

Forest Engineering in Iran; Background, Education and Looking Forward Ten Years

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Abstract:

The objective of this paper is background of forest harvesting, development and prediction of forest engineering and forest engineering education in Iran. Techniques in forest engineering must not be transferred directly from developed countries. They must match existing social, economic, and physical conditions. In Iranian temperate Forests, the importance of forests in supplying non-wood forest products such as water and soil protection, climate adjustment, ecotourism and wildlife is more than others and need to be considered when decisions are made about forest engineering activities, such as road construction and forest harvesting. Forest operations, as an important part of integrated forestry, should be planned from the point of view of sustainability of both timber and non-timber forest products. It is evident that a concerted effort is needed to encourage forest development programs that harmonize interests in conserving forests as well as to wisely use the potential of the forest while maintaining its full regeneration capacity. All forest engineering activities, such as forest resource surveying and harvesting planning, forest road planning and construction, harvesting, post-harvesting site disposal, planting and protection and so on should serve the key purpose of sustainable forestry. In view of the forest quality decline in Iran, it is essential that forest engineering practices are carried out in a manner to guarantee the sustainability of the forest resources base.

Keywords: forest engineering, development, Iran, looking forward.

1 Introduction

Over the years, the forests of north of Iran have seen several different timber and wood/pulp harvesting systems. Until 1958, all felling and bucking was done with axes and hand saws and all skidding was done with mules. After that, chainsaws, 4-wheel-drive rubber-tired skidders, crawler tractors (bulldozers) and crawler skidders began to replace axes, handsaws, and mules. The following will describe and discuss these harvesting systems, all of which are still in use in Iran.

Nowadays we know that forests have multiple-functions. They not only provide timber as raw materials, but also protect such resources as water, soil, and the ecosystem. From an overall point of view, the protection functions of forests, especially in mountainous areas, are extremely important to humanity. Due to the extensive destruction of forests in mountainous areas, there is a risk of serious environmental consequences such as reduced water supply, decreased agriculture production, increased soil erosion and flooding, instability of mountain hillsides and adverse impact on climate conditions.

According to the latest survey of commercial forest in north of Iran in 1997, the total forest area is 1.9 million hectares of broadleaved (mixed hardwoods species: beech, oak, hornbeech, maple, ash ...). Now in Iran, the classical system to harvest hardwoods is: 1. motor manual felling, delimiting and bucking at the stump, 2. extraction with cable skidders or traditional skidding by mules, depending on the slope and road network.

1.1 What is forest engineering?

Forest engineering is a hybrid of engineering, forestry, and management. Forest engineers are unique people who can combine skills to solve problems in the natural environment, with a focus on the forested landscape. Forest engineers have broad knowledge and solid technical competence.

Forest engineers are adept at solving problems that arise in the competing environments. In conservation forestry there is tension between ecological and societal needs. In plantation forestry there is tension between economic, societal and environmental requirements. It takes a person with a deep understanding of the situation and strong technical skills to make sensible decisions.

A forest operation is a complex system of people, equipment, and methods to implement management prescriptions within physical, ecological, economic, and social constraints. Therefore, the research approach is also complex, integrating basic scientific disciplines of engineering, forest ecology, silviculture, human science, economics, and forest products. We must build on this underlying science and knowledge base to develop and apply innovative technology and better management of machines and systems to improve performance.

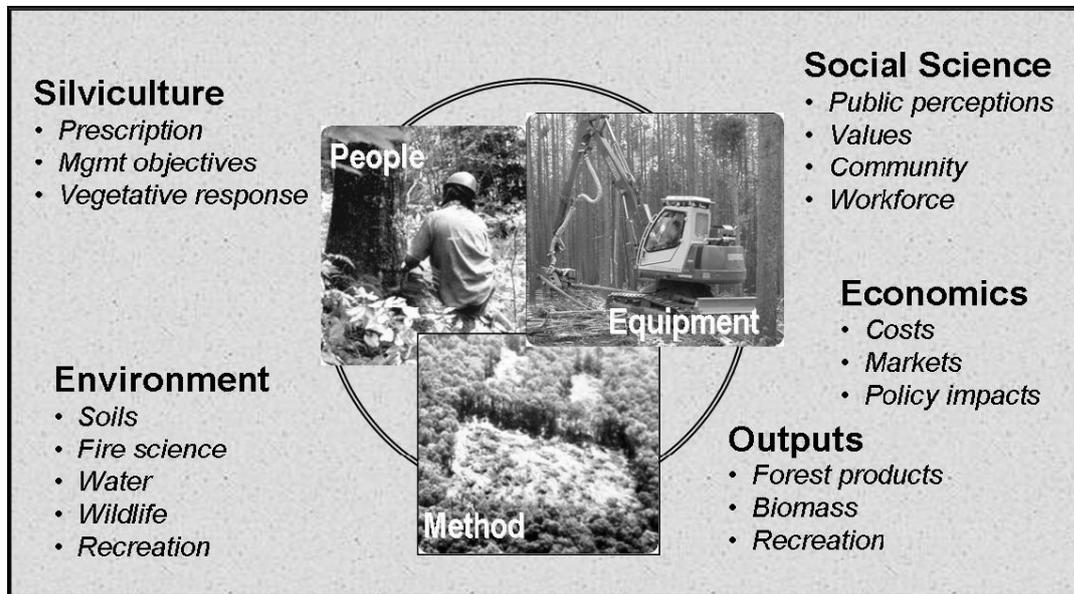


Figure 1: Choosing machinery should be based on some approaches

2 Recognizing of northern forests of Iran

The northern forests of Iran which is called Hyrcanian forests, Caspian forest or northern Alborz mountain forest with length of 800 km and width of 20-70 km is extended on southern margins of Caspian Sea. These forests are residue of third geology period or Tertiary period. According to existence official data (2004) it can be described that the area of northern forest of Iran is 1.87 million hectare. 1.2 million hectare of this forest is commercial and the rest are categorized as protected forests. These forests are rich of the number of tree and shrub species. Approximately 80 tree species and 50 shrub species are naturally found in these forests. These forests are very similar to broadleaved forests of central Europe and north of Turkish and Caucasus.

These forests are only a single source of wood production in Iran and the forest engineering branch was initiated and developed in these forest. The most important of these reasons are:

⇒ its high value from commercial point of view,

- ⇒ its high fertility from site ability point of view,
- ⇒ high density of trees and high volume per hectare,
- ⇒ diversity of species with industrial wood,
- ⇒ population density at the edge of these forest,
- ⇒ planning and construction of forest roads with high density and etc.

3 Forest engineering in Iran

Until 1963, the economy in Iran was a traditional system. All forestry enterprises were private and carrying out their forestry activities according to their desires.

In forest operations, almost everything was introduced from Germany and the United States, including cutting systems and harvesting systems. The clear cutting system took the place of selection cutting, regardless of the physical conditions. The Russian crawler skidder Zetor (Figure 2) and Romanian TAF rubber tired skidder (Figure 3) were introduced to replace animals and labor in extraction of timber.



Figure 2: Rubber tired skidder (TAF)



Figure 3: Crawler skidder (Zetor)

The main advantages of skidders are their speed and ability to operate under all but the most adverse conditions. Therefore, they are the lowest-cost harvesting systems. The principal disadvantages are the relatively higher levels of damage to residual stands and skid roads, plus increased soil compaction. However, these disadvantages may be minimized or even eliminated when the equipment is run by a careful operator who carefully plans his hitches and skid roads, and avoids skidding when soils are wet (to reduce soil compaction).

Regarding to broadleaved trees in Iran and their branches, there is a lot of small pieces of round wood after logging. Farm tractors are using for smaller pieces of wood such as bolts and some residues diameter limited to 5cm. These tractors are working after logging by skidders, whenever the extraction of small wood by skidders is not commercial.

Many European skyline gravity systems “WYSSEN” for shelter wood system and three high lead systems “MODIL” for clear cutting were used in 1975 to 1996.

Like many other developing countries, Iran is characterized by: 1) the ample availability of cheap labor; 2) the expensive machinery cost; 3) lack of funds for forestry activities and road building; 4) lack of experts and maintenance and repair facilities for advanced machinery.

Temperate and steep forests and these characteristics determine that the forest harvesting technology in Iran should match its existing social-economic and physical conditions, but not the same as in the industrialized countries for the time being. A significant part of research work was carried out on design and development of advanced equipment, while the production cost and profit were neglected.

Nowadays the simple mechanized and cost-effective technology is necessary for Iran. A great deal of research work has been concentrated on improvement or development of logging system and equipment.

The chainsaw STIHL was introduced in 1958. Now, the 070 and 085 STIHL is a popular chainsaw in north of Iran. In Iran, about 1 million cubic meters of hardwoods are harvested every year, but it has become more and more difficult to find skilled chainsaw operators, especially for harvesting big size trees or for wind thrown trees.

The crawler skidder J-50, powered by a 50 Hp diesel engine through a five speed transmission, equipped with a single drum winch and frame bank on the rear, which can be raised and lowered hydraulically to carry the front end of tree-length off the ground, is specially designed for operations in forest terrain. The flexible carrier can automatically adjust to terrain conditions and travel in the woods more smoothly than agricultural tractors. It has a downhill skidding capacity of 5-8 cubic meters. There is no protective structure, such as ROPS (roll-over protective structure), FOPS (falling objective protective structure) and OPS (operator protective structure).

A four-wheel drive skidder TAF was introduced at the beginning of 1970s.

The yarders used in Iran were semi-stationary, mounted on sledge legs and powered by engine ranging from 25 to 70 Hp. The most popular yarding system was a gravity skyline system; composed of double (or single) drum winch, skyline, mainline and a carriage with or without built-in stopping device. The setting up of such a system requires a survey of the skyline corridor and the selection of appropriate spar tree as well as support trees in the case of multi-span system. The winch was usually mounted at the top end of skyline opposite of the landing location.

At landing, the loaders can perform loading, timber piling, grading and clearing of landings. The mobile loaders and general cranes are popular in the forests of Iran.

As the cutting system will be changed from local clear cutting into selective cutting, the equipment used for forest harvesting will also be changed. Chainsaw will remain as the dominant felling equipment. Light weight machines for timber extraction (skidders) technology will dominate and some suitable machines such as cable cranes and forwarders are necessary in the next ten years.

The existence barrier in development of the forestry mechanization of northern forests of Iran:

- ⇒ topography and mountainous status of forest regions,
- ⇒ low level of harvesting per area,
- ⇒ lack of investment in field of machine construction in country,

- ⇒ lack of new machine because of the decreasing of financial ability of forest company,
- ⇒ face to international sanction against Iran,
- ⇒ lack of development of agro forestry and afforestation.

4 Wood harvesting

The harvesting from northern forest of Iran was initiated in 1960 s. At first, clear cutting method was performing in framework of 10-year forestry plan. In 1990 s this method was replaces with single tree selection cutting method and the harvesting rate decreased with increasing danger sense of Iran government from forest destruction. As in a 10-year period the harvesting was stopped. In recent years the ultra view to forests protection causes to increase pressure from public units (NGO) and environmental protection organization on stopping forest harvesting. Figure 4 shows the reducing process of harvesting:

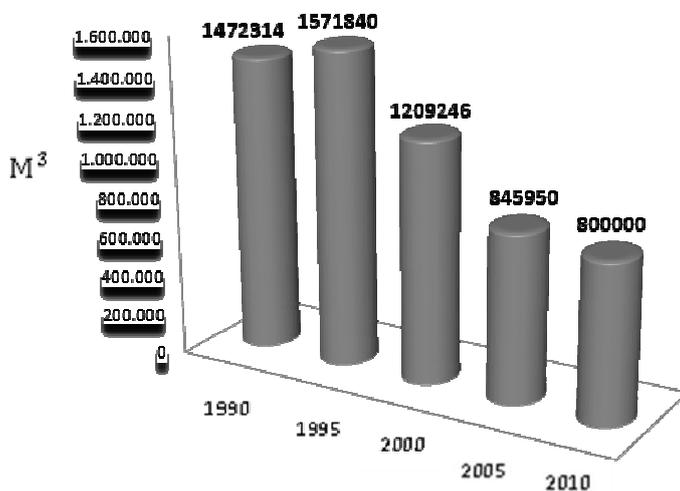


Figure 4: Harvesting volume from northern forest of Iran in recent two decades

It can be concluded that the harvesting should not be high or low. If the forest is harvested more than its potential it would damage and if the forest is harvested less than its potential we would have economic problem. Having a sustainable forest is possible through:

- ⇒ Wood supply → wood requirements of human.
- ⇒ Economic performance → positive level of harvesting activities.
- ⇒ Society objectives → society requirements of human.
- ⇒ Ecological objectives → ecological balance in forest ecosystem.
- ⇒ Moral issue → healthy of the relation among plant, animal and human.

4.1 Cutting system

In some areas clear cutting prevailed in 1970's in north of Iran, causing serious problems for the regeneration and needs of factories. Many research works were concentrated on the impact of various

cutting systems on the environment and regeneration. Since 1980s, clear cutting was stopped. Clear cutting is now permitted with limited area restriction—no more than 0.5 hectares, followed by manual regeneration-planting. Experiments show that selective cutting and now close to nature cutting, in spite of the more expensive logging cost, if carried out properly, may result in optimum protection of the environment and regeneration. In protection forests on steep slopes and environmental sensitive mountainous regions, cutting is prohibited.

With the development of close to nature cutting system and the execution of protection at the national level, the selective cutting system and light and suit machinery for logging will be the prevailing systems in Iran in the coming 10 years.

4.2 Harvest planning and road network

Strategic planning optimizes the needs of both roading and harvesting. Suitable landings and terrain breaks are identified, and the road system is built through these whenever possible. The resulting road network is shorter with more harvesting opportunities. Fewer roads mean a savings in capital and maintenance costs.

In Iranian Forests the traditional layout of forest roads is to build roads along the stream valley, so most of roads are located along stream valleys under mountainous conditions. The shape of timber harvesting settings are often irregular depending upon topographic features and area limitation, with upper boundary at hill ridge and lower boundary at road side along streams. So the skidding distance directly depends on slope length which often exceeds 1000 meters.

Most of forests and forests to be harvested in Iran are growing in mountainous areas.

The theory of optimal road spacing (Matthews) was introduced into Iran in 1970s. Studies were made to determine the optimal road spacing in forest regions. Optimum forest road density is calculated for a range of 15-21 m/ha, but average constructed roads are about 11 m/ha, so there are some long skid trails, in some cases more than 2000 meters.

Animal logging, farm tractors, or crawler tractor systems are not economical for skidding trees long distances. Therefore truck roads or forwarder roads need to be built to reduce skidding distances for these systems. Where frequent entries to remove low volumes are anticipated, the investment in good road systems makes sense, particularly where they increase access for fire protection and recreational uses.

The road network in forest regions is still insufficient so, the density of forest road network will increase in the next ten years but it appears that there is a need to suitable machinery with a long distance hauling.

The advanced sophisticated machines, such as harvester, feller-buncher, delimeter, processor, etc., cannot become the prevailing technique due to their high cost, steep train, broadleaved forests and adverse impact on the environment.

With the development of optimization techniques, some optimum design systems have been implemented. By applying network analysis and linear programming, a logging network analysis system can evaluate the maximum flow, shortest path, least-cost flow and the critical path. The technique can be used for harvesting planning, layout of road network and tree-length bucking.

The GIS (Geographic Information System) has been used in the north forest area of Iran in planning forest road networks with economic and environmental considerations.

It seems that among the methods of timber extraction in the forest, animal skidding is one of the good choice methods. The main advantage of animal skidding is the low level of damage to the residual trees and the forest soils. The main disadvantage is the low limit on skidding distance for which draft animals are economical.

Generally, heavier equipment will have a greater impact, although the skill of the operator is an extremely important and under-appreciated factor. The difference between some animal logging operations and some large skidder operations are, believe it or not, quite minimal, especially after a few years.

For timber extracting by mules, the logs should be sawn as small as a mule can skid it. A mule can carry about 150 kg and two pieces of timber (14*32*280cm) are fastening to it; one side on mule and other side on the ground, so it can walk. It fits the poor operation conditions of forest harvesting, particularly in the forest with low density of roads and steep trains, so there is a need to improved animal skidding techniques and its equipments in the coming ten years.

Forestry machines, especially skidders, cause definite compaction of soil by increasing the soil bulk density, decreasing the aeration porosity and the saturated hydraulic conductivity of the soil, which has the adverse impact on growth of seedlings and forest regeneration and its ready to erosion. Studies show that rubber-tired machines have more significant impact on soil physical properties than crawler machines. Also studies show that the effect of animal skidding in Iran is just for top 10cm of soil more than rubber tiered skidders, but in the second 10cm in depth, the compaction of skidders is more.

5 Forestry education

Forestry education in Iran consists of two parts: high education (BC, Msc and PhD degrees) and reeducation (Engineers).

There are 14 forestry departments in different universities and about 1600 students in BC, 220 Msc and 40 PhD are studying. There are about 100 PhD as faculty member in forestry that are graduated in different countries; such as Germany, France, Austria, United States, Belgium, Russia, Iran and others. Forest engineering has a portion about 20% in forestry education in Iran.

The higher education in forest engineering in Iran will be increased smoothly in the coming ten years due to the economy and interested youngsters to university.

Another part is reeducation that is doing in governor organizations and factories. These courses are about one week training and an examination in the end. The engineers are interested in, because of the administrative promotion.

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