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SUSTAINABLE LANDSCAPE ASSESSMENT OF RIVER CATCHMENTS IN THE EXAMPLE OF DİKMEN BROOK IN ANKARA, TÜRKİYE

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Abstract

In this paper a methodology is developed on landscape assessment for river catchments in the example of Dikmen Brook in Ankara. The method is the constructive part of the "National Approach for Catchment Management" which is produced as a model for Turkey by this work. Landscape assessment is identified by NRA (1993) as an approach to analyse the landscape and accordingly to produce recommendations for the protection, management and improvement.

River systems are very sensitive landscape components by their ecological and biological characteristics and by their role in natural processes. Also, the water bodies and surroundings are very attractive for many human activities. Therefore, a private planning approach for resource allocation and land-use decisions is required, which will covers the methods on both data collecting, recording, analysing, evaluating and also landscape management. In Turkey, however, a comprehensive national planning and management approach for urban and rural river systems is non-existent. Land-use decisions are generally produced in accordance with the socio-economic requirements and political reasons, and natural landscape elements (soil, vegetation cover, wildlife, climate, etc.) and processes (soil losses, hydrological cycle, etc.) are frequently neglected. Consequently, the landscape features are lost and also environmental problems arise due to mal-function of ecosystem, particularly in the areas where urbanisation is extensive.

The systematically constructed National Approach for Catchment Management (CM) in the present work, particularly landscape assessment method as its indispensable part which is explained in Dikmen Brook example, can be used for all other rural or urban river landscape.

Introduction

Most of major cities are set up along river corridors. Many cities are still using rivers for the purposes of transportation and of disposal of waste material, and many of them have lost their natural landscape characteristics.

River systems offer different characteristics of landscape in respect of biological, ecological, cultural and socio-economic features. Therefore, a strategic planning approach is required for data collecting, reporting, analysis and assessment.

River systems are sensitive ecosystems because of their geomorphologic features and due to the quantitative and qualitative biodiversity of their landscape components. Therefore, these systems are also extremely sensible to human interventions, so they compels a particular planning and management approach in resource allocation or land use decisions. In Turkey this kind of particular approach is non-existent covering all kind of urban or rural river systems within the boundary of water divide which contain entire catchment.

The natural landscape is a dynamic and hierarchical setting. As Smuth (1926) stated, each whole is a system in itself but is connected with and depends on other (ZONNOVELD 1994). The natural landscape comprises so many hierarchically constructed ecosystems from a single molecule to the whole Earth and even the limitless emptiness called the Space. Every ecosystem has its own borders yet is in relation with other ecosystems through the flow of energy and data (type of material, radiation and organisms) which ensure the continuity of the system. A system is theoretically in balance when the inputs and outputs required for its functions are equal. Therefore, the assessments in defining the capability, capacity and sensitivity of the area for any human activity should be performed within the natural boundaries. At many instances, the political borders do not overlap with natural borders, which causes mis-landuse decisions. For a river landscape, the boundary of the system is the water divide of the catchment.

In order to be able to manage a landscape, it should be discovered how the landscape is formed by analysing all descriptive physical and ecological factors starting from geomorphologic structure. When the catchments are considered, the most effective landscape components of hydrological cycle are the most important parameter in the land use planning and catchment management (CM) since water is of limited supply.

Insufficiencies of actual planning approaches and the need for a national approach

The existing planning approaches covering river systems are insufficient and deficient in many respects. All related parties in decision making process are unable of making long-term effective and lasting decisions because of incomprehensive strategies, authorisation conflicts and ineffectual planning approaches. This state results in striving to find out solutions whenever and wherever problems arise, and generally time, money and irreversible losses are happened. The existing planning methods are mostly developed in accordance with the political requirements and socio-economical needs. The ecological basis is frequently neglected, which results

in environmental problems. On the other hand, the lack of collaboration and co-ordination among various professional disciplines in urban planning does not allow extensively comprehensive plan and project production.

There are a number of laws and regulations enacted to govern the use and enhancement of water resources in river systems. The following legislations comprise various measures concerning the use of water resources: Law of the Organisation and Duties of Directorate General of State Water Works (SWW) Law of Underground Water, the Regulation of Water Pollution Control and Cost Law and its regulation. While the said legislations provide the legal basis required for the planning and management of the catchments, they are short in respect of the scope and the organisation supposed to enforce it. On the other hand, the said legislations and regulations cover the main rivers such as Seyhan, Ceyhan, Kızılırmak, Yeşilırmak, Sakarya, Gediz, The Tigris and The Euphrates, but not their tributaries.

The insufficiencies and deficiencies of the current planning approaches as well as with the relevant legislation in force might be generally gathered under the following headings:

1. Insufficient knowledge on water systems.
2. Lack of an ecosystem approach.
3. Lack of technical and methodological uncertainties in data collecting, recording, analysing, evaluating, monitoring and auditing.
4. Taking into consideration only a limited number of water resources in limited characters.
5. Lack of an organisational strategy in Catchment Management.

In developed countries river basins have been dealt within entire catchment for more than 20 years. Even local associations or organisations apart from governmental authorities are devoted to the management of river basins. The models studied in present work, however, contain planning approaches in a private project level. The point is that in order to make and implement effective resolutions the subject must be taken up at the level of policies, plans and programmes.

On the other hand water bodies and surroundings are very attractive or required for many human activities, and a number of authorised institutions (Municipalities, State Highways, State Water Works, etc.) are of concern on land-uses, water management and control. Therefore, a national approach is needed to determine landscape potential of whole river systems in Turkey covering all the river systems regardless of the catchment size, or of the river class. So that, while the quality of ecological environment would be promoted on the one hand, a database which would enable to take sustainable land-use decisions would be constructed on the other. The CM is a broad term which covers many assessment procedures and methodologies as well as contributions of many professionals in collaboration. As stated (1993b) by NRA, the

Landscape Assessment is one of the step in Catchment Management, and embraces all the various ways of looking at, describing, classifying and evaluating landscape.

All included parties whose activities are likely to affect the water resources and surrounding landscape (e.g. the Government, local authorities, farmers, sports clubs, NGOs, local people, etc.) should take an active part in this approach. Each organisation and institution playing a part in the land-use decision making and implementation should produce their work schemes and technical document in accordance with the proposed National Approach as a complimentary part of each other.

The method of landscape assessment developed in the example of Dikmen Brook in the present work is aimed to be adaptable to other kinds of rivers.

A method for landscape assessment of river catchments

In the developing of the method the following publications are particularly have been made use of: "Nature Conservation and River Engineering" (NCC, 1983); "The Quality of Rivers, Canals and Estuaries in England and Wales" (NRA, 1991); "Otters and River Habitat Management" (NRA, 1993); "The Biology and Management of the River Dee" (JENKINS, 1985); "River Project and Conservation" (GARDINER, 1994); "River Corridor Surveys: Methods and Procedures" (NRA, 1992); "River Landscape Assessment: Methods and Procedures" (NRA, 1993); "Ecological Engineering: an Introduction to Ecotechnology" (JORGENSEN and MITSCH, 1989); "Landscape Planing and Ecological Networks" (COOK and van LIER, 1994); and from the previous editorial book particularly "The Hydrological Landscape Structure as a Basic for Network Formulation: a Case Study for the Regge Catchment" (BUUREN, 1994) and also "Ecological Design Framework for Urban River Landscapes" (BASCHAK and BROWN, 1994).

The developed method for landscape assessment for river catchments is the constructive part of National Approach and the Catchment Management, and consists of the following three main frameworks which are the integrated parts of a whole and systematically interlinked with each other:

1. Catchment Management Scheme (CMS)
2. Strategic Planning Approach (SPA)
3. Holistic Assessment (HA)

Catchment Management is the process of ensuring that all the problems and opportunities resulting from the uses within a catchment are presented within a well-defined, flexible framework capable of maximising the overall well-being of the water environment (GEE and JONES, 1995). The most strategic level of any land-use or resource allocation decision is the CMS (Figure 1). The implementation of Figure 1, which should be of a legal and regulatory nature, compels the co-ordination

of all parties involved in the Catchment Management. Figure 2 sets out the responsible state bodies in Turkey and a proposal for the administrative co-ordination among them in implementing a CMS. The parties which are primarily in charge the preparation and follow up CM plans are the SWW, the Ministry of Environment and the local authorities. In all level of implementation the participation of the public and NGOs are of concern.

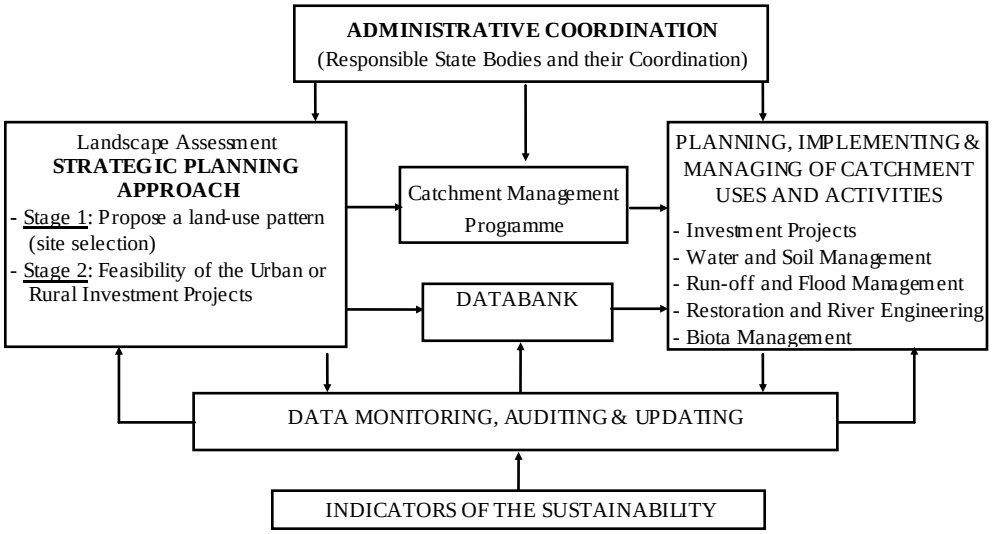


Fig. 1. Catchment Management Scheme (source: Şahin 1996).

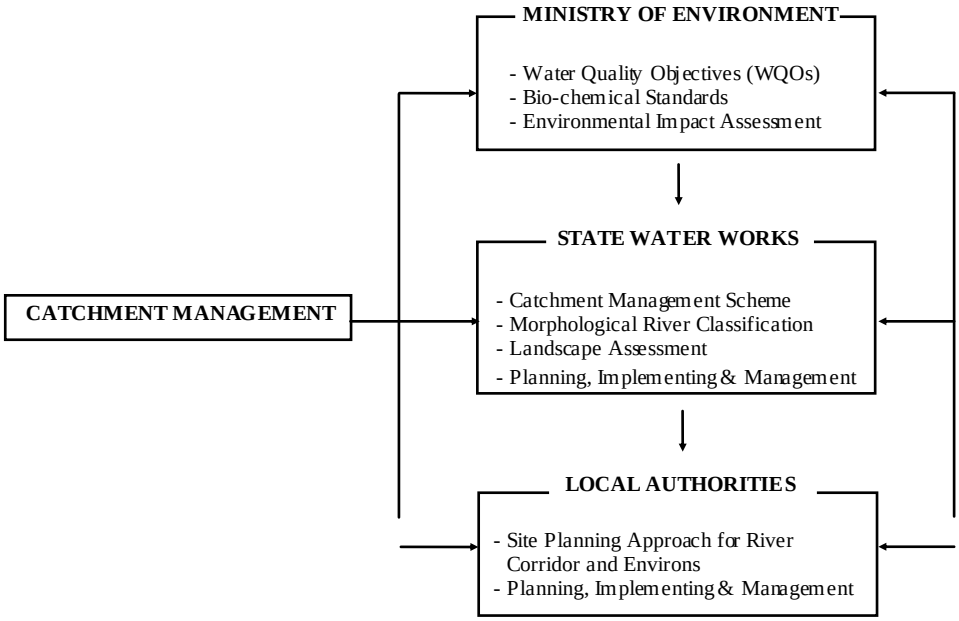


Fig. 2. Administrative Co-ordination of CM *(source: Şahin 1996).*

The formulation of a standard method for landscape assessment of river catchments regardlessof the size and river class should be the task of SWW. The existing Regulation of the Water Pollution Control has already assigned this task to the SWW.

In pursuance of the proposed Administrative Co-ordination, the Government (as the Ministry of Environment) is expected to draw up a technical and official paper outlining water quality objectives of the streams in accordance with its class in respect of usage. The end results of the works carried out by SWW, as the state body in charge of rivers is supposed to constitute and implement the CMSs, is to be incorporated in the set targets of the Government. The Regulation of Water Pollution Control assigns this task to Governors or to the SWW. Aware of its responsibility, the SWW should first of all classify the streams by their drainage type and by their other physical characteristics. The classification should cover every kind of streams excluding seasonally dry brook beds. According to the set river classes, the more detailed definitions on usage possibilities with required water quality levels are outlined by the same authority in accordance with the standards set out by the Government.

The planning approach of local authorities for the river corridors and environments should constitute a whole with the CMS as well as with the environmental standards and requirements. The Urban Plan Law and its regulation should ensure the compliance with the Approach.

An important stage of CMS is data management covering data monitoring, auditing and upgrading. Monitoring means to control the consequences of the implementation of the decision (or plan) and raised environmental impacts. The auditing means to endeavour to see if the decision (or plan) adopted previously on the basis of recent methods and technological opportunities are correct.

The CMS compels a "Strategic Planning Approach" (SPA) to be used in landscapes assessment. The SPA is a systematically constructed decision making process in defining land-use or resource allocation alternatives. It should be the duty of the SWW to prepare the technical document to be used in the landscape assessment of stream systems in according to the mentioned SPA.

The National Rivers Authority (1993) summarised occupational fields related to river landscapes to which efforts of landscape assessment might contribute as follows:

- The assessment of the environmental character and quality of rivers;
- The planning, design and environmental assessment of capital works;
- Catchment planning and integrated river corridor assessments;
- The identification of opportunities for river landscape enhancement schemes;
- The assessment of planning applications;

- The production of maintenance programmes for rivers, e.g. pollarding willows and bank maintenance.

The SPA consists of two stages with a different set of objectives as follow:

- Stage I: Propose a land-use pattern (site selection).
- Stage II: Feasibility of the rural or urban investment projects.

A method called the Holistic Assessment within the framework of SPA (Figure 3) has been developed in order to determine the suitability or capability of the land for certain uses. Land-use pattern which will be defined in accordance with that approach called Holistic Assessment should cover possible alternatives ("0" alternative included). The most suitable land-use pattern is chosen after the overall comparison of all alternatives.

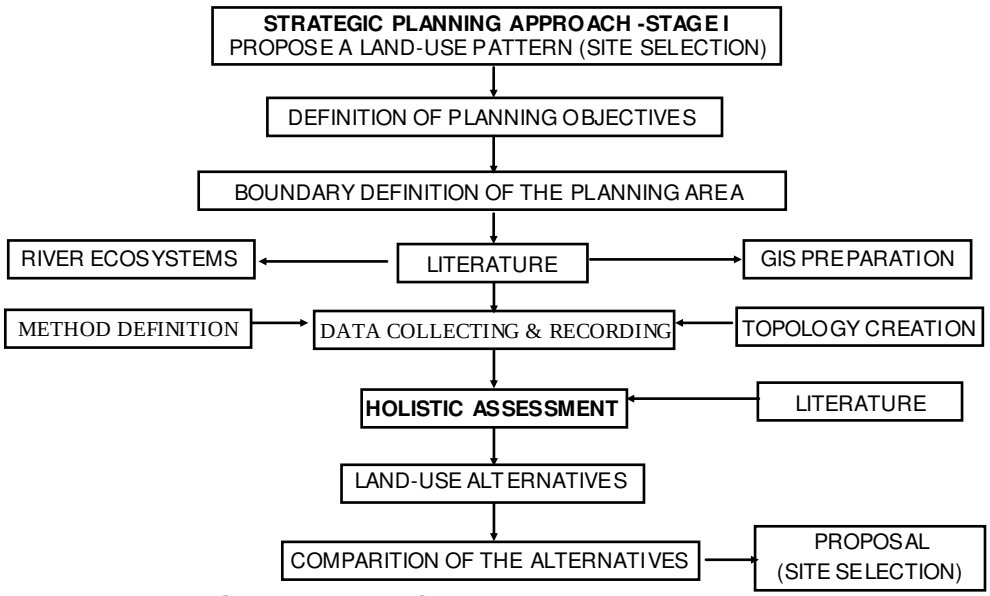


Fig. 3. Strategic Planning Approach - Stage I (source: *Şahin 1996).*

In the Stage II of the SPA, a method called "Multi-Criteria Assessment" has been proposed (Figure 4) to be used in deciding whether an investment project to be carried out in the areas determined in the Stage I is feasible or not. Economical analysis and assessment of possible effects on the environment are the backbone of this approach. In the case area of the present work this stage has not been conducted.

The most critical framework for the land-use decisions is the Holistic Assessment (Figure 5). Landscape assessment of the area will become more sophisticated with the increase of land-use alternatives and ecological diversity. Under the method employed, the combination and/or intersection of the "Development Demand" and the "Conservation Demand" indicates the land-use suitability of land-use capability of the area. It is possible to benefit from the methods of the Land-Use Capacity

(McHARG 1969, KÖSEOĞLU, 1982; KURUM, 1992; OREA, 1992) and/or Risk Analysis (AULIG et al., 1977 in KÖSEOĞLU, 1982) in determining the development demand.

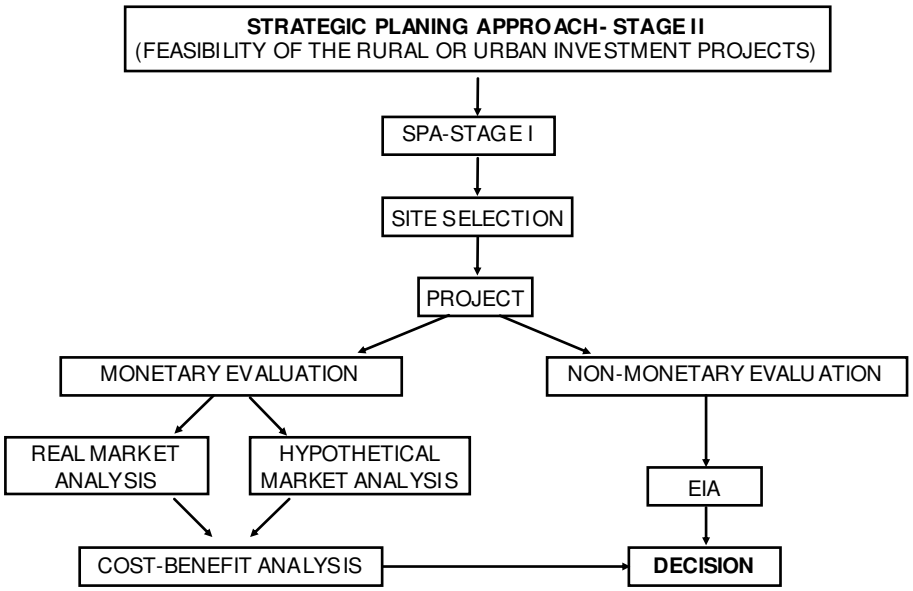


Fig. 4. Strategic Planning Approach- Stage II *(source: Şahin 1996).*

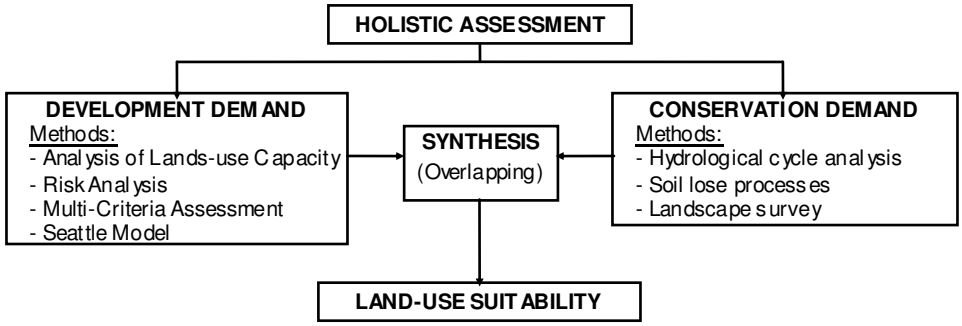


Fig. 5. Holistic Assessment *(source: Şahin 1996).*

For the determination of the conservation demand the essential ecological processes which provide system stability, sustainability, biodiversity and quality should be examined within the water-divide as ecosystem boundary. The interrelations between the neighbourhood ecosytems are also analysed to be able to establish an ecological

network. Whenever the matter is discussed within the context of a river catchment two important processes withdraw attention, which are erosion and hydrological cycle.

Case area

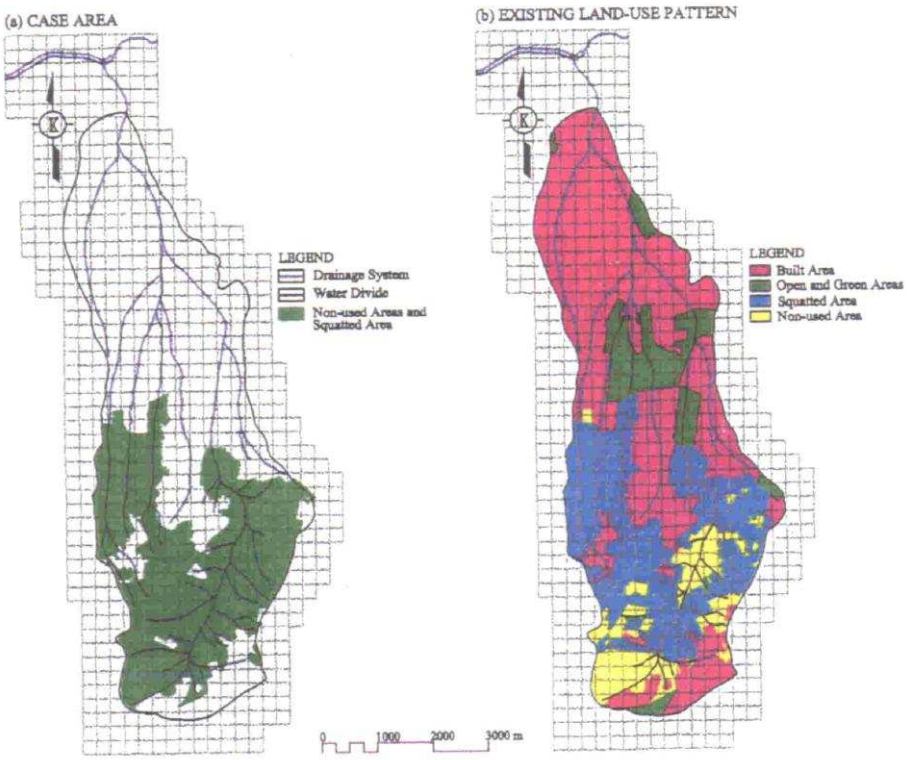
The Dikmen Brook is a stream located in the southern direction of Ankara's urban development. The stream catchment area is as large as 28 km^2 (Map 1a). The total length of river corridor was formerly 13 km, but presently a large portion of it was covered. At present only 4.5 km of upstream river corridor is in its natural state. Like the other streams of Ankara, the Dikmen Brook serves as an open sewage channel.

Poor planning approaches accompanied with uncontrolled urbanisation have caused significant radical changes in the river valley system. A large part of the catchment have been covered with impermeable material for transportation and dwelling activities (Map 1b) and the infiltration of rainfall waters have thus been stopped with the result that recharge of underground waters was significantly prevented. This development has led to the drying up of someone springs which were previously feeding up the Dikmen Brook. At present, the brook draws its water from a few springs in the upstream. The contribution to the brook of rainfall waters is limited to very short climate periods as the rainfall in Ankara is quite low. As a result of the drying up of the springs, the water amount in the brook has significantly diminished.

The flora, which performs significant functions in the water recycle, has almost disappeared with the exception of a few steppe plants grown outside of squatted areas. In the uncovered section of 4.5 km along the river corridor most of existing willows and poplars were planted afterwards. As such trees use great amounts of water the flow regime of the brook is adversely affected.

Another fact worth mentioning is the impermeable surface coverage over carrying capacity of the catchment area, which causes the increase on surface water run-off, followed by inundation and flood risks. Floods have become lately a serious problem in Ankara as in other cities with stream valley systems as a result of the previously adverse changes. Mis-landuses in urban areas adversely affects the extremely important ecological functions of the valley systems, the end result being that the valley systems become a grave problem in stead of positive contribution to urban ecology and built environment.

Another problem related to the river is the ever present possibility of landslide in addition to erosion particularly on the slopes with an inclination of over 30% due to the geological structure and soil characteristics of the area. It is worth mentioning that squatted houses built on steeper slopes as well as legally built apartments are under a constant threat of probable landslide due to geological structure containing clay stratum.



Map 1: Case-area (a) and existing land-use pattern (b) *(source: Şahin 1996).*

No doubt the Dikmen Brook performs important functions in securing the air and water circulation of the Capital as do other valley systems. In view of the fact that the city is built in a bowl-like geomorphologic formation, the river corridors are of vital importance in ensuring the change of the polluted air of Ankara considering the direction of the prevailing winds in Ankara as well as the local air movements. The Dikmen Valley is of particular importance because of the way it is situated. The north and northeast winds drive off the polluted air through the Dikmen Brook situated at the South. As the local air movements occurre during the daytime in the valley systems reinforce the main discharge of polluted air in question. In other words the required air movements which will carry away the polluted air from city centre situated in downstream to the upstream. It is exactly for this reason that high structures likely to hinder the removal of polluted air would affect the entire city. On the other hand it should be pointed out that local winds formed in late hours blow from the upstream to the centre of the city at downstream. Due to this fact the charge of polluted air produced at upstream and its surroundings will be carried to the centre. Since the green areas absorbing the polluted air is scarce along river corridor, the polluted air will be carried to the city centre at an increasing rate. This fact underlines the absolute necessity of plantation of the Valley corridor of Dikmen Brook from the viewpoint of air pollution of Ankara City.

River valleys may have microclimatic features as a consequence of their geomorphologic structures. When compared to that of the city itself, the mean annual rainfall on the Dikmen Valley is 72.6 mm. The vegetal enrichment of the Valley would bring about an increase in rainfall and humidity, which would, in turn, reinforce the microclimatic characteristics.

The foregoing is a discussion of the local environmental effects and problems caused by poor-urbanisation in the catchment area of Dikmen Brook. Yet local problems might grow into regional, and in the long term even national and even global problems if neglected.

Result and discussion

The Holistic Assessment which is the part of the proposed Landscape Assessment method for river catchments in present work is implemented in Dikmen Brook example by determining development and conservation demands of the area. In method application the ArcCAD as a GIS engine is used.

In defining the development demands, the requirements and current pressures have been taken into account. Through the analysis of conservation demand, areas to be protected are established at various degrees of importance and through the analysis of development demand, the requirements and opportunities for land-use types are defined.

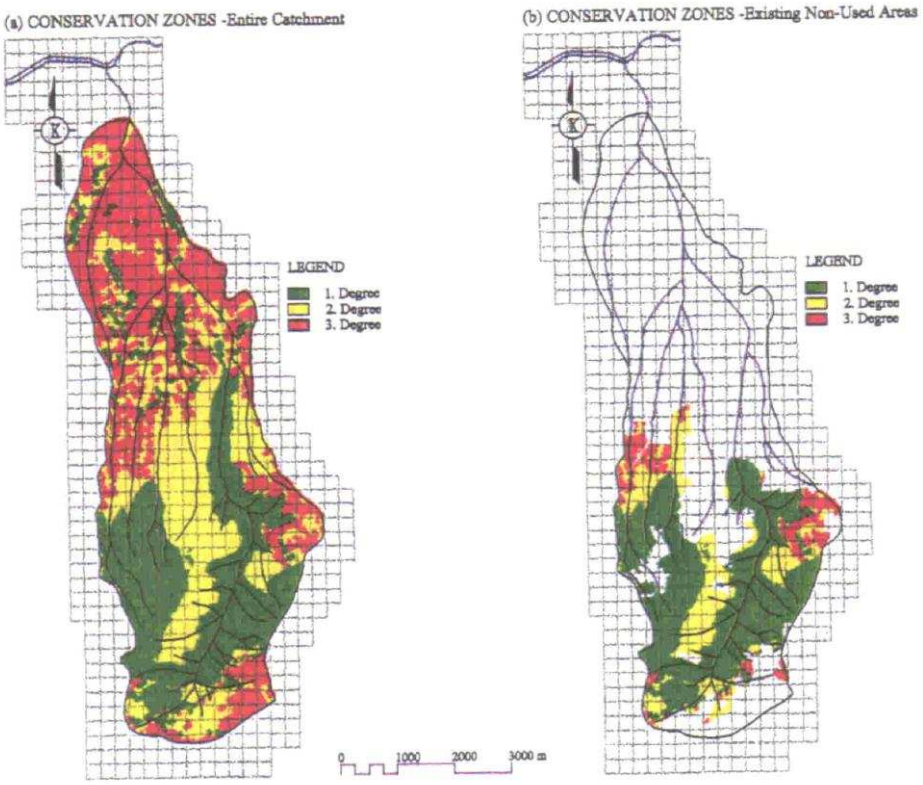
The analyses on infiltration zones and erosive landscapes of the area have been used to delineate the most sensitive areas to be conserved. The areas with primary degree in conservation demand should be preserved with priority since they are of vital importance for the recharges of underground water, soil protection and for the establishment of the ecological landscape network.

In the determination of the recharge areas of the underground water which must be protected from the viewpoint of ecological concerns the method of Hydrological Analysis of Landscape Structures has been made use. This method was employed in the Regge River Basin in Holland by Buuren (1994) (COOK and van LIER, 1994). Geological structure and soil characteristics of the area are the descriptive parameters in this method which enables to fix infiltration zones and consequently to determine the primary degree areas which must be preserved and protected from the viewpoint of ecological network.

In the delineation of erosive landscapes of the area the qualitative method which was elaborated by ICONA in Spain has been employed (MAPA-ICONA, 1983; ŞAHİN and BARIŞ, 1996; GARDI et al., 1996). The result of this analysis of conservation demand is shown in the Map 2.

In the case area, land-use demands of dwelling, recreation, urban agriculture and their combinations are evaluated, giving priority to conservation of the site. The non-used

bare areas and squatted regions of the case area have been under the heavy pressure of intensive dwelling demands. The recreational demands of urban people and the need for larger areas for that are getting increase considering high population growth rate.

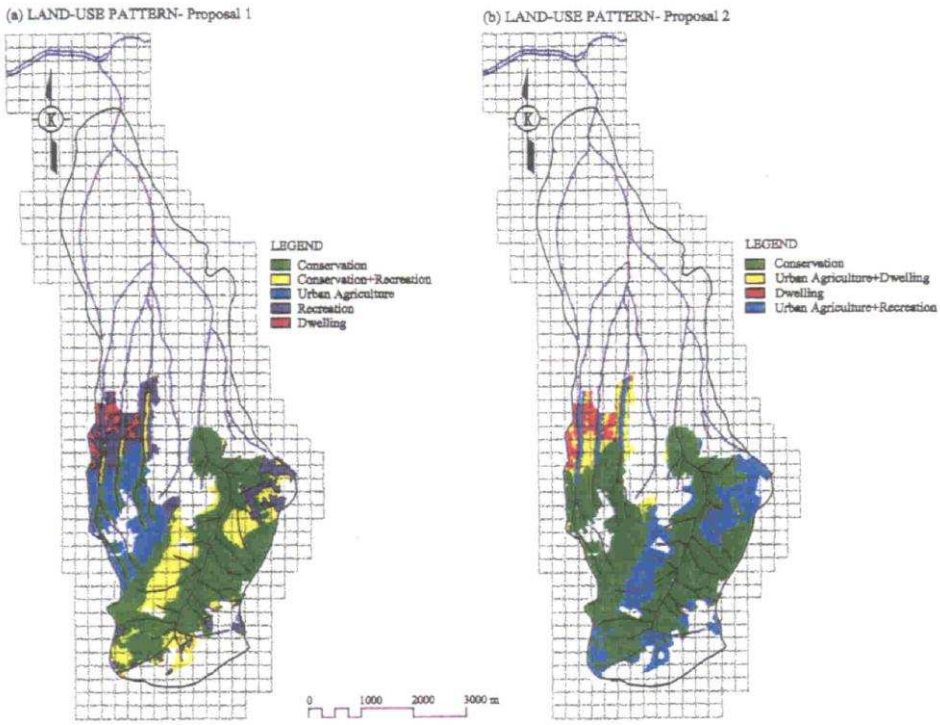


Map 2: Conservation Zones in whole catchment (a) and in existing non-used area (b) (source: *Şahin 1996).*

Easily accessible open and green areas in a short while have become a must for socio-cultural and ecological reasons in urban environment. As pointed out by McHarg (1969) there is no need to seek or re-create open and green areas in urban environment, since they are already in their proper places. In regard to this say river corridors carry prior importance within open and green areas system of the city with their linear characteristics and ecological functions.

In the present study the synthesis of the results of development demands and conservation demands has determined the land-use opportunities. In the synthesis the map of conservation demand has been overlapped with visual and ecological areas of interest emerged as a result of the land survey. The produced land-use patterns are presented in two proposals (Map 3a and Map 3b) which prove that the Dikmen Brook is bound to become an important part of Ankara's open and green areas system.

The case area has a potential to meet the needs for urban forestry, urban agriculture, recreational pathways (non-motorised recreational access to pedestrians), bio-garden, various sportive activities and other recreational demands. Particularly, the river corridor presents a significant recoverable landscape component both with functional and aesthetical reasons requiring landscape restoration works.



Map 3: Proposed land-*use pattern (a and b) (source: Şahin 1996).*

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