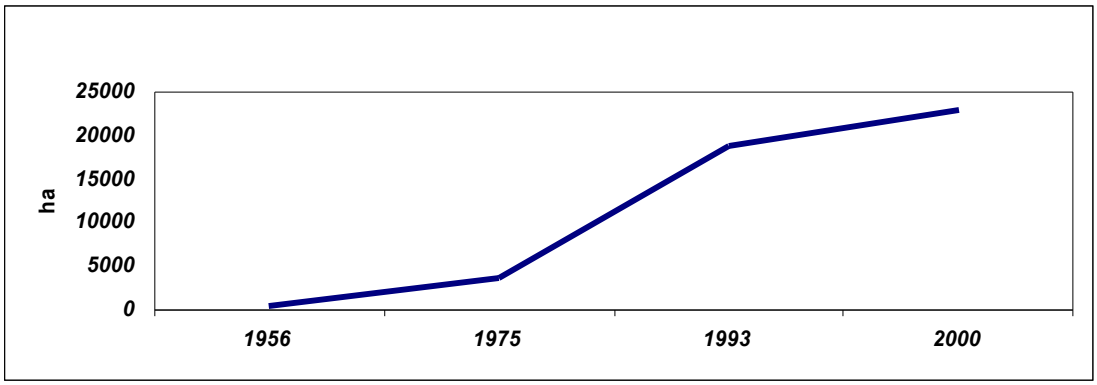
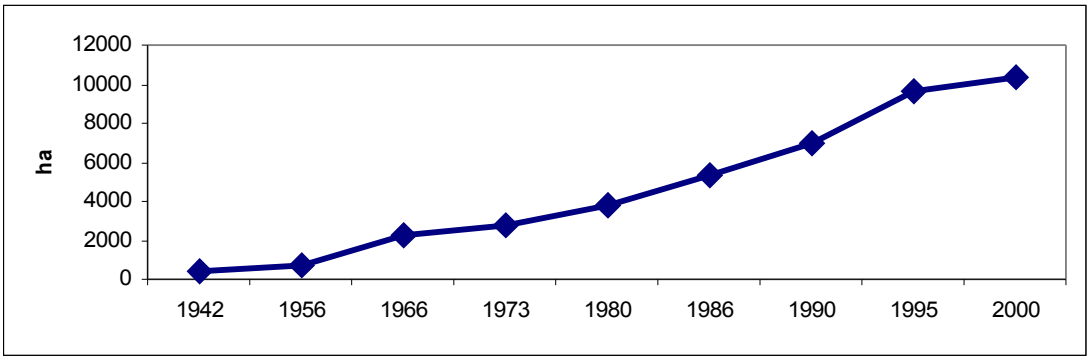


Figure 3. Soil Sealing in the Adana-Tarsus-Mersin Region



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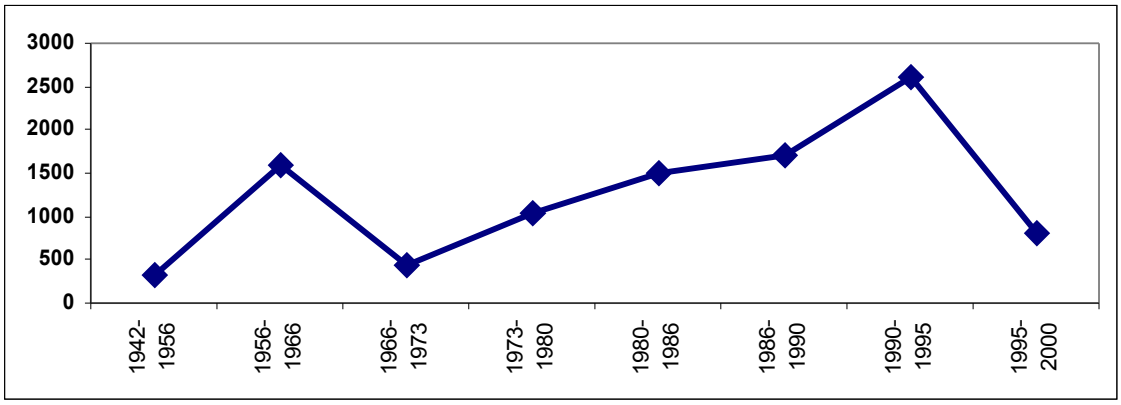

B

Figure 4. Total urban expansion (A)
and periodical soil sealing in Adana city (B)

(Gültekin and Ortaçeşme, 1999).

SOLUTION

The preliminary approach for the solution lies in the ideal land use patterns modified by Cangir et al. (2000) for conditions in Turkey, from guidelines stated by Eswaran et al. (2000) (Table 1). Table 1 is developed following the completion of the natural resource database of the country, regarding the rapidly increasing population coupled to land degradation and resource consumption, which significantly impacts the ability of food, demands. Knowing the capacity of nation's natural resources and rates of degradation will help to develop an appropriate strategic plan securing sustainable land management. This will also help Turkey and similar countries of the Mediterranean basin to prepare their land use plans, which will also be environmentally friendly. However, the two important framing questions for national land use planners, as stated by Cangir et al (2000) and Eswaran et al. (2000) are; a) the rates of resource consumption to be permitted in different parts of the country, and b) the minimization of the mismatches between land use and land quality. Thus, the probable answers to these questions can be found in the indigenous technical knowledge (ITK) and methods of ancient Anatolia, which reached its climax during the Roman Period. This unique Mediterranean cultural agroenvironmental concept developed at this period in especially the coastal towns along the Southern coast of Turkey such as Elaiussa Sebaste (Merdivenlikuyu) (Schneider, 2001) (Figure 9), Korykos (Kızkalesi) (Öcal et al. 1997) (Figure 9), Nagidos (Bozyazı) and Kelenderis (Aydıncık) (Zoroglu, 1999), which in fact is a "multi-functional integrated satellite towns system - MISS". The term satellite town is introduced in detail by Murphy (1966) as differing from suburbs in that they are separated from the central city by certain distances with little daily commuting to or from the central city, although economic activities of the satellite are closely connected to those of the central city ie the satellite is an industrial center indicating a secondary role by not standing alone and having ties with a larger city.

Table 1. Idealised land use pattern for conditions in Turkey.

Land Capability Class	Agriculture (Food crops)	Biodiversity Zones		Urban / industry / infrastructure
		Forestry	Wilderness	
	Percent of land			
I	80	15	3	2
II	70	25	3	2
III	60	30	5	5
IV	55	35	5	5
V	50	40	5	5
VI	20	55	20	5
VII	0	60	40	<1
VIII	0	20	80	<1

However, the current issue of soil sealing prevention studies requires a highly interdisciplinary cooperation with complex discussions to be amalgamated for a mutual cause – the SLM. Disciplines to contribute namely are soil science, agronomy, environmental sciences, landscape architecture, horticulture, geology, geography, archaeology, botany, chemistry, animal husbandry, city planning, economics, and sociology. Thus, a holistic interdisciplinary approach to combine the common denominators of nature along with the indigenous technical knowledge for crops, animals, and methods, concern the rational natural resource management for the sustainable welfare of the future generations (Figure 10).

The primary common denominator in the coastal Mediterranean environment is the olive tree, which has been widely distributed in Anatolia and the Levant since the Hellenistic and Roman times as well as other dry areas of the Northern and Southern Mediterranean Basin that are regarded to be under the threat of future desertification, bordering desert margins (Reich et al. 2000) (Figure 11). Actually, the presently existing indigenous olive strips covering large parts of the Mediterranean coast are the representatives of the resource management domains (RMDs), ie the increment of agroecological zoning, which is a delineation of areas of rural lands that could be earmarked for one or another use or non-use, based on identical physico-biotic

conditions and prevailing socio-economic infrastructure, of FAO (1995) together with other indigenous cash crops such as vine, carobs, figs, almond and rangeland strips (for small ruminant grazing) located between wall terraces following contours of the gentle to steep slopes of the coastal land (Akça et al. 2002) (Figure 12). Similar inland conditions prevail as large patches of highlands sprinkled throughout the Mediterranean basin with identical geomorphological strips of caliche to be devoted for ideal land management (Figure 13) with some parts already under indigenous use for olives and grazing. Thus, these RMDs of the agro-ecosystem/agroforestry zones for the Mediterranean Basin could denote the sustainable production belts, which could stand against the misuse of natural resources (Dinç et al. 2001).

EXAMPLES OF SUSTAINABLE URBANISATION

Governmental

The concept of the "Integrated rural-urban development project - IRUDP" (Yavuz et al. 1978) is the first governmental attempt in Turkey, for ideal SLM of the RMDs, and is partly similar to the MISS of the Roman town settlement context (Figure 9). The structural layout of the IRUDP is given in Figure 14 illustrating the ties between the satellites. Here, each of the coastal/epicoastal towns is allocated for certain agricultural and agro-industrial functions that should be indigenous to the area and needs modification by recent technologic input (Figure 9).

The aims and related measures to be taken for the IRUDP concept were;

a. Meeting low cost demands for commodities of urban dwellers
b. Creating job prospects and land ownership for the unemployed and the landless in the agricultural sector via a probable land reform and land consolidation,
c. Preventing migration to cities for sustainable urbanization,
d. Encouraging private attempts in rural areas,
e. Increasing productivity of the rural areas,
f. Introduction of recent low cost technology,
g. Sustainable use of the unexploited or misused local sources,
h. Encouraging capital savings,

i. Solution to problems in low cost credits and prevention of usurer intervention.
j. Determining optimal population ranges for settlement sites (villages/satellites) in the system

And had to be implemented via the following administrative hierarchical approach particularly seeking the ultimate aim of equity in income of the rural population,

a. Village and sub-village settlement units,
b. Center villages (of cluster villages),
c. Counties (generally county centers),
d. Cities (generally city centers),
e. Regional centers,
f. Metropolitan centers.

Unfortunately, besides numerous political shortcomings, the project was abandoned due to the difficulty in creating the holistic interdisciplinary approach (Figure 10) along with the lack of coordination between the responsible bodies both in public and government and political instability.

The Roman concept comprised satellite towns that executed a separate function, agricultural or industrial, which was in harmony with the functions of the other. As in the Korykos and Elaiussa – Sebaste examples the functions for commercial, religious and administrative activities were seated on the immediate coast whereas the satellite towns in the north were devoted for agricultural (cereal), similar to the block agricultural production in Southern Turkey during the Ottoman Period (Soysal, 1976), and animal production (goats). Animal production was performed on well-managed pasture strips developed on wall terraces also used for water harvesting into cisterns and preventing soil erosion. The olive oil and wine pools together with flourmills were based near the administrative complexes and/or on main roads directly connected to the coast (Figure 9).

Public

Recent public attempts throughout the world are on the path of establishing non-governmental organizations (NGOs) as well as Unions seeking solutions for integrated

rural-urban development. A similar recent attempt in Adana, S. Turkey is the Adana Solidarity Foundation (ASF). The goal of this establishment is stated as to turn public awareness, and attention to declining economy, develop policies toward investment activities in traditional and promising fields of economy along with to stimulate public support and participation on social and cultural events. Since Adana is one of the major immigration centers of the country, the ASF activities primarily seek to organize educational complexes as well as meetings on agriculture bring together government officials, academicians, farmers and unions of citrus, cotton and olive etc. to discuss the possible remedies for sustainable agricultural development and determination of optimal crop pattern for the region. This attempt might easily contribute to the development of a similar rural-urban settlement and land use system provided an interdisciplinary approach is adapted using the IRUDP approach. Moreover, the indigenous technical knowledge since the Roman period, to provide clues for low cost technology should be incorporated for sustainable MISS.

CONCLUSIONS

Soil sealing is inevitable in developing societies with booming populations, however, its effect on natural resources might be reduced via the application of the IRUDP system, which is the present version of the ancient integrated urban-rural land use on a satellite town basis as stated by Murphy (1966) and Yavuz et al. (1978). The structure of the IRUDP in Figure 14 explains the relations between the satellites allocated for particular functions as cultivation (olive, vineyards, cereals, carobs, fodder, apiculture, vegetables etc), grazing (small ruminants), ceramic and construction material production (kitchen ware, storage vessels, stones, timber) and agro-industry (flour, olive oil, wine, wool, honey). The functional connections between the optimally populated satellites (villages) in the IRUDP system (Figure 14) seek to decrease the pressure of population on the administrative centers, which induces sealing via preventing new infra and superstructure development.

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