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The Pattern of Deforestation in an Oak Forest: Evidence of Forest Transition in Western Iran

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Abstract: *According to the forest transition theory, in industrially developed countries economic development, civilization and agriculture industrialization can dictate the patterns of changes in forest coverage. The forest transition theory has been proved in many western countries and a few developing countries such as China. In this study we tried to express the change of the forest coverage according to the forest transition theory in a part of western forests of Iran. We estimated the rate of deforestation in a mature stand of oak (Quercus brantti Lindl.) using aerial photographs of this area in 1955 and 1990. The results obtained from this study indicate a relatively low rate of deforestation of 0.16 percent annually. The possibility that this low rate of deforestation is due to the forest transition is discussed.*

Keyword: *Forest transition- Deforestation- Qurcus brantti - Western Iran- Chahar Zebar*

1. INTRODUCTION

The forest transition is an empirical regularity of long-term changes in forest cover that has been observed in a number of countries and large regions (Walker, 2008). Forest transitions have occurred in two, sometimes overlapping circumstances. In some places economic development has created enough non-farm jobs to pull farmers off of the land, thereby inducing the spontaneous regeneration of forests in old fields. In other places a scarcity of forest products has prompted governments and landowners to plant trees in some fields.

Alexander Mather coined the term 'the forest transition' to describe one of the first empirical generalizations to emerge from this work. Derived from historical studies of forests, this idea asserts that stocks of forests change in predictable ways as societies undergo economic development, industrialization and urbanization (Mather, 1990; Mather and Needle, 1998; Walker, 1993). A large decline in forest cover occurs; then the trend turns around, and a slow increase in forest cover takes place (Rudel, 1998).

In view of the significant detriment to the land and to socioeconomic conditions, forestry began to be regarded as a new chance to recover and renew rural areas. Thus, particularly from the mid-20th century, a number of policy tools, such as grants, premiums and subsidies have been developed and launched to make aforestation programmes socially attractive (Clinch, 2000). Forest transitions begin during a period of deforestation. Initially, forests decline in extent as growing numbers of cultivators, with help from loggers, clear forested lands and convert them into fields in order to meet growing demands for food and fiber from human populations that reside, increasingly, in cities. Eventually, agricultural expansion ends. Arguments about forest recovery after agricultural expansion take two general forms. In one line of argument, farm workers leave the land for better paying non-farm jobs. The loss of laborers raises the wages of the remaining workers and makes more agricultural enterprises unprofitable. Under these circumstances farmers abandon their more remote, less productive fields and pastures. 1 These lands then revert to forest. The loss of farm laborers stems from urbanization and economic development, what Polanyi (1944) has called 'the great transformation' (Mather, 1992). The concept of 'forest transition' was proposed to describe national or regional shifts from net deforestation to net reforestation that occurred in many temperate countries over the last centuries (Mather & Needle, 1998; Rudel et al 2005). A few cases of forest transitions in tropical countries have also been identified, mainly in Latin America (Grau et al 2003; Klooster, 2003; Perz & Skole, 2003; Baptista & Rudel, 2006; Hecht et al 2006).

Forest transition formed as a project with economic development in west countries and this process has taken almost a long time from middle 19th century to last decade of the 20th century. Rudel (1998) propounded two main reasons for the transition. In the first stage, after fast decrease of the forest, the value of forest production would be increased, so plantation would be suggested. In addition, with increase of life level and city dwelling development, some rural have left villages and they consume wood fuel fewer. Some evidence was propounded for confirmation the theory in various European countries like Scotland, Denmark and China (Rozelle et al 2000, Zhang et al 2000). On the basis of prepared information by Food and Agricultural organization of UN in 1990, %38 of world countries have shown increase rate of its forest growth that may be have sign of forest transition completion in the country (Rudel, 2005). Data from the latest Forest Resources Assessment (FAO, 2006) showed a net increase in forest cover between 1990 and 2005 in four Asian countries: Bhutan, India, China and Vietnam (Kauppi et al 2006; Mather, 2007).

In order to study forest transition theory in Kermanshah province, historical reports, remains of old trees, paleontology studies and aerial photography were investigated. Acquired result by Wright in field of vegetation ecology shows that vegetation of Zagros region was as step from 14800 years ago with gradual withdrawal of glacier in the late of Pleistocene period (VanZeist and Wright, 1963). This growth change to Savan like growths about 13000 years ago and by climate warming and damping, Savan has change to Oak forests about 5500 years ago. At this time climatically conditions are provided for Oak forest development (Meymandi Nejad, 1974). Remained small thickets have united coverage that had covered through out the Zagros to some years ago. Natural growth of trees had remained as untouched in number of villages of Paveh and Euramanat Zone, Ravansar and Gahvareh in Kermanshah province and large zone of graveyards at Kurdistan province. in view of ecology, the trees in various zones of Kurdistan and Kermanshah are important from different aspects and have contained information which could have answerable of technicians in various field, like succession, climax vegetation, especially past of oak forest (Sharifi, 2000). In collecting statistics of forest, it's important that pay attention to forest level determining of a zone and variety kinds. By help of aerial photos could measure forest area (Zobeiri, 1971).

2. MATERIALS AND METHODS

Investigated zone, Chahar Zebar, is an open wood land zone and habitat of *Quercus brantii* that has area about 10035 ha. and located in the south west Kermanshah province and has longitude about 46 degree and 39 minute to 46 degree and 49 minute and latitude about 34 degree and 9 minute to 34 degree and 14 minute and the zone height is 1700 and 2155 from sea level too.

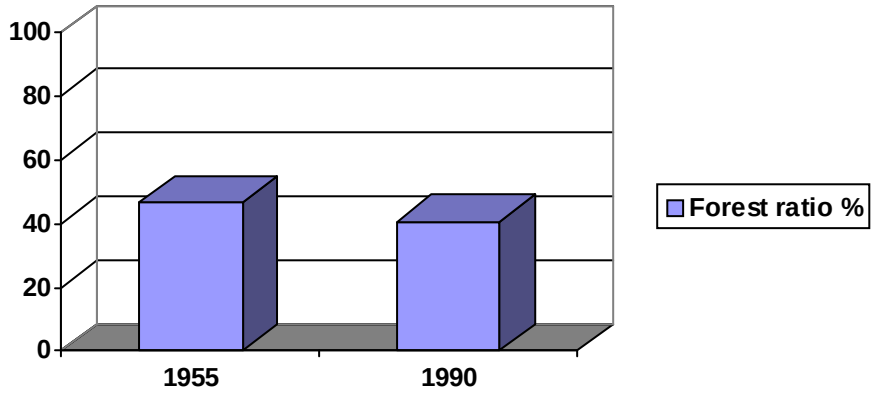

Fig.1. *Forest lands ratio percent in the year 1334 and 1369*

By estimate the rate of deforestation in a mature stand of oak (*Qurcus brantti* Lindl) using aerial photographs of this area in 1955 and 1990. Useable procedures in the examination performed according to Zobeiri (1971) procedure. After restriction of zone limits and preparing photos for sight and use of calculated level for each photography period, was separated border of forest and nonforest zone each other by putting a clear sheet for purpose of drawing kind of forest and nonforest lands by mentioned aerial photos (Figures 1, 2). Then Planimetri and determining proportion of kind of mentioned forest lands and estimation changes rate of forest level with comparison obtained areas was performed by each of photography projects.

3. RESULTS

3.1. Woodlands Changes During Examination Time

Woodlands changes in the investigated limits are as follow:

By use of the formulate, $E = P_j \pm Sp_j$, E = %46/6 ± 3/1 find out that about %95 of the investigated limits with approximate area 4676 hectare is covered with forest in the year 1334 and the area of forest have decreased to 40.7±3.1 with approximate area 4084/240in the year 1369.

Average of woodlands had confronted to area decrease with approximate area 602 hectare consist of 17/2 hectare annual mean from 1955 to 1990. Therfore average of demolition percent and change of forest lands to nonforest lands is about 17/2 hectare in the zone.

Purpose of the studies is adapting examination of decrease rate of trees growth with forest transition theory from 1334 to 1369.In the studies was assumed that annual rate is about zero and so human effects decrease provide conditions for second reconstruction of forest.

Determining the changes specified purpose of the studies on the basis of reliable documents like aerial photos in 35 years period. Data of these studies by related photos to aerial photos of Iran registered at Natural Resources Office in title aerial photos project 34, 69.

3.2. Woodlands Changes in Mentioned Temporal Interval

Changes of under cover areas of any kinds of lands (including forest, Rangeland, agriculture, etc.) Shown in the below table1:

Tab. 1. *Changes of under cover areas of any kinds of lands Changes of under cover areas of any kinds of lands*

Year of photography	**The area of each type of lands**			
	Forest	Rangeland	Agricalture	Other
1955	4676	3221	1777	361
1990	4074	2107	3382	472
Changes of areas	602-	1114-	1605+	+111

by attention to above table, in addition to decrease of mentioned woodlands , pasture lands have decreased about 1114 hectare with 1/8 hectare annual mean and agricultural lands have increased about 1605 hectare and 46 hectare annual mean and so other lands have increased about 11 hectare with 3 hectare approximate mean in year. Therefore could have understand that forest lands change to pasture lands firstly and pasture lands which have better position change to agricultural lands. Changing amount to other lands like road, installation or lands bereft of trees provided by under cover lands of natural growth (Figure 2).

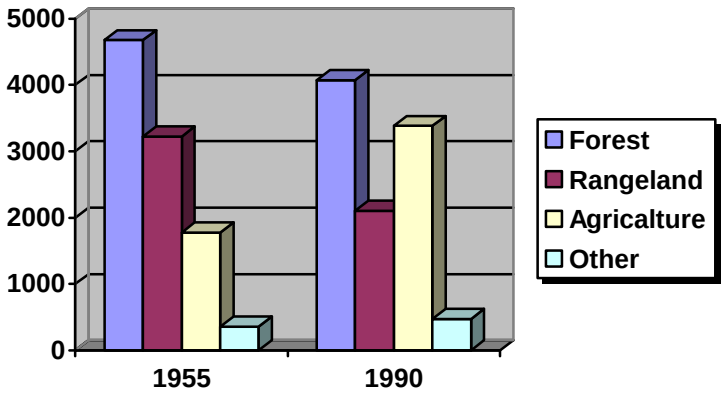

Fig.2. *Changes of area in each type of lands*

3.3. Changes Comparison of Forest Areas by Drawing Kinds of Forest and Nonforest Lands in the Mentioned Limits by Aerial Photos

Forest areas difference is equal to 641/6 hectare and on the average in 35 temporal interval was decreased about 18/33 from forest lands and added to nonforest lands annual.

In other words demolition and changing rate of forest lands of this zone is equal to 5/95 percent in 35 years period and in one year is equal to %/17. In the table 4 has shown that there weren't many difference in each of procedures for estimation forest and nonforest areas.

Tabel 2. *Comparison of two method of estimate of forest and nonforest lands*

	Changes of forest land ha	*Anually decrease of forest lands ha*	*Deforestation rate in 35 years*	**Anually deforestation rate**
The First method	602	17.2	%6	%0.16
The Second method	641	18.33	%5.95	%0.17

4. CONCLUSION

According to the forest transition theory, in industrially developed countries economic development, civilization and agriculture industrialization can dictate the patterns of changes in forest coverage. It is now known that in 18 and 19 centuries, the primary economic and social development has caused an intense reduction in forest coverage. Following a rapid deforestation a slow increase in forest vegetation has been observed. This theory has been proved in many western countries and a few developing countries such as China. In these countries economical transition with the reduction of forest coverage has been taken about 1 to 2 century after which the deforestation has been stopped in last 2 to 3 decade in twenty century and after that, there was an increment in forest coverage.

Matter theory (1990) indicated that changes in forest coverage is together with social changes. In primary stage of social development, forest coverage diminished quickly but forest coverage will be increased slowly after social – economic development and demand decrease for wood as important energy source.

On the average at a 35 years period (from 1955 to 1990) forest coverage 602 hectares and annual average 16% that including annual average 17/2 hectares had area decrease 6%. Therefore percent average of forest coverage demolition to nonforest coverage equal 17/2 hectares at the period. It's small quantity in comparison with demolition rate of world wide. According to global bank report, annual average of forest demolition in low income countries with annual growth 5% equal 48343000 km and countries with middle income and annual growth 1% equal 42278000 km. However in 1990 to 2005 high income countries (European countries) haven't forest demolition as well as have annual growth 1% and forest growth equal 7137000 km.

Estimated rate of forest demolition in Chahar Zebar is about demolition rate of other Iran areas. It's like study that performed in Nave Asalem and indicated north forest area decreased about 4% annually (Zobeiri et al. 1984). Tavakoli studied quantitative and qualitative changes of Kermanshah, Ahooran and Hezarkhani forest and concluded to have decreased about 1/15% annually (Tavakoli 1996). Mahdavi studied quantitative and qualitative change of Mankro forest of Harra between Geshm and Khomeir port and concluded that area of the forest was 8026 hectares in 1967 and decreased to 8016 hectares in 1994 (Mahdavi et al 2002).

There aren't accessible studies of forest demolition in western areas, but there are testimonies that indicated important changes arising from western forest exploitation in recent decades. Can conclude that forest coverage change into pasture coverage after gradual demolition then pasture coverage with better situation change into agricultural coverage easily. Transformation rate to other areas like road, installations or areas without coverage provided from natural coverage areas. Ecological studies in Chahar Zebar area indicated it have slope between 40% - 80% (khanhasani 2006) which suitable for plough and change into agricultural areas but other areas are virgin lands because steep incline between 20% - 80%. Thus foresters haven't tendency toward demolition it. Consequently there is a few forest lands that suitable for farming. The changes as theoretical model of forest transition process illustrated in Fig. 3, which indicated quick decrease of forest coverage and gradual reforestation.

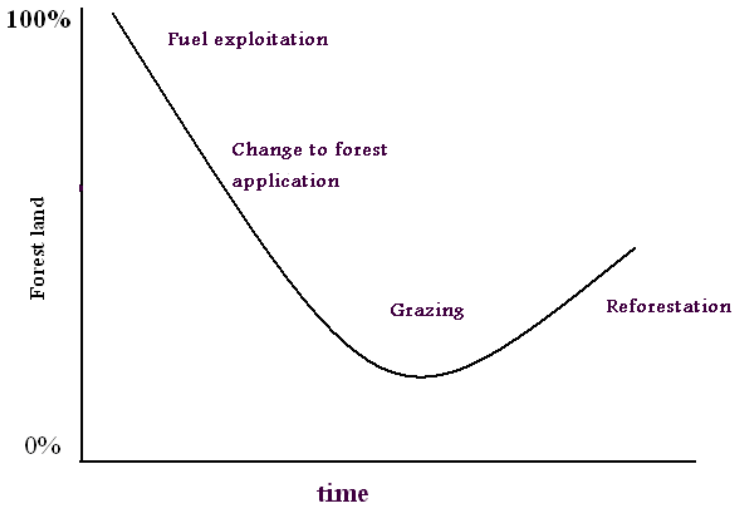

Fig. 3. *A theoretical model of Forest transition process*

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