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Estimating the Water Conservation Value of Forest Ecosystems

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Introduction:

Forests are one of the most valuable terrestrial ecosystems that provide variable goods and services. There is no market value for most of forest ecosystem services. One of the most important functions of the forest ecosystems is regulation of surface runoff water in watershed by holding the water and its gradual distribution to the rivers. Unfortunately there is no significant real market value for these ecosystem services and usually these function are not be obvious until their disorder (*de Groot et al 2002*). However the role of forest in protecting water resources in countries with water resource constrain is more important (*Zhao et al 2003., Biao et al 2010*). To calculate the value of this function, it is necessary to estimate the forest contribution in surface water runoff controls, and then it is possible to calculate the value with using economic valuation methods. In this study a part of Iranian Caspian forest has been selected to determine this functions value. Caspian forests in north of Iran , with an area around 1.9 million hectares, have an unique features among world forests.

Methodology:

In this study, height and volume of the surface runoff in the current status of the study area (natural forest) was calculated with using Justin experimental methods.

$$R = \frac{K S^{0.155} P^2}{(1.8T + 32)} \quad S = \frac{H_{max} - H_{min}}{\sqrt{A}} \quad W = R.A$$

-In these equations:

R: Height of the runoff in the basin

P: Annual rainfall in the basin

T: Average annual temperature

K : Coefficient determined based on basin characteristics (in this study $k=0.1$ for natural forest, $k=0.12$ for degraded forest and $k=0.19$ for eroded pasture) (*chow et al 1988*).

H: height of the basin

A: Watershed area

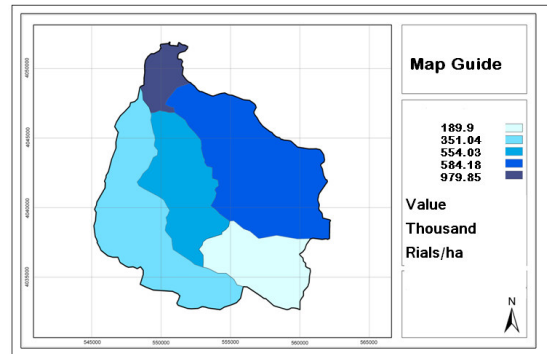
W: Volume of the runoff in the basin

Two scenarios have been defined including converting the forest area into degraded forest, and next into an eroded pasture. The amount of water that has been hold in each scenario was calculated separately. The value of this forest ecosystem function has been estimated by using replacement costs method. The replacement cost method uses the cost of replacing an ecosystem or its services as an estimate of the value of the ecosystem or its services. This method was used by Shabman & Batie at the first time in 1978(*Shabman & Batie 1078, Pagiola et al 2004*). In this study the cost of providing water for agricultural sector, has been used as replaced cost.

Results:

As you see on table, results indicate that converting the study area into degraded forest will make the amount of surface water more than twice, and changed into eroded pasture will make the amount of surface water more than six times. This means reduction in amount of water stored in underground water table. Also results shows that each hectare of the study area has a value as 102 Thousand Rials in conserving the water resources, compared with a degraded forest, and 464 thousand Rials compared with an eroded pasture. The map of this ecosystem service has been made by using geographic information system in each basin.

Hydrological basin	Area (ha)	Difference between runoff in natural forests & eroded pasture (Million M ³)	Water Conservation Value in each basin (Thousand Rials/ha)
1	21/1158	73/1	85/979
1-1	6120	45/5	18/584
1-1-1	56/3143	91/0	90/189
1-2	21/3919	31/3	03/554
1-3	51/6241	34/3	04/351
Total	49/20582	56/14	05/464



Conclusion:

As shown in Figure, this rate is different in several basins from 189 to 979 Thousand Rials. It should be noted that this value only includes use value of water in agricultural sector and it is not included non-use values, including inherent value, existence value and heritage value. Using other methods such as contingent valuation methods, can be provided to the disclosure of other aspects of the value of ecosystems, especially the non-use values and it can help estimating more comprehensive result in this area. Using Geographic Information System (GIS) in showing the results in a spatial form, cause more easier application of the results in local planning. The difference value in basins is due to structural differences in the ecosystem. So it is necessary, not rely on average estimations. It is important to note that Iran is in earlier stages of economic valuation of its ecosystems, so considering the differences in ecosystems structures, play an important role in increasing the reliability of results .

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