Chapter 5

Land Degradation, Urbanisation and Biodiversity in the Gediz Basin-Turkey

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ABSTRACT

Gediz basin lies in the West Anatolian part of Turkey covering an area of over 1.7 million ha around Gediz river and its tributaries. It is an important land-farming river basin and agricultural centre from a financial point of view. The area has a typical Mediterranean climate. Forest area in the basin is around 470.000 ha., the agricultural area is 472.000 ha. and grasslands cover 101.266 ha. The basin has a rich plant diversity which includes 319 endemic taxa from 206 genera and 60 families. The endemics constitute 10 per cent of the total endemic plant cover of Turkey. The seaward fringe of the basin is an ecologically important wetland ecosystem forming a category A nature reserve. The delta is used by 211 bird species out of a total of 426 recorded in Turkey.

The basin includes 2.3 per cent of the total area of Turkey and 2 per cent of the irrigated land, supporting 3.7 per cent of the population. It is traversed for 401 km by Gediz river which irrigates 521.000 ha of land out of 2 million ha spread over four states. Approximately 386.000 ha of the total irrigated land area constitute the plains. Nearly 1.5 million ha (84.69 per cent) have different slopes. The land degradation problems pose a serious threat to the rich biodiversity and agricultural areas. Forests originally protected the soils on the mountains, but the trees have been cut for building and to provide firewood. During the last 20 years, the population of the basin has increased from 2 to 4 million inhabitants. This increase,

together with unsustainable land use practices and migration have led to increased urbanisation resulting in land degradation problems as well as unhealthy development in the city outskirts. Annually tonnes of sediment are transported to the Aegean Sea due to erosion. Urbanisation is increasing and large parts of prime quality land are being permanently removed from agricultural use. These are the major environmental problem of the basin. An attempt has been made here to highlight this situation.

INTRODUCTION

Population growth, industrial development, land degradation and environmental pollution; which threaten natural resources in every country on earth;have made environmental problems one of the most important concerns of man in the last quarter of the twentieth century (PRB,2004). These problems are actually extending beyond the national boundaries which necessitates international cooperation, and such problems are going to be a determining factor in international relations in the 21st century (Arslan and Okmen, 2006; Okmen and Parlak, 2006). The situation in Turkey is not different from other corners in the world. One of the major problems we are facing in this connection is land degradation. It is believed that although land degradation is more important than environmental protection; because it includes additional aspects not considered in the concept of environmental protection; it has not received the global attention that it deserves (Ozturk *et al.*, 2002).

Land degradation in Turkey started centuries ago and has been on-going but has gained a greater momentum during the last few decades (Ozturk *et al.*, 2008). The factors responsible for this are urbanisation, salinization and alkanization, grazing, forest cutting, fires and logging (Ozturk *et al.*, 2010). In particular, urbanisation puts greater demand on arable land (Ozturk, 1995, 1999). In addition, large areas of arable land have been taken over by urban sprawl, while some areas are used for non-agricultural activities. Moreover, forest cover is becoming thinner and erosion exposes the surface and results in great deflation of the topsoil. Some environmental issues such as soil pollution, erosion, generation of dust, and soil compaction are emerging at a fast pace. Erosion alone is resulting in a loss of millions of tonnes of sediments, which are transported to the Aegean Sea (Alpaslan and Atýþ, 1995; Ozturk *et al.*, 1994). Wrong irrigation practices are leading to a dramatic increase in the salinization of arable lands due to an increase in the area of irrigated land. In Turkey nearly 1.5 million ha are facing acidity and 2.8 million ha show salinity-alkalinity problems (Guvensen *et al.*, 2006).

Gediz Basin is getting an equal share from these unfavourable developments taking place in the country.It lies in the West Anatolian part of Turkey covering an area of over 1.7 million ha around Gediz river and its tributaries and is an important land-farming river basin as well as an agricultural centre from a financial point of view. The climate is typical Mediterranean. The mean annual precipitation is 609 mm, but varies between 492 mm(Salihli)-726 mm(Manisa). Rainfall is common in winter and scarce in summer. The temperature varies between 6.2–27.7°C. These climatic features are highly favourable for agricultural productivity.

The 401 km long Gediz river traversing through the basin is a backbone for the irrigation of nearly 522.000 ha of land out of 2 million ha spread over four states. More than 100 thousand ha in this green corridor are used for the production of several agricultural crops like grapes, cotton and tobacco. Overuse of water for irrigation results in a rise of the water table, water-logging, salinization and ultimately secondary salting of soil (Ozturk *et al.*, 2007). The patches of salinity are visible at the farm level. The basin is experiencing a decrease in productivity and biological diversity because of the decrease in nutrient-use efficiency, physical and chemical degradation of soil, and inefficient water use. The use of monocultures, mechanisation and excessive use of chemicals for plant protection are affecting the crops, plant, and animal diversity negatively. During the last 20 years the population of the basin has doubled followed by heavy urbanisation (SIS,2004). The demographic outburst together with water erosion and unsustainable land use have lead to land degradation problems in the basin and are also threatening its biodiversity. Present communication gives a synopsis of these degradation factors and their possible future impacts in the basin.

LAND DEGRADATION

The ruined cities in the wide, fertile plain of the Gediz basin were probably settled for the first time in the third millennium B.C. They experienced droughts, earthquakes, famines, fires, floods, invasions, landslides, and sieges (Ozturk *et al.*, 1994,1995). The area was the western terminus of the Persian royal road described by Herodotus. The splendor of ancient Sardis in the basin is still evident and gives reason to ponder over the future of this basin. Much of the history of this basin is reflected in the soil. The top layer of the soil at the interface between earth and atmosphere is the place where atmospheric attack is maximum. A layer of phytosphere lies between the soil and atmosphere, which depending on its density has a protective role. The processes of soil degradation are accelerated when the vegetation is destroyed by human activities (Figures 5.1 and 5.2). The data on land degradation in the Gediz Basin was summed up from the sources provided by the Directorate of Water and Soil Resources, Menemen, as well as the data published earlier by Ayyildiz (1983), Gul *et al.* (1995), Taysun and Uysal (1995), Ozturk *et al.* (1994, 1995, 1996a,b, 2007), Gokmen *et al.* (1997), Gecgel *et al.* (2000), Ozturk and Guvensen (2002), Guvensen and Ozturk (2003).

Gediz basin includes 2.3 per cent of the total area of Turkey and 2 per cent of the irrigated land, supporting 3.7 per cent of the population. Total area of land is 1.721.895 ha.,out of which agricultural areas constitute 643990 ha, grasslands 101266 ha, and forest and macchia 919423 ha. The soils are entisols and inceptisols on steep slopes or in alluvial valleys, affected by landslides, erosion, alluvial deposition and overuse through cultivation. Approximately 400.000 ha of the total irrigated land area constitute the plains. Nearly 1.5 million ha (84.69 per cent) have different slopes.The area of different classes of soils is; 134,578 (Class-I), 124,086 (Class-II), 127,349 (Class-III), 134,896 (Class-IV), 124 (Class-V), 315.537 (Class-VI), 845.623 (Class-VII), and 39.702 ha.(Class-VIII). These abound in mica flakes, which contribute to sliding, especially when they are irrigated. In earlier times farmers had designed settling pots

at close intervals in certain water lines so that soil sediments could be removed periodically. This practice is not used now(Gul *et al.*, 1995). The percentage of the irrigated cotton area is about 50 per cent, however, the area has decreased from 50.000 ha (1980) to 36.000 ha (2000). On the other hand, the area of vineyards has increased from 10.000 ha to 25.000 ha during the same period, whereas the area of

Figure 5.1: (*a*) Soil Extraction for Brick Factory (*b*) Industrial establishment for cement production and the together with a waste dump

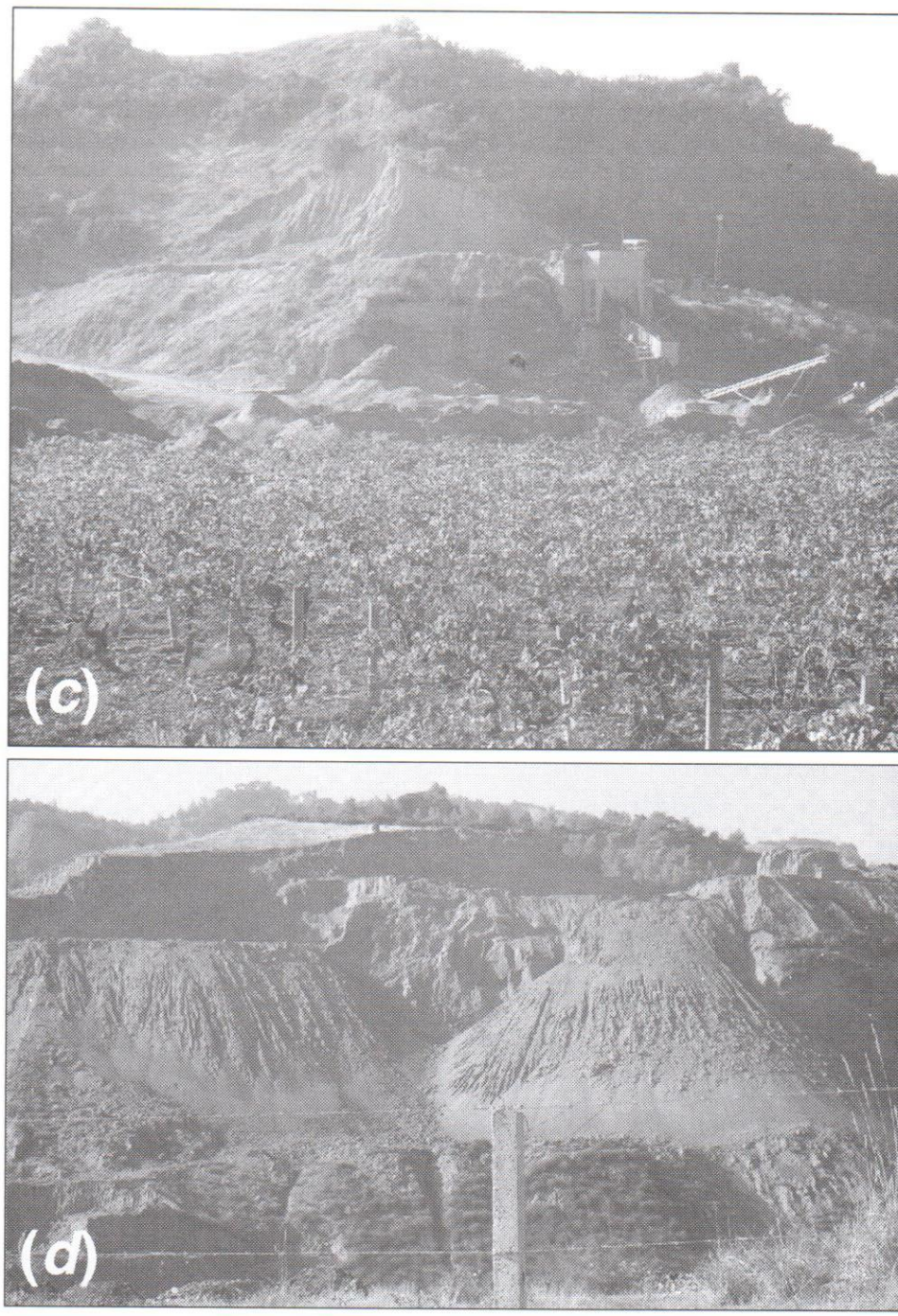

Figure 5.1: (c) Degradation of forest areas
(d) Soil extraction for brick factory
Visible alongside the highway crossing the study area.

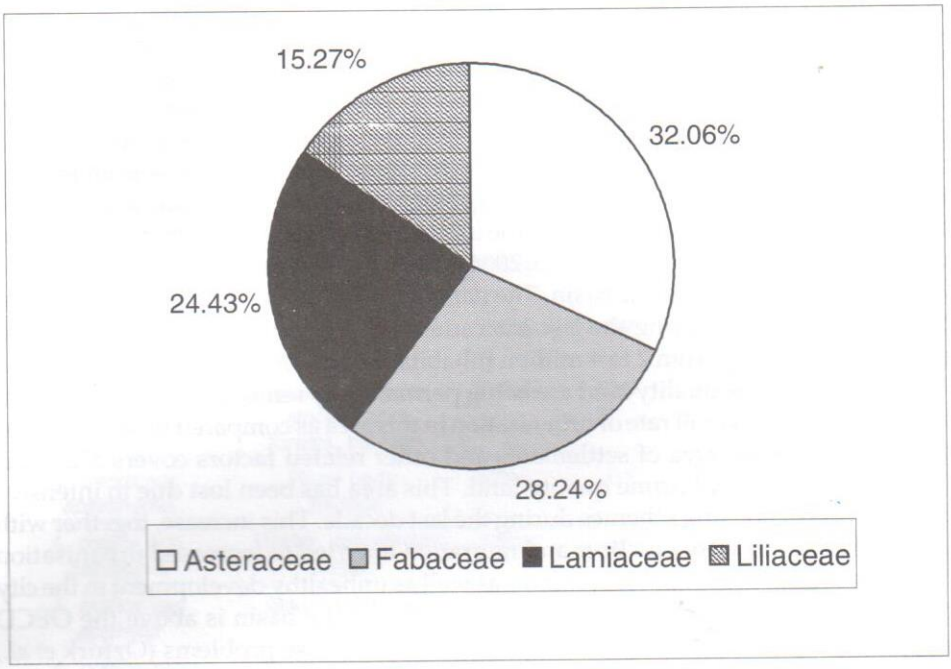

Figure 5.2: Percentage of Dominant Families on the Basis of Endemics in Gediz Basin

tobacco is decreasing (Gecgel, 2000). The erosive agents like rainfall and runoff are very effective in the soil erosion.The different forms of water induced erosion include geological and man-induced forms. A major part of the land, nearly 1.5 million ha (84.69 per cent) show slight, medium, steep or very steep slope. Soils on upper slopes have been overgrazed by goats and sheep for centuries. Forests originally protected the soils on the mountains, but the trees were cut for construction purposes and to provide firewood. Different degrees of water erosion are observed and these affect nearly 90 per cent of the land area (Taysun and Uysal, 1995). Only 265.000 ha of the land surface here are safe from erosion. Medium, strong and very strong erosion is observed on 220.000, 640.000 and 540.000 ha respectively (Gul *et al.*, 1995). Erosion and deforestation pose a great threat. Approximately 100.000 ha of agricultural land around Kemalpasa, Turgutlu, Salihli, and Alasehir has been used for non agricultural purposes. In addition to this loss today millions of hectares of land are awaiting planning due to wrong use or over use. During the last few decades the brick and tile factories are using large areas of the productive land from the basin. In general, 60 per cent of the land from the most productive class I-IV soil groups has been used unsustainably (Ozturk *et al.*, 1994,1995). More than 30 brick factories and some leather workshops are a major cause of pollution in this region.

URBANISATION

Human activities are the determining factor at all stages of degradation. Industrialisation and demographic explosion have been an important driving force

in urbanisation (SIS,2004). Improved individual mobility of inhabitants has changed the pattern of urban growth. The latest trend in the region has been to use the best quality arable lands for housing schemes, highways, touristic establishments, sports complexes, universities, airports and other activities. An increase in the land of construction on a monetary basis results in a decrease in the productive value of cultivated areas. The causes, mechanisms of deterioration, and the impacts underlying this originate from population increase together with emmigrations due to favourable climatic conditions. For urbanisation, the information published by the State Institute of Statistics was used (SIS, 1995, 2003, 2004) together with the quesstionares collected from the muncipalities in the basin. The demographic developments have followed an increasing trend during the last 2 decades and the population of the basin has doubled goimng up from 2 to 4 million inhabitants. Urbanisation is increasing and large parts of prime quality land are being permanently removed from agricultural use. Although an overall rate of urbanisation in this area as compared to other regions of Turkey is lower, area of settlements and other related factors covers 57216 ha. including 16.000 ha of prime quality land. This area has been lost due to intensive construction of housing schemes during the last decade. This increase, together with unsustainable land use practices and migration have led to increased urbanisation resulting in land degradation problems as well as unhealthy development in the city outskirts. The noise pollution in the major cities of the basin is above the OECD standards (65 dB) and the waste disposal sites also cause problems (Ozturk *et al.*, 1994, 1995).

PLANT DIVERSITY

The productive forest area in the basin covers 120.000 ha, degraded forest 350.000 ha, agricultural fields 340.000 ha, orchards 132.000 ha, and grasslands 101,266 ha. The basin in general shows a thermo-mediterranean and mediterranean plant cover mainly represented by *Pinus brutia* forests and macchias, but in the supra-mediterranean parts forests of *Pinus nigra* ssp. *pallasiana* dominate and in the sub-alpine zone we come across the species of *Astragalus* and *Acantholimon.* In the grasslands, major taxa are; *Phleum, Hordeum, Cynodon, Alopecurus, Stipa, Avena, Trifolium, Vicia, Onobrychis, Medicago, Carex, Phalaris, Sinapis, Raphanus, Agropyron, Papaver,* and *Glycyrrhiza.*

The plant collections were done during spring, summer and autumn seasons of 1998-2000. These were identified with use of the Flora of Turkey and the East Aegean Islands (Davis,1965-1988, Davis *et al.*, 1988;Guner at al.,2000). Gediz basin is included in the mediterranean phytogeographical region with varying habitats which embody a rich plant diversity. In all 319 taxa belonging to 206 genera and covering 60 families were collected, all included in the division Spermatophyta. The dominating families are Asteraceae (32.06 per cent), Fabaceae (28.24 per cent), Lamiaceae (24.43 per cent) and Liliaceae (15.27 per cent). In all 77 taxa are from Mediterranean, 49 from Irano-Turanian, 2 from the Euxinic phytogeographical regions and 3 from the unknown group. Some of the taxa are listed in Table 5.1.

The endemics constitute 10 per cent of the total endemic plant cover of Turkey (Ozturk *et al.*, 1992; Ekim, 2009). Most important ones are; *Achillea nobilis spp. sipylea,*

Table 5.1: List of the Plant Taxa Collected from Gediz Basin

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
		ASTERACEAE				
Doronicum reticulatum	Alpine slopes	Yellow	6-7	PR	1700-2000	MED
Senecio castagneanus	Rocky slopes, forest openings	Yellow	4-6	PR	1250-2200	MED
Anthemis cretica spp.*tenuiloba*	Steppe, ruderal, river bed	Yellow	5-6	PR	300-2100	IR-TR
A. cretica spp. *anatolica*	Steppe, ruderal, moist heaps	Yellow	5-7	PR	280-2285	IR-TR
A. cretica spp. *leucanthemoides*	Serpentine rocks, slopes, pine forests, hill tops	Yellow	5-6	PR	200-1600	IR-TR
A. cretica spp. *absinthifolia*	River beds, hill tops	Yellow	4-7	PR	700-1070	IR-TR
A. cretica spp. *candicans*	Rocky, calcareous slopes	Yellow	5-6	PR	800-2000	IR-TR
A. cretica var. aciphylla	Mixed subalpine forests	Whitish	5-7	PR	350-1600	MED
A. cretica var. discoidea	Subalpine forests	Whitish	5-7	PR	300-1600	MED
A. xylopoda	Schist rocks	Yellow	7	PR	1400-1600	MED
A. dipsacea	Slopes, mountain base	Yellow	6-7	AN	800-1500	MED
A. wiedemanniana	Moist slopes, steppe	Golden yellow	5-6	AN	400-1800	MED
Achillea phrygia	Steppe, moist slopes, oak associations	White or yellow	5-7	PR	700-1500	IR-TR
A. nobilis spp. *sipylea*	Forest, steppe, grassland, rocky slopes, volcanic areas		6-8	PR	400-2350	MED
Tripleurospennum hygrophilum	Base of mountains, grassland	White	4-5	PR	800-980	MED
T.conoclinium	Meadows	White	4-7	BI/ PR	0-1200	MED
Cirsium leucopsis	Edge of spring waters		7	PR	1400-1600	MED
Carduus olympicus ssp. *Hypoleucus*	Rocky slopes, black pine forests	Purple	6-9	PR	1400-1700	MED
Jurinea cadmia	Rocky mountains	Lilac-pink	6-8	PR	1070-2100	MED
J. pontica	Forest, steppe, grassland	Purple	6-8	PR	50-1450	IR-TR
Serratula lasiocephala	Steppe	Pink	6	PR	1700-2000	IR-TR
Centaurea amasiensis	Forest, slopes	Yellow	6-7	PR	100-1100	IR-TR

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Table 5.1–Contd...

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
C. zeybekii	Open red pine forest	Pink	6	PR	600-1300	MED
C.a olympica	Forests	Rose purple	7-8	2	500-1200	MED
C. polyclada	Red pine forests, maquis, grassland	Rose purple	6-8	PR/BN	0-500	MED
C. sipylea	Higher elevations	Rose purple	7	PR/BI	*	MED
C.calolepis	Sandy heaps, grassland, ruderal	Rose purple	6-7	PR	50-1300	MED
C.aphrodisea	Steppe, hill tops	Rose purple	6-8	PR	1300-1900	MED
C. acicuaris var. urvillei	Rocky areas	Yellow	5-6	PR	0-1200	MED
C. lydia	Pine forests, grassland		6-7	PR	400-1600	MED
C. reuterana ssp. *reuterana*	Rocky slopes	White	5-7	PR	1300-2100	MED
C.pichleri ssp. *extrarosularis*	Steppe, rocky slopes		6-7	PR	750-3200	MED
Scorzonera suberoza ssp. *cariensis*	Cultivated areas	Lilac or purple	5-6	PR	1200-1650	IT-TR
S. acuminata	Grassland slopes	Yellow	5	PR	950-1400	IR-TR
S. eriophora	Pine forest, calcareous steppe	Yellow	5-6	PR	500-1900	IR-TR
S. tomentosa	Steppe, rocky slopes, hill tops	Yellow	6-8.	PR	800-2600	IR-TR
Tragopogon olympicus	Arid habitats	Yellow	7-8l	PR	1500-2300	MED
T. subacaulis	Arid habitats, calcareous rocks	?	7-8	PR	1100-1500	MED
Picris olympica	Mountain slopes, subalpine meadows	?	7-8	PR	1500-2100	MED
Hicraceum leucutechum	Rocky habitats, steppe	Yellow	6-7	PR	1340-1960	MED
H. tumeloum	Mountain steppe	Yellow	7	R	1300	MED
Cicerbita variabilis	Rocky places, wet slopes, pine and fur forests	Blue	6-8	PR	1400-2000	MED
	LEGUMINOSAE					
Chronanthus orientalis	Oak forest, High slopes	Yellow	6	PR	Over 1000	MED
Genista involucrata	Maquis, Conifer forests, Wet rocks	Yellow	6	PR	600-1500	IR-TR
G. aucheri	Rocky slopes, Steppe, Meadow	Yellow	6-7	PR	500-1500	IR-TR

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Table 5.1–Contd...

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
Colutea monocalyx sp.*davisiana*	Forests, Rocky slopes	Yellow	3-5	PR	0-1250	MED
Astragalus macroscepus	Calcareous steppe, Red pine forests		6-8	PR	700-1460	IR-TR
A. oxytropitolius	Pine forests, Wet slopes		5-7	PR	850-2100	IR-TR
A. papasianas	Oak and wheat associations	Yellow	5-6	PR	50-100	MED
A. ptilodes var. *ptilodes*	High plateau	Whitish	6-7	PR	Over 500	MED
A. ptilodes var. *cariensis*	High plateau	Whitish	6-7	PR	Over 500	MED
A. strictispinis	Rocky places, Pine forests	Pink	5-8	PR	850-2000	IR-TR
A. condensatus	Steppe, Forest	Pink	5-7	PR	900-3000	IR-TR
A.weidemannianus	Steppe, Meadows	Pink	5-7	PR	900-2200	IR-T
A. baibutensis	Mountainous areas	Purplish	6-7	PR	500-2130	IR-TR
A. mitchelianus	High altitudes	Pink	7	PR	700-1100	MED
A. squalidus	Pine forests, Calcareous steppe	Purple, rarely greenish yellow	5-7	PR	500-2350	IR-TR
A. gaebotrys	Pine forests, *Calcareous steppe*	Yellowish	6	PR	–	IR-TR
A. acmonotrichus	Rocky slopes	White or purplish Yellow	5-7	PR	1500-1900	MED
A. gymnolobus	Steppe, Meadows, Forest	White or Yellow	5-6	PR	1000-1800	IR-TR
A. trojanus	Steppe, Maquis	Pink	5-7	PR	0-1040	MED
A. consimilis	High altitudes	Red	6	PR	900-1200	MED
A. lydius	Steppe, Meadows	Purplish-blue	5-7	PR	100-1400	IR-TR
A. paecilanthus	Cedrus forests	White or Yellow	5-6	PR	940-2000	IR-TR
A. flavescense	Rocky slopes	Yellowish	7-8	PR	1750	MED
A. vulnerarie	Forest, Steppe slopes	Yellow	5-7	PR	750-2150	IR-TR
Trifolium caudatum	Forests	Purple, Pink, Cream	5-8	PR	600-1600	IR-TR
T. pannonicum ssp. *Elongatum*	Meadows, Steppe, Forest	White or Cream	6-8	PR	300-2350	IR-TR
T. chlorothricum	Open areas	White	5	AN	–	IR-TR
Melilotus bicolor	Dry, rocky places	White	4-5	AN/BN	1000-1200	IR-TR

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Table 5.1–Contd...

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
Trigonella eretica	Waste grounds, Eroded areas	Yellow	4-6	AN	100-500	MED
T. rostrate	Rocky slopes, steppe, Black pine forests	Bright yellow	5-6	AN	850-1500	IR-TR
T. smymea	Rocky slopes, Wet rocks	Bright yellow	5-6	AN	0-1150	MED
T. cephalotes	Wet phrygana, River banks, Lower places	Yellow	4-5	AN	0-50	MED
Lotus macrothricus	Wet valleys, Riversides	Yellow	4-7	AN	50-1000	MED
Hedysarum cappadocicum	Wet rocks, Steppe, Rocky slopes	Pink, purple or Yellowish	5-8	AN/ PR	800-3500	IR-TR
Onobrychus podperae	Wet rocks, slopes	Pink	5-6	PR	300-1000	IR-TR
O. armena	Wet rocks, Steppe, Maquis, Ruderal forest	Dark Pink	5-8	PR	100-2000	MED
Ebenus plumose var. *plumose*	Arid places	Pink	6-7	PR	100-850	MED
		LABIATAE				
Lavandula stoechas ssp. *cariensis*	Red pine forest, Maquis, Phyrygana, sand dimes, Ruderal	Blackish-purple	3-6	PR	0-700	MED
Sentellaria salviifolia	Rocky areas, Maquis, Forests	Bright yellow	5-8	PR	400-1900	–
Phlomis russeliana	Conifer forests, Hazelnut shrubs	Yellow	5-9	PR	300-1700	EX
Phlomis armeniaca	Pine forests, cereal and fallow fields	Yellow	6-8	PR	800-2350	IR-TR
P. capitata	Steppe, Rocks, Oak forests	Yellow	6-8	PR	540-2400	IR-TR
P. nissolii	Rocky areas, Ruderal, Steppe	Yellow	6-8	PR	0-1550	IR-TR
Lamium pisidicum	Dry calcareous areas	Pinkish-purple or Lilac	5	PR	915-1830	–
Wiedemannia orientalis	Dry rocks, Steppe, Ruderal, Open areas	Pale or dark pink, Lilac, purple	4-6	AN	700-1650	IR-TR

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Table 5.1–Contd...

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
Ballota nigra ssp. *anatolica*	Valleys, River banks, Heaps, Waste ground	Purple or pink	5-9	PR	0-1900	IR-TR
Marribium rotundifolium	Calcareous habitats	Whitish	5-7	PR	700-2000	MED
M. globosum ssp. *globosum*	Rocky slopes	Whitish	4-8	PR	800-2500	IR-TR
Sideritis sipylea	Calcareous places, Mixed forest	Yellow	5-8	PR	200-1600	MED
S. tmolea	Sloppy rocks	Yellow	7-8	PR	1900	MED
Stachys tmolea	Calcareous places, young forest	Pale lemonade yellow	5-8	PR	200-1900	MED
S. cretica ssp. *smyrnea*	Red pine forest	Rose pink	4-8	PR	5-1380	MED
S. cretica ssp. *anatolica*	Meadow, calcareous slopes	Rose pink	5-9	PR	100-2900	IR-TR
S. setifera ssp. *lycia*	Stream banks, wet plains	Pink	5-8	PR	750-1400	IR-TR
Nepeta cadmea	Rocky slopes	White	7-8	PR	200-1900	MED
N. nuda ssp. *lydiae*	Rocky slopes	Purplish-blue	6-8	PR	600-1700	MED
N. viscida	Rocky slopes	Pale purple or white	5-7	PR	740-1800	MED
Origanum spyleum	Calcareous rocks, Forest, maquis	Pink	6-8	PR	100-1500	MED
Micromeria cristate ssp. *phyrgia*	Calcareous rocks, steep places	White, Lilac or Purple	7-8	PR	1000-2000	MED
Thymus zygioides var. *lycaonicus*	Red pine forest, open maquis	Pink	4-6	PR	0-1600	MED
T.sipyleus ssp. var. *sipyleus*	Mountain steppe, Rocky slopes	White or pink	5-8	PR	400-2700	MED
T. chaubardii ssp. *chaubardii* var.*anatolianus*	Open conifer forests	Pale pink	5-7	PR	250-2200	MED
Zizophora taurica ssp. *eleonioides*	Steppe, open habitats	Reddish-purple, Lilac	5-8	AN	100-2060	MED
Salvia cedronella	Shrubby ground	Yellow	5-6	PR	–	MED
S. wiedemannii	Calcareous areas, Steppe, Rudera!	Lilac or Blue	5-7	PR	500-1400	IR-TR
S. pisidica	Oak maquis, Field borders	Purplish-blue	5-7	PR	950-1750	IR-TR

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Table 5.1–Contd...

Family and Plant Name	*Habitat*	*Flower Colour*	*Flowering Time*	*Habit*	*Altitude (m)*	*Element*
S. tehihatcheffii	Calcareous areas, Red pine forests, Vineyards	Light purple or White	5-6	PR	400-1200	IR-TR
S.cadmica	Rocky slopes, Steep slopes, Oak shrubs	White	5-7	PR	900-1810	?
S. smymaea	Rocky habitats	Purplish-blue	5	PR	920	MED
S. dichroantha	Steppe, Forest, Ruderal	–	7-9	PR	810-1810	IR-TR
		LILIACEAE				
Allium sibthorpianum	Grassland, Rocky slopes	Lilac pink or Purple	8-9	PR	700-2500	MED
A. phyrgium	Artemisia steppes, ruderal	Purplish-Brown	8	PR	900-1850	IR-TR
A. olympicum	Forest, Grassland, Shrubby ground	Purple, Red, Lilac, Pink	7-8	PR	1300-2800	EU
A. huber-monathii	Forests, Shrubs, Maquis, Rocks, Dry areas	Pale pink or white	6-8	PR	1000-2000	IR-TR
A. pictistamineum	Maquis, Shrubs, Steppe, Rocks	Pale green, yellowish-green	5-6	PR	200-980	MED
A. proponticum var. *proponticum*	Maquis, Steep slopes, Coast, Rocky places, Vineyards	Pale Purple or Purple	5-7	PR	0-1600	MED
A. stylosum	Forest, Shrubby, Rocky places, Steppe	Dark purple	5-7	PR	100-1800	MED
A. reuterianum	Slopes, Rocky habitats, Calcareous places	Pink, Red or Wine red	7-8	PR	1800-2100	MED
Chionodoxa lucilae	Open slopes	Lavender, Blue	5-6	PR	1600-2000	MED
C. forbesii	Open slopes, forests	Bright blue	3-4	PR	1000-2500	MED
C. sardensis	Pine forests, Wet North slopes	Bright blue	3-4	PR	550	MED
Ornithagalum nivale	Snowy slopes	White	6	PR	–	MED
Muscari aucheri	Wet places, forests	White or Pale blue	4-6	PR	1000-3000	–
M.latifolium	Pine forests	Purplish-Black	4-5	PR	1100-1800	MED
M. bourgaet	Wet places, Calcareous areas	Light blue	5-7	PR	1500-3000	MED
Hyacenthalla lineata	Shrubs, Forests, Grasslands	Dark blue	3-5	PR	200-1500	MED

Contd...

Table 5.1–Contd...

Family and Plant Name	Habitat	Flower Colour	Flowering Time	Habit	Altitude (m)	Element
Fritillaria buhynica	Forest, Shrubs	Greenish-yellow	3-5	PR	100-1200	MED
F. flerschenana	Clayey heaps, Steppe, Shrub	Dark pink	2-5	PR	1000	IR-TR
F. canca ssp. *canca*	Forest, Rocks, Calcareous places	Yellow or orange	3-5	PR	200-1500	MED
Tulipa armena var. *lycia*	Rocky slopes	Pale red, pink or yellow	4-6	PR	1000-2750	MED

MED: Mediterranean; IR-TR: IranoTuranian; EU: Euxin; AN: Annual; BN: Biennial; PR: Perennial.

A. phrygia, Anthemis cretica spp.absinthifolia, A. cretica spp.anatolica, A. cretica spp.candicans, A. cretica spp.leucanthemoides, A. cretica spp.tenuiloba, A. aciphylla var. aciphylla, A. cretica var.discoidea, A. dipsacea, A. wiedemanniana, A. xylopoda, Carduus olympicus ssp. hypoleucus, Centaurea acicularis var. urvillei, C. amasiensis, C. aphrodisea, C. calolepis, C. lydia, C. olympica, C. pichleri ssp. extrarosularis, C. polyclada, C. reuterana ssp. reuterana, C. sipylea, C. zeybekii, Cicerbita variabilis, Cirsium leucopsis, Doronicum reticulatum, Hieraceum leucotechum, H. tmoleum, Jurinea cadmea, J. pontica, Picris olympica, Scorzonera acuminata, S. eriophora, S. suberosa ssp. cariensis, S. tomentosa, Senecio castagneanus, Serratula lasiocephala, Tragopogon olympicus, T. subacaulis, Tripleurospennum conoclinium, T. hygrophilum (ASTERACEAE); Astragalus acmonotrichus, A. baibutensis, A. condensatus, A. consimilis, A. flavescenses, A. gaeobotrys, A. gymnolobus, A. lydius, A. macroscepus, A. mitchelianus, A. oxytropifolius, A. paecilanthus, A. papasianus, A. ptilodes var. cariensis, A. ptilodes var. ptilodes, A. squalidus, A. strictispinis, A. trojanus, A. vulneraria, A. weidemannianus, Chronanthus orientalis, Colutea melanocalyx sp.davisiana, Ebenus plumose var. plumose, Genista aucheri, G. involucrata, Hedysarum cappadocicum, Lotus macrotricus, Melilotus bicolor, Onobrychis armena, O. podperae, Trifolium caudatum, T. chlorothrichum, T. pannonicum ssp. elongatum, Trigonella cephalotes, T. cretica, T. rostrate, T. smymea (FABACEAE); Ballota nigra ssp. anatolica, Lamium pisidicum, Lavandula stoechas ssp. cariensis, Marrubium globosum ssp. globosum, M. rotundifolium, Micromeria cristate ssp. phyrgia, Nepeta cadmea, N. nuda ssp. lydiae, N. viscida, Origanum sipyleum, Phlomis armeniaca, P. capitata, P. nissolii, P. russeliana, Salvia cadmica, S. cedronella, S. dichroantha, S. pisidica, S. smyrnaea, S. tchihatcheffii, S. wiedemannii, Sideritis sipylea, S. tmolea, Stachys cretica ssp. anatolica, S. cretica ssp. smyrnea, S. setifera ssp. lycia, S. tmolea, Thymus chaubardii ssp. chaubardii var.alternatus, T. sipyleus var. sipyleus, T. zygioides var. lycaonicus, Wiedemannia orientalis, Ziziphora taurica ssp. cleonioides (LABIATAE); Allium huber-morathii, A. olympicum, A. phyrgium, A. pictistamineum, A. proponticum var. proponticum, A. reuterianum, A. sibthorpianum, A. stylosum, Chionodoxa forbesii, C. luciliae, C. sardensis, Fritillaria bithynica, F. carica ssp. carica, F. fleischeriana, Hyacinthella lineata, Muscari aucheri, M. bourgaei, M. latifolium, Ornithagalum nivale, Tulipa armena var.lycica (LILIACEAE), Chaenorhinum litorale ssp. pterosporum, Digitalis cariensis, Linaria genistifolia, L. corifolia, Scrophularia cryptophila,

S. depauperata, S. floribunda, S. scopolii var. smyrnaea, Verbascum antinori, V. cheiranthifolium var. asperulum, V. coronopifolium, V. exuberans, V. kastamunicum, V. lobatum, V. luciliae, V. lydium var. lydium, V. parviflorum, V. salviifolium, V. serratifolium, V. smyrnaeum, V. splendidum, V. stenotachyum, V. uschakense, V cuneifolia ssp. cunefolia, Veronica elmaliensis, V. multifida (SCROPHULARIACEAE); Arenaria acerosa, A. macrosepala, A. sipylea, A. tmolea, Bolanthus minuartioides, B. spergulifolius, Dianthus anatolicus, D. brevicaulis ssp. setaceus, D. leucophaeus var. leucophaeus, D. lydus, Gypsophila tubulosa, Minuartia juressi ssp. asitacia, M. mesogitana ssp. lydia, M. saxifraga, Saponaria chlorifolia, S. prostrata ssp. prostrata, Silene phrygia, S. sipylea, S splendens, Velezia hispida (CARYOPHYLLACEAE); Astrantia maxima ssp. haradjianii, Bupleurum sulphureum, Eryngium bithynicum, E. thorifolium, Ferula anatolica, Ferulago humilis, F. macrosciada, F. aucheri, Heracleum platytaenium, Muretia aurea, Peucedanum chryseum, Pimpinella cretica var. cretica, P. tragium ssp. polyclada, Tordylium macropetalum (APIACEAE); Consolida aconiti, C. phrygia ssp. phrygia, C. raveyi, Delphinium fissum ssp. anatolicum, Ranunculus heterorhizus, R. reuterianus (RANUNCULACEAE); Corydalis solida ssp. solida, Papaver argemone ssp. davisii, P. strictum, P. virchowii (PAPAVERACEAE); Alyssum davisianum, A. fulvescens var. stellatocarpum, A. oxycarpum, Erysimum kotschyanum, Hesperis balansae, H. buschiana, H. kotschyi (BRASSICACEAE); Fumana paphlagonica, Helianthemum nummularium ssp. lycaonicum (CISTACEAE); Amygdalus balansae, Alchemilla bursensis, Crataegus dikmensis, Potentilla buccoana, P. sublaevis, Pyrus anatolica (ROSACEAE); Rosularia chrysantha, Sedum hispanicum var. planifolium (CRASSULACEAE); Valerianella glomerata (VALERIANACEAE); Pterocephalus pinardii, Scabiosa hololeuca, (DIPSECACEAE); Herniaria olympica, Paronychia anatolica ssp. balansae, P. angorensis, P. chionaea (ILLECEBRACEAE); Hypericum adenotrichum, H. aviculariifolium ssp. aviculariifolium var. aviculariifolium, H. aviculariifolium ssp. aviculariifolium var. bourgaei (GUTTIFERAE); Malope anatolica (MALVACEAE); Linum aretioides, L. cariense, L. hirsutum ssp. anatolicum var. anatolicum, L. hirsutum ssp. pseudoanatolicum, L. tmoleum (LINACEAE); Erodium absinthoides ssp. absinthioides (GERANIACEAE); Haplophyllum megalanthum, H. myrtifolium (RUTACEAE); Acer hyrcanum ssp. keckianum (ACERACEAE); Asyneuma limonifolium ssp. pestalozzae, A. rigidum ssp. sibthorpianum, A. virgatum ssp. cichoriiforme, Campanula betonicifolia, C. lyrata ssp. icarica, C. lyrata ssp. lyrata, C. raveyi, C. teucrioides, C. tomentosa, Jasione supina ssp. timolea (CAMPANULACEAE); Vincetoxicum canescens ssp. pedunculata (ASCLEPEDIACEAE); Convolvulus galaticus (CONVOLVULACEAE); Alkanna tinctoria ssp. gladulosa, A. tubulosa, A. areolata var. areolata, A. areolata var. sublaevis, Moltkia aurea, Nonea macrosperma, Onosma armenum, O. isauricum, Paracaryum aucheri, P. calycinum, Symphytum anatolicum (BORAGINACEAE); Acanthus hirsutus (ACANTHACEAE); Acantholimon acerosum var. brachystachyum, Limonium effusum (PLUMBAGINACEAE); Aristolochia hirta (ARISTOLOCHIACEAE); Euphorbia anacampseros var. tmolea, E. erythrodon, E. falcata ssp. macrostegia (EUPHORBIACEAE); Quercus vulcanica (FAGACEAE); Asperula daphneola, A. lilaciflora ssp. lilaciflora, A. lilaciflora ssp. phrygia, A. nitida ssp. hirtella, A. tenufolia, Crucianella disticha, Galium brevifolium ssp. brevifolium, G. campanelliferum, G. dumosum, G. incanum ssp. centrale, G. pendiliflorum. G. stepparum (RUBIACEAE); Phoenix canariensis (PALMAE); Arum balansanum, Biarum tenuifolium (ARACEAE); Sternbergia schubertti (AMARYLLIDACEAE); Crocus biflorus ssp. nubigenus, C. flavus ssp dissectus, C. fleischeri, C. oliveri ssp. balansae, Gladiolus anatolicus, Iris purpureobractea (IRIDACEAE); Juncus

sparganiifolius (JUNCACEAE); Carex distachya var. phyllostachioidea, C. divulsa ssp. coriogyne (CYPERACEAE); Alopecurus davisii, Bromus cappadocicus ssp. sclerophyllus, B. macrocladus, B. sipyleus, Festuca pinifolia var. phrygia, Helictotrichon pubescens ssp. longifolia, Pseudophyleum gibbum (POACEAE).

FAUNAL DIVERSITY

The seaward fringe of the basin is an ecologically important wetland ecosystem; forming the A category nature reserve which used to receive excess water from the Gediz River, but since 1990, with restrictions on irrigation releases, the reserve suffers from water shortages during summer months. There are four freshwater lagoons, namely; Kýrdeniz Dalyan (400 ha), Homa (1824 ha), Chilazmak (725 ha) and Bağyppasha (500 ha). In addition Cigli swamp (140 ha) and Sazlý lake (30 ha) are two spots worth noting. These form rich habitats for waterbirds, fish and other organisms.The delta is used by 211 bird species out of a total of 426 recorded in Turkey, 46 being local, 54 summer migratory, 43 winter migratory, and 30 transitory (Sylej, 2002). The important species are; Great Cormorant *(Phalacrocorax carbo)*, *Pygmy Cormorant (Phalacrocorax pygmeus)*, *Dalmatian* Pelican *(Palecanus crispus)*, *Greater Flamingo (Phoenicopterus ruber)*, Ruddy Shelduck *(Tadorna ferruginea)*, Lesser Kestrel *(Falco naumanni)*, *Eurasian* Oystercatcher *(Haematopus ostralegus)*, *Black-winged Stilt (Himantopus himantopus)*, *Pied* Avocet *(Recurvirostra avosetta)*, *Eurasian Thick-knee (Burhinus oedicnemus)*, *Collared Pratincole (Glareola pratincola)*, *Kentish Plover (Charadrius alexandrinus)*, Spur-winged Lapwing *(Vanellus spinosus)* and Common Redshank *(Tringa totanus)*.

Livestock number 1.3 million heads. The land degradation problems pose a serious threat to the rich biodiversity and agricultural areas. Forests originally protected the soils on the mountains, but the trees have been cut for building and to provide firewood.

CONCLUSIONS

The phenomenon of degradation cannot be arrested by physical or technical means alone. Guiding human activities towards consideration of ecology and natural landscape variations would be a positive step in assuring that future civilizations will enjoy greater success and persist longer than did past civilizations. Interdisciplinary efforts to better understand the environment and its relationships to the welfare of inhabitants would contribute towards a more optimistic view of the future.

There is a need to evaluate land resources to assess the desertification threats and potential for degradation to manage the resilience characteristics of the systems and select technological options in the framework of the resilience properties (Ozturk, 1995; Feoli *et al.*, 2003).

Although Agenda 21 (UNCED, 1992, Ch.12) emphasizes desertification with activities set-up for preventive actions, by mentioning that "to strengthen regional and global systematic observation networks linked to the development of national systems for the observation of land degradation and desertification caused both by climate fluctuations and by human impact, and to identify priority areas for action",

but land degradation is receiving very little attention. A comprehensive new agenda is needed to protect the sustainability of the ecosystem and prevention of land degradation. The new agenda should indude a science based approach, to understand the land quality and its changes by management alternatives (Sakcali and Ozturk,2003). In the preparation of the new agenda, all sectors including stakeholder and non-governmental organizations should work together.

Tonnes of sediments are transported to the Aegean Sea due to the overgrazing and subsequent soil erosion as well as other land degradation activities (Ozturk *et al.*, 1994, 1996a,b; Alpaslan and Atis, 1995). Erosion control is particularly critical for maintenance of soil fertility for food production as well as environmental quality considerations in the basin in general. There is an urgent need for a mobilization of the scientific community to start an integrated program for data collection, sample areas for assessment, monitoring of land degradation and development of mitigation technologies; develop methods for integrated and sustainable monitoring and management of biodiversity; land use models including natural and human-induced factors; information systems that link environmental monitoring, accounting and impact assessment; policies that encourage sustainable land use and management; and finally develop economic instruments in the assessment of land degradation to encourage the suitable use of land resources. In order to avoid an induced impoverishment and the desiccation of land, it would be more plausible to start taking measures now through well organised ecological land use planning.

With demographic outburst and economic growth, the demands on the functions of the water resources system are increasing at an alarming rate in the basin. An effective utilisation of land and water inventory data for land use planning is needed vis-a-vis the re-charging of groundwater reservoirs in areas of water table decline related to the agro-industrial watershed based planning. For example, until 1980 deep wells were almost unknown in the basin. The picture of the challenges facing irrigated agriculture is becoming clear in the context of increasing water scarcities. There is no option other than the improvement of efficiency in order to achieve high production annually. Government should double grants for water development, in order to reduce by half the number of muncipalities lacking water treatment systems. For a protection of biodiversity, water management will play a critical role by optimizing the performance of the water resources system in order to satisfy the socio-economic as well as ecological requirements. This can be acheived through an interstate cooperation.

The rich biodiversity of Gediz Basin flourishes on different ecological habitats such as alpine/subalpine zone, forests, macchias phrygana and wetlands in the deltaic zone. These are mainly dominated by the plants belonging to the mediterranean phytogeographical region. The area shows an endemic ratio of 20-25 per cent. These endemics constitute 10 per cent of the total endemic plant cover of Turkey (Ozturk *et al.*, 1992; Ekim,2009). The plant diversity in general is under great pressure, in particular nearly 50 species of endemics. Overexploitation can result in a decrease of genetic diversity (Ozturk *et al.*, 2008) together with the degradation or destruction of the wetlands around the deltaic zone due to excessive use of Gediz river, which leads to a rise in the water table, water-logging, and salinization. The herbaceous and long

rooting taxa like species of *Medicago, Agropyron, Bromus inermis, Festuca ovina, Lotus corniculatus*, shrubs like *Capparis* spp., *Pistacia* spp., *Rhus coriaria, Rosmarinus officinalis, Crateagus monogyna, Paliurus spina-christii, Vitex agnus-castus*, trees like *Populus tremula, Robinia pseudo-acacia* and *Pinus brutia* can be used for reforestation and reclamation of problematic areas, and prevention of erosion. The salinized lands can be reclaimed and evaluted by planting economically important halophytic taxa or salt resistant species.

Greater pragmatism is required to subscribe to a new land ethic, to safeguard ecological, biological and genetic diversity as well as the economic productivity potential of the basin. We believe that this study will add greater value to the concept of land degradation and provide a forum to identify the research gaps and needs concerning the assessment, monitoring and development of mitigation technologies, indicators for early warning of degradation and determination of land quality. There is an urgent need for the establishment of a sustainable land management institution, to carry out the above mentioned tasks.

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