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**[Research]**

# Processes of forest products and production costs in Guilan forests, Iran

**R. Naghdi*[1], A. Bonyad[1], H. Maskani[2]**

*1- Department of Forestry, Faculty of Natural Resources, University of Guilan, Somehsara, P.O. Box 1144,Iran.*
*2- Environmental Research Institute of Jahad Daneshgahi, Rasht, Iran.*

** Corresponding author's E-mail: rnaghdi@guilan.ac.ir*

## ABSTRACT
This research was conducted in the west forest of Guilan, northern Iran. Data from various harvesting methods for 20 years were collected. Results showed that, productivity rate of round wood, pulp wood and fuel wood has had an upward trend, while rate of traditional products (lumber, sawn wood, charcoal, etc.) has had a downward trend. Production cost has been investigated in this research. The results showed that, the main cost is the opportunity cost. Due to the disability of competition between the domestic wood price with the imported wood price, domestic wood industries will face serious investment difficulty in the future.

**Keywords:** forest products, productivity rate, traditional products, industrial products, Guilan province, Iran.

## INTRODUCTION
Forests have a large number of advantages including watersheds protection, soil conservation, microclimate stabilization and carbon source and so on. According to the reports by FAO in 1999, 13.7 million hectares of the natural forests in the developing countries has been decreased from 1990 to 1995 to. The most important reasons for increasing forests destruction in these countries were inefficient management and lack of using appropriate methods and technologies of logging. Wood material is utilized and exploited by different ways and follows a long process to supply to the consumer in Iran.

Regarding to the high wood demand and low area of commercial forests, it is important to have an appropriate plan to consume this source. In this manner, changing forest products from traditional system to the industrial system will increase the economic value and also decrease damage to the forests. On the other hand, the analysis of wood production cost and evaluation of different economic parameters of market price are effective steps towards advancement in programming affairs of fore st management. Since the costs of wood production allocate the main part of cost in a managerial unit of forest, to optimize production we must know how much cost involved in profit and loss is associated with wood production and how much is related to other parts, the calculation and analysis of the current production is required in this regard.

Lohmander (1987) investigated the time series of stumpage prices in Sweden, Norway and Finland. Baumgras *et al.*, (1993) have used a computer simulation called SIM – GB to provide a model for determining products from exploitation and its current rate. Howard (1995) estimated price trends for stumpage and selected agricultural products in Costa Rica. Carter and Newman (1998) examined the impact of reservation prices on timber revenues from federal timber sale auctions in North Carolina from a game-theoretic perspective by recognizing the effect of competition on optimal bid strat-

egies. Linden and Uusivuori (2000) investigated the stochastic properties of timber prices in Finland during the period 1900 to 1995. Andersson and Eliasson (2003) by providing a model for assessing performance of forest productivity system introduced some variables like size and number of logs, transport distance, topography and personnel's skill as the most effective factors in forest logging system.

In Iran, wood production, according to the rule of forestry plan provision which has been implemented since 1963, has had a deterministic schedule. Therefore, each compartment has a fixed and unchangeable wooden production and the companies have to follow the schedule in order to harvest the forests. Hence, the only way for increasing profit in the Iranian commercial forests is decreasing the harvest and production costs. Recently, a few study has been made regarding to the production cost assessment, felling, bucking, primary transportation, loading and secondary transportation in northern forests of Iran. Bonyad (1989) evaluated the allocation rate of costs on cutting production and estimated the price of each cubic meter of produced wood in west forests of Guilan.

Naghdi ( 2004) has studied the assessing performance of wood extraction in two methods of tree length and cut to length logging in Neka forest (northern Iran). His results showed that the production costs of each cubic meter of wood in tree length logging method are lower than cut to length method. Heshmatolvaezin (2000) estimated the rate of return in the investment at private and governmental forest harvestings in the north forests of Iran. He concluded that both methods are conditionally rejected in present situation. Mohammadi Limaei and Lohmander (2007) studied the trend of timber prices and harvesting costs in Iranian northern forest. They suggested an autoregressive model for prediction the future timber price and harvesting costs.

In this study by collecting the required data, change in processing of forest products in Guilan forests over a 20 year period was investigated. Production costs also have been studied for industrial products such as round wood. Finally by evaluating production rate and production costs over a 10 year period and including annual inflation rate, lowest possible cost was reported and the rate of opportunity cost was predicted for the following year.

## MATERIAL AND METHODS

### Study area

This research was conducted in forests of Guilan and the region of Shafaroud. In order to study changes in processing products of different logging methods in forests of Guilan during two decades (1977 - 1997), report of Forests, Rangelands and Watershed Organizations of Iran (FRWI) about the harvesting performance has been used. The forests under supervision of Shafaroud forest company with an area of 150000 hectares were chosen for estimating the production cost. These forests has expanded from sea level to higher elevations and have planted and natural forests. Therefore, it is typical to the Iranian commercial forests. In addition, it has different sectors and units such as forest harvesting, road construction, forestry, reforestation and administrative sectors.

### Methodology

In this research, collected data from ledger and cards of industrial and financial accountancy over a 10 year period (1990 – 2000) has been considered for estimating of production cost. Thus information such as direct labor costs, additional production costs, road contraction costs, reforestation and planning costs, taxes and stumpage costs, previous goods and produced goods supply has been collected. Then the classified costs were divided into three categories.

1- Primary materials costs: taxes and stumpage which are paid for logging operation.

2- Direct labor costs: personnel's labor costs who participate in felling, bucking and wood transportation.

3- Additional costs: indirect costs which are paid for production process, such as planning, road construction cost, reforestation and depreciation cost of machines, equipments and etc. In order to examine the production cost situation, two issues are necessary. First of all the costs for different years have to adjusted to a base year. Consumer price index was used to deflate the costs for the base year of 1998 (equation 1). In order to have an appropriate criterion of comparison, deflated costs based on

equation 2 were compared with the year 1998. Then the adjusted costs were compared in percentage to the cost of base year. Production rate has also been compared to the year 1998.
Equation (1):

$$i_t = \frac{a_t \times 100}{\gamma_t}$$

$a_t$ = cost in year t.

$\gamma_t$ = Consumer price index in year t.

$i_t$ = deflated cost to the base year 1998.

Equation (2):

$$k_t = \frac{i_t \times 100}{i_{(1998)}}$$

$k_t$ = percentage of change to year t.

$i_t$ = deflated number to the base year 1998 in year t.

$i_{(1998)}$ = deflated number in year 1998.

Exponential adjusting method in time series of Manna has been used to study long term process of production cost as to be able to eliminate the fluctuations influenced on economic process in a special period. At last examining process of expense elements and production cost over different years, the lowest cost during study periods was chosen as a base cost. Excel software was used and mathematical models for each parts of production cost was developed; such a model was chosen which had the highest $R^2$ and in Durbin - Watson test, had negative correlation errors. Then it was determined as an effective model in F - test.

## RESULTS

Analyzing the data of forest products in Guilan province during 1977 to 1997 showed that the production of round wood, pulpwood and fuel wood has had an upward trend, while traditional logging products, e.g. lumber, sawn wood and charcoal had a downward trend (Figure 1).

However, round wood production has increased from 12.8 % in year1977 up to 27% in year 1997. Lumber production has decreased from 28.5 % in year 1977 to 4.9 % in 1997.

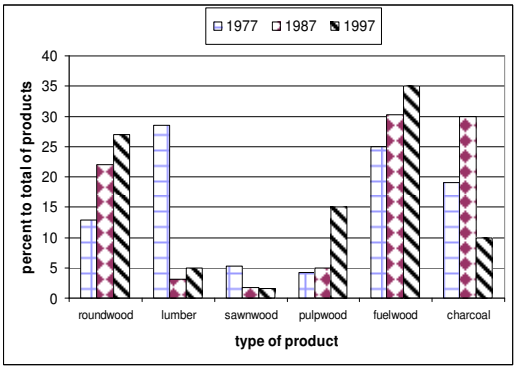


**Fig 1. Process of change in forest productivity in Guilan province during the years 1977 to1997.**

The first step in determining production cost of industrial products (round wood, pulpwood) is required to adjust the costs. Hence the production cost during the study period has been deflated to the base year of 1998 (table 1).

Manna time series method was used to evaluate long term process of production cost deflated to 1998 (Figure 2). In subsequent steps, in order to compare the production cost of elements with production, first these elements have been defined and the costs of each one have been estimated, then by calculating the percentage of production cost of elements, long term process of each element has been estimated by time series method of Manna and compared to the percentage of production.

The production percentage of stumpage cost, wage cost, road construction cost and reforestation cost as well as the percentage of long term trend and percentage of production compare to the year 1998 are shown in figures 3 to 6. Therefore it was possible to find the lowest cost of each element as a base cost during the period.

**Table 1. Production cost discounted to year 1998.**

| year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production Cost (Rial/$m^3$) | 181490 | 196080 | 178490 | 188180 | 166130 | 132740 | 206160 | 210580 | 229420 | 177180 | 174990 |

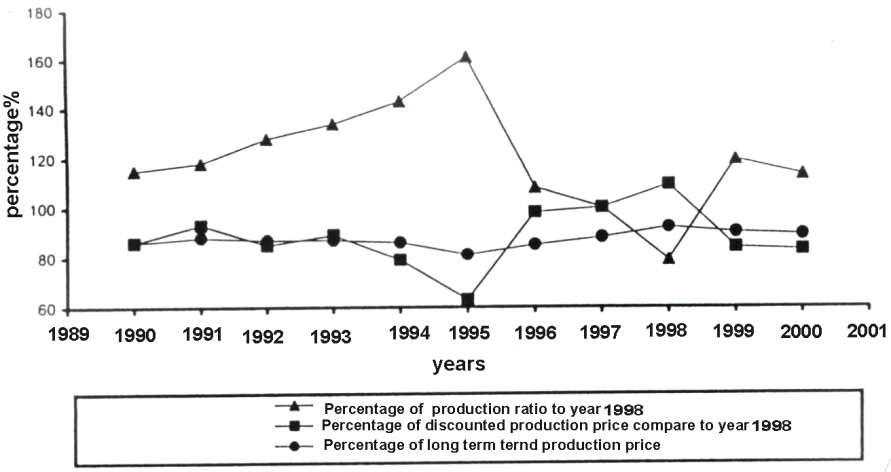


**Fig 2. Comparison of production cost, long term trend, and percentage of production.**

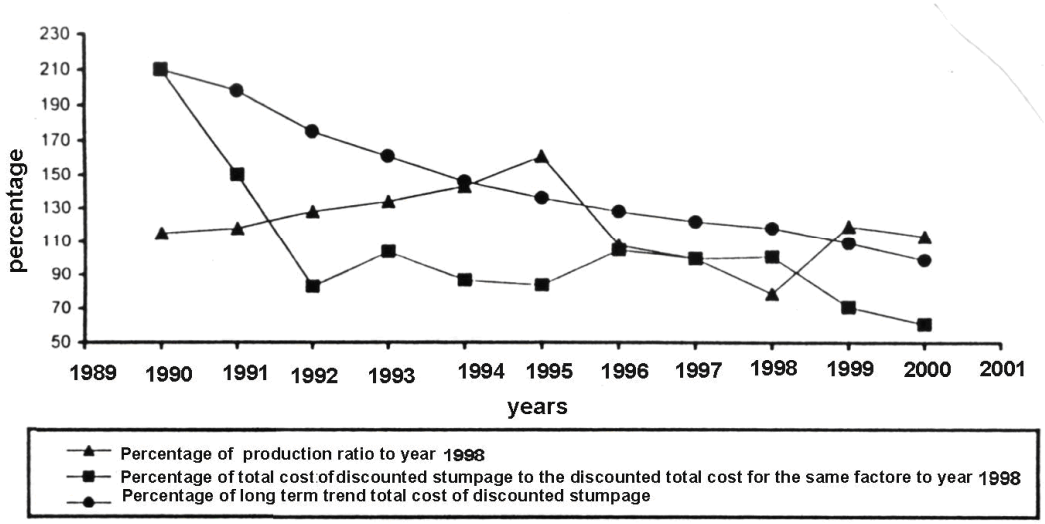


**Fig. 3. Comparison of percentage of discounted cost of stumpage, long term trend, and percentage of production.**

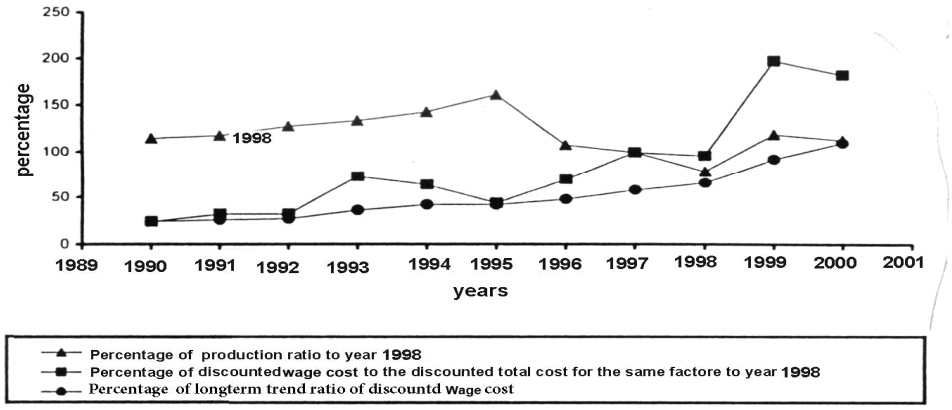


**Fig 4. Comparison of wage cost percentage, long term trend, and percentage of production.**

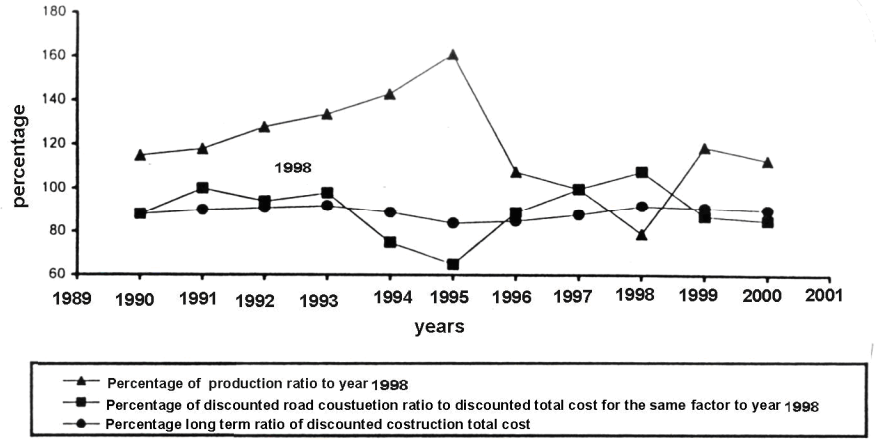


**Fig 5. Comparison of percentage of road construction cost, long term trend, and percentage of production.**

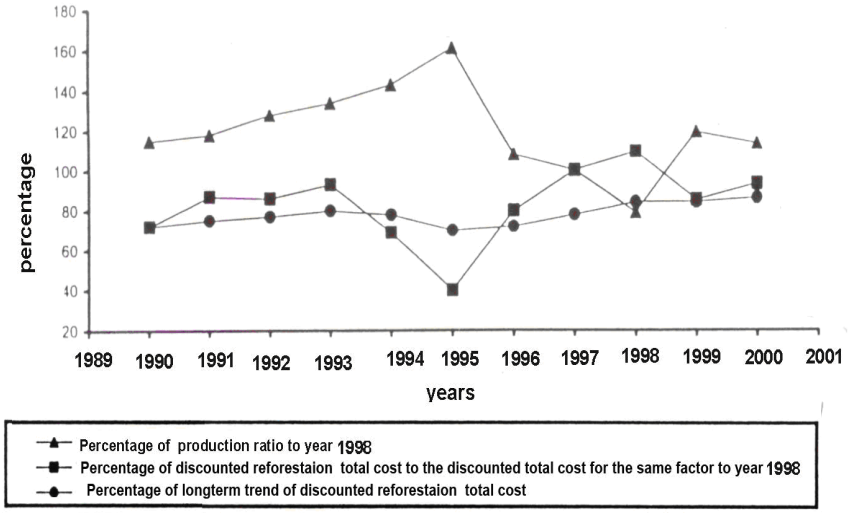


**Fig 6. Comparison of percentage of reforestation cost, long term trend, and percentage of production**

In addition, for predicting the average production cost of each items in appropriate and inappropriate conditions, first of all some models have been fitted in each element and a model was chosen that had the highest $R^2$ and in Durbin - Watson test, had negative correlation errors. Then it was determined as an effective model in F - test.

Table 2 and figure 7 show the parameters of regression model of production with ANOVA table and line fitted to the production table. Table 3 and figure 8 show regression model of ownership interest. Perdition of production cost under different conditions has been predicted (Table 4). Finally by examining the under study factors and determining the costs of each element in the following year, these costs have been compared with the base cost of each element and opportunity cost rate has been estimated.

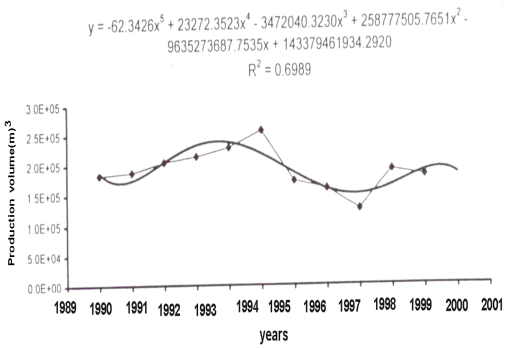


**Fig 7. Justified line to the production curve.**

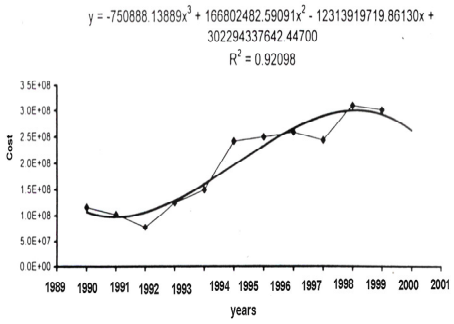


**Fig 8. Justified line to the stumpage curve.**

## CONCLUSION AND DISCUSSION

The results showed that industrial logging process has been increased from 1977 to 1997. It was obvious change in the productivity process of forest productions. This could be the results of application the new technology in logging and expanding the road network. It also could be the results of changing of wood consumption due to establishing of wood mills in the region, applying the new policies of FRWI regarding to the extraction of logs and lack of issuing the permission of charcoal furnaces. There was an increasing process in the production of round wood, pulp wood and fuel wood and a decreasing process in the production of lumber, charcoal and sawn wood. The reason could be attributed to the factors like changing the way of wood consumption, introducing fossil fuel as a substitute for timber, increasing technological power and enter the powerful machinery to the forest and higher added value of log compare to the other productions. Assessing production cost of industrial productions (round wood and pulp wood) over a indicates its obvious changes during the period.

In 1995, there was a significant decrease in production cost, in this manner by increasing 17% in the productivity, there has been a decrease of 16 % in the production cost. This showed that a noticeable decrease in production cost was not in the cause of centralization of labor force, rather it was due to increase of productivity.

During the years 1996 to 1998, we observed 53% of productivity decreased and 35% increase in production cost. During 1999 to 2000, there was relatively stable trend in production cost. The study of long term process of production cost indicates that 2% of production rate has been increased. Results showed that the labor decreasing had not significant effect on decreasing the production cost. The result showed that the wage cost has higher opportunity cost than the other costs. The next higher opportunity costs were reforestation and road construction, respectively. Since forest production activities have been done in a certain season and possession of heavy machinery which is used yearly causes to impose high opportunity cost on the production process.

Finally we can conclude that forest production in Iran is not profitable due to ignoring the wood production costs. Therefore forest production will be decreased at the near future due to inability to compete with the other investments at the country. Hence, we suggest that the forest companies have to take care about the production procedure in order to choose a profitable method to reduce the production costs.

**Table 2. Regression analysis of production results according to ANOVA test.**

| Source | SS | df | MS | F | $F_{(table)}$ |
|---|---|---|---|---|---|
| Regression | SSR=8569817279 | 1 | 8569817279 | 20.02 | 5.12 |
| Error | SSE=3704646134 | 9 | 411627348 | | |
| Total | SSTO=$1.227E_{10}$ | 10 | | | |

**Table 3. Regression analysis of stumpage results according to ANOVA test.**

| Source | SS | df | MS | F | $F_{(Table)}$ |
|---|---|---|---|---|---|
| Regression | SSR=$6.628E_{16}$ | 1 | $6.628E_{16}$ | 104.90 | 5.12 |
| Error | SSE=$5.686E_{15}$ | 9 | $6.318E_{14}$ | | |
| Total | SSTO=$7.1966E_{16}$ | 10 | | | |

**Table (4): Prediction of studied factors in different condition.**

| Road construction | wage | stumpage | production | Other Costs | Forest Management Planning | Reforestation | Condition |
|---|---|---|---|---|---|---|---|
| 13220508506.58 | 1698493411.39 | 261921523.69 | 184110.23 | 1329185120 | 186667140.84 | 19837536680.73 | Desired Condition |
| 1166299245.08 | 1350436356.93 | 1942.8852.14 | 238762.81 | 1193542779.96 | 16782085.13 | 1806542564.49 | Undesirable condition |
| 1474717768.07 | 2046550465.85 | 3296341195.24 | 129457.65 | 1464827460.04 | 2054626196.54 | 2160964796.96 | Normal condition |

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