MONITORING SOME LAND DEGREDATION PARAMETERS IN SOILS OF BALA AGRICULTURAL ENTERPRISE

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ABSTRACT

Due to mismanagement of the land, some of the main degradation type in Turkey are erosion by water or wind, soil salinization and alkalisation, soil structure destruction and compaction, biological degradation and soil pollution. Due to climatic and topographic condition soil erosion is the biggest problem in Turkey and approximately 86 % of land is suffering from some degree of erosion. There is no sufficient information on land degradation based on field studies and monitoring in Turkey. So, to understand status of degradation in Bala this study was handled.

In order to have some updated parameters of degradation, soil samples were collected from the reference soil profiles in Bala on the horizonation basis and analysed for comparison, assessment and interpretation. It is assumed that a basement to be established in such a way will lead to periodical checking and a database for the monitoring of degradation process.

Reference data being used as parameter affecting land quality are a set of horizon data of the typical soil profiles (18), once obtained from the detailed soil survey of the area conducted in early 1989. In this study likelihood changes, either negative or positive, occurred in the years between 1989 and 2002 are intended to monitor by comparing the existing data of 1989 with those obtained in 2002.

To this end, 1/16000 scale soil map of 1989 was digitised and a soil database was generated. Following a series of in queries, salt-alkali, drainage, boron, P_2O_5, lime, gypsum and organic matter status were displayed in map format. Results of sampling and analyses conducted in 2002 were incorporated into the database.

Because of topographic character of the study area which is apt to erosion, textural compositions (relative distribution of fractions in texture) of top layers have changed and organic matter contents have decreased within 13 years.

INTRODUCTION

Land degradation will remain an important global issue for the 21st century because of its adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life (Eswaran et al. 2001). In addition to natural disasters, it is known that land degradation is occurred by the human activities which are agricultural mismanagement, overgrazing, deforestation, industry and urbanization etc. One of the main causes of land degradation is agricultural mismanagement.

Assessment of the status of the land degradation should proceed before monitoring begins, in order to provide a base condition against which to compare later changes and to establish trends. The major question in monitoring is what to monitor and the time interval for the monitoring.
The key to land degradation monitoring is to identify indicators that are quantitative, sensitive to small changes, easy to measure, small in number, and reasonably unambiguous (NCRS, 2003).

At the second International Conference on land Degradation in Thailand, Eswaran et. al (2001) recommend 3 steps to address the issues and problems in land degradation 1-assessment 2- monitoring and 3- application of mitigation measures and / or technologies. The most accurate method for assessment and detection of land degradation is the direct measurement and observation at individual sites (Torrion, 2002). Assessment of the status of the land degradation should proceed before monitoring begin, in order to provide a base condition against which to compare later changes and to establish trends.

There are many processes that initiate or are responsible for land degradation and these can operate individually, simultaneously, successively, or in varying combinations. One set of processes or conditions, unless checked, frequently triggers others. To implement mitigating actions, it is important to evaluate the processes and address each, or a combination, in an organized manner. A clear understanding of processes, interactions and consequences is necessary to have meaningful results (Reich at all, 2000).

In Turkey, a few studies have been conducted to understand, find out and monitor degradation processes. Among them is PI model, which was studied to find out relationship between erosion and productivity. The research was carried out in 35 locations of wheat and barley-grown areas in the region. The soil samples of soil profiles which are the representatives of of Entisol, Inceptisol and Aridisol were analyzed for some physical and chemical properties. Erosion rates were calculated for each series by using TURTEM (Turkey Erosion Estimation Model). According to the results of evaluation, the differences in PI values which are between 0.05-0.10 shows that precautions in terms of soil conservation should be taken as erosion has considerable effect on crop yield.

For the estimation of mass movements hazards leading to soil degradation and the mapping of susceptible zones in Senirkent-Isparta, Arcak at all, (2002), conducted a project aimed at generating a GIS and RS aided model that could be very useful tool to be used in this regard. Additionally, in the study expediently generated soil maps were given special emphasis for their usage in degradation studies related to mass movement and provision efforts. Direct mapping methodology and Heuristic technique were applied in the study. Since direct method requires in large part a geomorphological approach, following a photo-interpretation based semi-detailed soil survey, a geopedological map of the study area was generated. Resulting mass movement features which were tried to delineate on the map are fans originating from mud flows; stone stripes located in relatively shallow gullies; debris and talus forms accruing from the disintegration and the slump of the rock substratum. In order to create mass movement hazard

zones, following relational queries, five groups were generated. Finally hazard severity classes were established as follows; very high, high, moderate, low, non or uncertain.

Long term changes in soil salinity of a 10000 ha area of the Yüreğir plain was studied considering irrigation, drainage, soil and topographic properties, using soil salinity data obtained in 1959 and 1979, with recently analyzed soils (surface horizon 0-15, 15-30 cm) collected from previously determined soil series. Results revealed that non-saline, slightly and moderately saline soils were 93% of the study area in 1959, 73 % in 1979, and 72% in 1999. Strongly and very strongly saline areas did not increase in comparison to the 1979 and 1999. The problem area in 1979 has been reclaimed by newly opened drainage canals, whereas areas with no salinity problems, surrounded by the Akyatan lagoon and its overflowed area, reveal increased salinity. The saline areas in the local lowlands have not significantly changed within a 40 year-period due to soil and topographic conditions. Land covered with natural vegetation exposes increased salinity at the top soil due to the increasing capillarity by roots, whereas parts devoted to agriculture have revealed decrease of salinity at the surface and increase with depth due to increased leaching by tillage (Çullu,2002).

MATERIAL and METHOD

In order to attempt to asses and monitor degradation in Bala agricultural enterprise, soil profile (23) data of previously defined soil series of 1989 were used as reference (Arcak,1992). For this purpose, a soil database was generated by digitizing 1/16000 scale soil map. Likelihood changes which might have occurred, in either negative or positive way, in the years between 1989 and 2002 are intended to monitor by comparing the existing data of 1989 with those obtained through the soil sampling in the same geo-referenced profiles in 2002.

The study was conducted at the Bala agricultural enterprise which is located in the southeast of Bala township, 90 km to Ankara. The annual average rainfall in Ankara is about 410mm. Almost whole of annual total rainfall is recorded in December- May period. Monthly mean temperature ranges from -2.9 ^{0}C in January to 29.8 ^{0}C in August (DMI, 2000). The average relative humidity changes between about 71-72% in winter to 37-41 % in summer. The area (8442 ha) is characterized by upland hills. Elevation changes from 750 to1000m. Land use is predominantly cropland in a rotation management system fallow-wheat (5117.2 ha), pasture (1024.8 ha), and meadow (1041.6 ha).

DISCUSSION

It can be understood from the thematic maps of 1989 that some of the Soil series have been effected in various degrees by salinisation and alkalinization. Lime contents of soil series are high and very high. Amounts of organic matter are usually at low levels. Similarly, P_2O_5 contents are low and very low, whereas K_2O contents are high and very high in soil series. Depending on seasonal movement of water table in alluvial sediments, drainage conditions show variation from poor to well.

For erodibility assessment TURTEM was used. The computer program TURTEM (soil erosion estimation model for Turkey) which has been developed to allow the prediction of soil erosion by rainfall. TURTEM uses the procedures of the Universal Soil Loss Equation (USLE) to predict average annual soil losses due to sheet and rill erosion. TURTEM makes recommendations on ways to reduce soil loss by way of changes to land and cover management practices (Özden and Özden, 1998). To calculate erodibility of soils some soil texture parameters, organic matter and structure and permeability classes were used. For actual erodibility, the same procedure was applied and erodibility values were transferred into database for the preparation of K map.

Another parameter used for erosion is topographic factor of which slope length and slope percentage were produced from DEM. For this purpose, digital elevation model was formed AS grid in Arcview 3.1, then model was transferred into TOPAZ module. Each series in soil map was considered and evaluated as a small basin. The output file obtained from TOPAZ was transferred into EXCEL, enabling LS calculation and average weight for each series. These data was then converted into database format in Arcview 3.1, and LS map was generated.

Erosivity parameter was obtained from TURTEM database for Ankara. Some layers of actual erosion parameters (R,K,LS) for the years were generated in Arcwiev, Then erosion rate was calculated by years (Figure 1 and Table 1).

Almost all of soil series seem have become more erodible in 2002. Erodibility values of 1989 ranges from 0.1 to 0.4, except 4. Pompa series. According to the findings of 2002 , most of K values changed between 0.2 and 0.4, however, K values in four series were calculated more than 0.4 (Figure 2.)

Erodibility assessment of 1989 reveals two classes as medium and highly erodible, whereas erodibility data of 2002 had to be separated into four classes ranging from very less erodible to highly erodible. Conclusions from the assessments suggest that majority of the soil series become vulnerable, resulting in more soil losses.

Except Yaşlı series, a general decrease in organic matter content was observed in the soil series. While an organic matter content of less than 1% was recorded only in Evcioğlu series in 1989, the content in Sığırcılık and Büvelek series fell below 1% as well in 2002 (Figure 3). Phosphorus level was determined to be between 1-3 kg/da in Omohun, Yaşlı, Höyük, İkinci pompa, Uyku tepesi and Kumseki series in 1989. The level was found to be between 3-6 kg/da in the same series in 2002. Although potassium showed a little decrease in 2002, the level was considered sufficient (Figure 4).

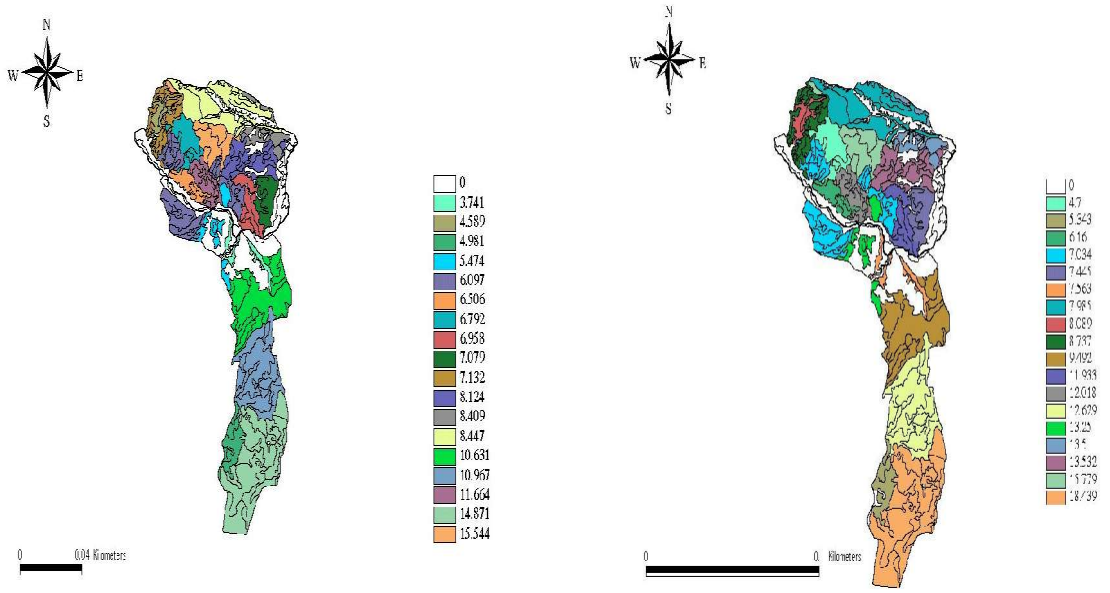

Figure 1.Soil loss, ton/ha/years 1989 and 2002

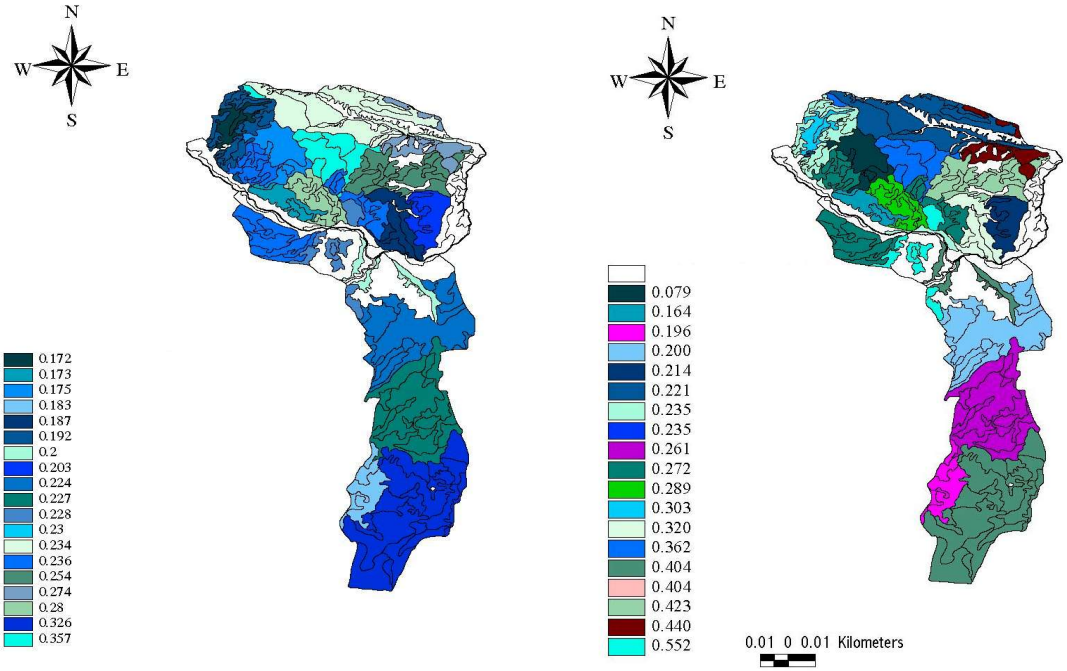

Figure 2. K Factors 1989 and 2002

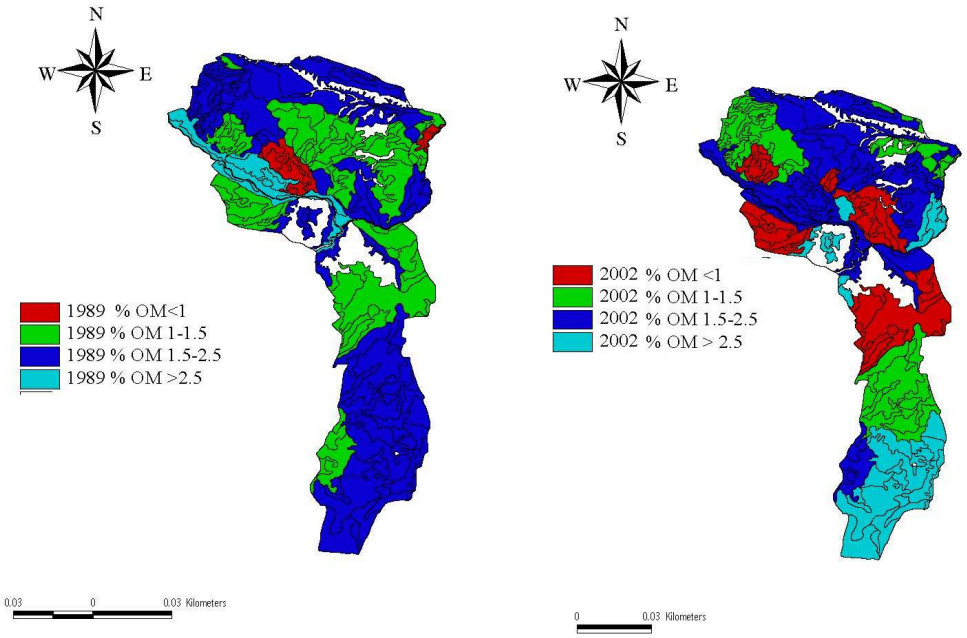

Figure 3. Organic Matter Levels Belong to 1989 and 2002

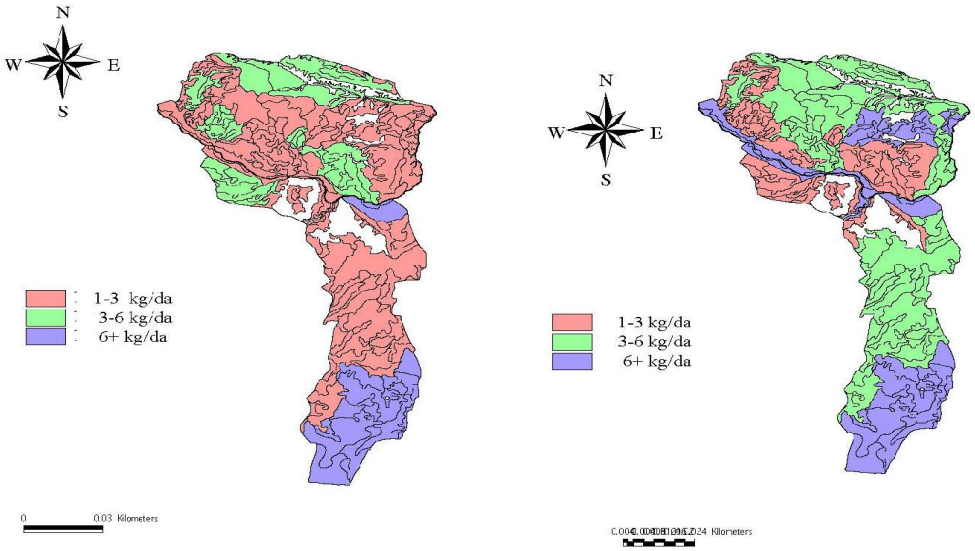

Figure 4. Phosphor Levels Belong to 1989 and 2002

Series Name	K factor 1989	K factor 2002	Soil loss 1989	Soil loss 2002	OM 1989	OM 1989	Phosphor 1989	Phosphor 2002	Potassium 1989	Potassium 2002
Çit Series (CT)	0.200	0.404	3.74	7.56	1.62	1.29	2.19	5.00	91	72
Tavukçuluk Series (TA)	0.236	0.272	6.10	7.03	1.18	1.97	1.41	1.60	201	85
İsletme Altı Series (IA)	0.172	0.303	4.59	8.09	1.35	1.75	3.44	5.60	55	91
Yaşlı Series (YA)	0.183	0.196	4.98	5.34	2.73	1.6	4.07	1.60	134	128
Sarı Sırtı Series (SA)	0.274	0.440	8.41	13.50	0.81	1.72	3.63	4.60	153	193
Uyku Tepesi Series (UY)	0.254	0.423	8.12	13.53	1.54	0.95	2.36	1.10	99	134
Çiftekum Series (CI)	0.203	0.214	7.08	7.45	2.05	1.29	1.38	1.10	91	83
Şeritler Series (SE)	0.234	0.221	8.45	7.99	1.59	1.45	1.62	3.70	116	116
Bahçe Arkası Series (BA)	0.192	0.235	7.13	8.74	1.35	0.83	2.31	3.40	72	99
Sığırcılık Series (SI)	0.187	0.320	6.96	11.93	2.02	1.14	3.00	3.80	125	153
Ağıl Series (AG)	0.173	0.164	6.51	6.16	2.27	2.12	3.19	1.60	153	171
Kumseki Series (KU)	0.175	0.079	6.79	4.70	2.15	1.66	6.90	5.40	402	153
Evcioğlu Series (EV)	0.280	0.289	11.66	12.02	1.48	2.24	1.69	11.70	193	201
İşletme Series (IS)	0.357	0.362	15.54	15.78	1.97	2.64	2.56	10.10	171	402
Höyük Series (HO)	0.326	0.404	14.87	18.44	1.41	1.78	2.38	4.60	85	125
Büvelek Series (BU)	0.224	0.200	10.63	9.49	2.03	3.54	1.31	2.40	99	91
Omohun Series (OM)	0.227	0.261	10.97	12.63	2.35	1.45	2.13	3.10	83	99
Purlu Series (PU)	0.228	0.552	5.47	13.25	1.15	0.37	2.50	1.10	128	55

Tablo 1 .Autochthon Series 1989 and 2002 years LS, K factor, Soil loss, Organic Matter, Phosphor and Potassium values

Generally, an outstanding improved condition in drainage was observed in the study area in 2002. Some conversions from very poorly drainage to imperfectly and well drainage associated with the decrease in water table were observed in some parts of Mezarlık series. In addition to improved drainage conditions, alkaline properties of the series disappeared in 2002. Changed drainage caused salts in the soil profile to tend to accumulate in a depth starting as from C_1 horizon of Mezarlık series. Salt level of 0.318 % in 1989 increased up to 0.759% in the same series in 2002. Similar drainage conditions was observed to prevail in the north part of the study area where İkinci, Üçüncü, Dördüncü pompa and Trafo series are located. As drainage conditions improved, salts tended to accumulate in the subsurface horizons. Salt level of 0.615% in A_2 horizon of İkinci pompa series in 1989 increased up to 2.54% in 2002. Although alkali-affected areas were reduced in size, problem seemed to persist in some phases, and some didn't reveal any sing of problem in 2002.Gypsium maintained its previous level in Trafo series in 2002, very little decrease was determined in the remaining soil series.

CONCLUSION

It can be concluded that because of topographic character of the study area which is apt to erosion, textural compositions (relative distribution of fractions in texture) of top layers and amount of some macro nutrients have changed and organic matter contents and have decreased within 13 years.

In order to implement a monitoring scheme, availability of a set of reference data, which developing countries usually lack is a must. To facilitate such a program, detailed soil data, preferably maps indicating soil variables at phases level are unquestionably indispensable materials.

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