COST Action FP0601
Forest Management and the Water Cycle (FORMAN)

Antalya, Turkey, 24-26 March 2010
IMPACT OF LAND USE ON WATER YIELD IN DARIDERESI WATERSHED

Ayten Erol
Suleyman Demirel University
Faculty of Forestry
Department of Watershed Management
Isparta/TURKEY
INTRODUCTION
Aim

- The aim of this study was to define guidelines for watershed management for Darıderesi watershed according to the previously established potential erosion problems of the area and works conducted by responsible bodies.
Objectives

- Resistance of soil to erosion in Darıderesi watershed was defined using erodibility indexes.

- They were evaluated according to water yield.

- The present land use of the watershed and the effect of land use on water yield in the watershed has been based on erosion indexes and technical works of institutions in the watershed.
Materials and Method

- Evaluative
- Statistical
- Comparative
Watersheds are importance to reserve natural resources for water yield.
Watershed management is essential to protect the use of natural resources.
Soil erosion can be defined as a process of detachment and transportation of soil material.
For the sustainability of the natural resources of the watersheds, it is of importance to determine the potential erosion problems in those areas.
The susceptibility of the soil to erosion, known as soil erodibility, depends on runoff and the soil resistance to particle detachment by raindrop impact.
When the soil’s cover of vegetation is wholly and partly removed from sloping land, rainwater runs off more rapidly with increased volume.
Subsequently, soil erosion outsets which then causes great damage to the soil and its remaining vegetation. Therefore, erosion index has been used in some studies for the assessment of soil stability for water yield in watersheds.
Darıderesi

- It is located in the South of Turkey, into the border of Isparta and near the border of Antalya
- It is one of 26 basins that are in Mediterranean Watershed and Lake Region
- One of the part of Isparta Creek forms water resource of the watershed.
Geographical Location of Darıderesi Watershed
Darıderesi

- Size: 2497.8 ha. A big watershed that is vulnerable to erosion in terms of topographical structures, vegetation and land use.

- Topography: Highland, high slope and high altitude.
Climate type of the research area: near the Oceanal Climate (insufficient moist, mezotermal, scarce water or short water).

Geological formation of watershed: Limestone, andesite, flysch, alluvial deposit.

Basic soil group: Brown Forest Soil.

---

Darıderesi

- Land uses include:
  - Forestland
  - Rangeland (often extensively destroyed and recovering forestlands)
  - Agricultural land (with Legume and Gramineae)

- Additionally, the total area include destroyed forest land of 41% and agriculture land of 17%.
Darıderesi

- Class VI area.
- No arable lands/restricted arable lands and woodlands.
- Shallow.
- However, the land is cultivated.
- HENCE there is a critical erosion problem in the area.

Slope of the land

- 65% very steep slope
- 24% slope close to the level
- 7% steep slope
- 4% mid slope
Aspect, height and slope of the land

- North - South Dominant aspects
- 1569 m Average height
- 57.7% Average slope
Darıderesi

- A dam for irrigation has been constructed in Darıderesi watershed.
- The construction work was started in 1995 and completed in 2009.
- Due to the topography of the land, no work has been carried out on the upstream of the watershed during the construction process.
- Moreover, the area had been misused; exposed to intensive and lasting erosion.
Dwelling

- There is just one residential area in the watershed: Darideresi Village.
- Isolated little village: has a population of only 100 and 50 houses.
LAKE REGION
Works Done for Darideresi Area

- **Institutions:**
  - Isparta Regional Directorate of Environment and Forests (ÇOBM-OGM),
  - Regional Directorate of State Hydraulic Works (DSİ).

- They are mainly responsible for afforestation, erosion control and increase water yield in the watershed.
The first work done by these institutions on the area was in 1969.

Since then, no significant work has been carried out, small attempts have been done by the institutions independently.

In 2003, a protocol was signed between the two institutions for watershed management in Darideresi watershed.
Collection of Data

Documents related to Darideresi watershed were retrieved from the abovementioned institutions which includes:

- Protocols between the two institutions
- Forest Management plans
- Reports regarding the construction of the dam
- 1:25,000 scaled maps and stand maps
<table>
<thead>
<tr>
<th>Land Type</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productive forest land</td>
<td>521.1</td>
</tr>
<tr>
<td>Destroyed forest land</td>
<td>190.8</td>
</tr>
<tr>
<td>Open land</td>
<td>1421.3</td>
</tr>
<tr>
<td>Destroyed coppice</td>
<td>277.6</td>
</tr>
<tr>
<td>Agricultural land</td>
<td></td>
</tr>
<tr>
<td>Destroyed oak coppice</td>
<td></td>
</tr>
<tr>
<td>Afforestrated land</td>
<td></td>
</tr>
</tbody>
</table>
Erosion indexes of the study field have been determined for analysing the effect of land uses on water yield.
The constant values of some erodibility indexes vs mean rates from the research area

<table>
<thead>
<tr>
<th>Dispersion rate (%)</th>
<th>Kolloid-moisture equivalent rate</th>
<th>Erosion rate</th>
<th>Clay rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;15 not resistant</td>
<td>&lt;1.5 not resistant</td>
<td>&gt;10 not resistant</td>
<td>Big clay rate means high erodibility of soil</td>
</tr>
<tr>
<td>39.45 %</td>
<td>0.53</td>
<td>95.09</td>
<td>7.69 %</td>
</tr>
</tbody>
</table>

Dispersion rates

- Dispersion rates in forest, agriculture and range soils were higher than 15%.

- Hence, soils were not resistant to erosion.
Erosion rate

- The soil is sandy because of the parent material.

- The erosion rates of range soil is higher compared to those of agriculture soil and forest soil.

- All land uses in the watershed, particularly range lands, were not resistance to erosion.
- **Forest soil** had higher level of moisture equivalent rate and organic matter than **agriculture soil** and **range soil**.

- Researches showed that the texture and organic matter amount have an impact on absorption of water, thereby on the moisture equivalent rate.
Clay rate

- High clay rate means that the moisture equivalent rate is high.

- The erosion resistance of soil increases when clay rate decreases.

- The vast amount of soil in the area have very high clay rates, but the erosion resistance of rangeland soil was smaller than that of forest soil.
Kolloid moisture equivalent rate

- The runoff was lower in forest soils than in agriculture and range soils.

- As an erodibility index, kolloid moisture equivalent rate indicates permeability of soil. If this rate is high, soil is more resistant to erosion, i.e., infiltration is higher but runoff is lower.
In conclusion,

- It was shown that forest, agriculture and rangeland were not resistant to erosion.
Vegetation type

- Varies both on the upstream and downstream parts, on northern and southern aspects.

- Below 1460 m, South aspect: Oak, Juniper, thorn apple and gramineous.

- Just on 1460 m, South aspect: Pinus nigra and Cedrus.
Vegetation type

- Above 1460 m: Pure Cedrus stand.

- North aspects: Pinus nigra and oak.

- In general, downstream of the watershed: often Quercus coccifera and Juniperus oxycedrus, (rarely Styrax officinalis Berberis vulgaris, Creteagus crategina, Rosa canina, and Prunus spinosa).
Results

- The results showed that the construction of the dam took quite a long time (1975-2009).

- Moreover, no sufficient measures were taken regarding the conservation of the vegetation of the land during construction.
Despite the protocol signed in 2003, the institutions did not act in accordance for the improvement of the area.
The watershed should have been managed for water yield of human factor, soil and vegetation.

Human resources (land use),

Soil resources (intensive and very intensive erosion),

Topographic structures (high slope and altitude),

Vegetation (destroyed forestlands) had poorly features in terms of water yield.
In the watershed, soil conservation practices were done.

Works done with the aim of erosion and flood control were not adequate.

whereas that was an obligation for the watershed.

Required organization process was not carried out by the institutions altought the area was dealt with for water yield with quality and quantity.
The institutions should have had a watershed management plan. 
or
The institutions’s works should have based on the watershed management approach.

In the future, the present land use will be negative effects on water yield.
THANK YOU FOR YOUR KIND ATTENTION!...