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By Gerhard Hüller

Ultilization of Forest Resources in Northern Iran

ALTHOUGH SCARCELY MORE than 10 per cent of Iran is forest, of which about a fifth can be regarded as potential commercial forest (2.1 per cent of the area of the country), Iran has done little in the past to arrest the harmful exploitation of forest land by the rural population or to forbid the constant conversion of forest margins into farmland. After the Government established the Land Reform Act and the Ministry of Natural Resources became responsible for all forest areas, new thinking took place on the most beneficial methods for forest preservation and use.

Although it was essential to preserve the forests in order to stop soil erosion, and to protect them from excessive damage by floods and avalanches, at the same time it was necessary to supply the immediate and future demands of the country for wood.

In 1967 the Industrial and Mining Development Bank of Iran (IMDBI), (*IRDN*, Vol. IV, No. 3, pp. 16–18), was responsible for a project covering the Caspian forest region. The aim of the project was to produce fibrous raw material for supplying pulp to a viscose staple fibre plant planned for Southern Iran and the construction of a mill with a capacity of 40,000 tons per year for dissolving pulp. In consequence an Austrian consultancy firm was requested, in conjunction with the Ministry of Natural Resources, to prepare a feasibility study on integrated forest utilization aimed particularly at the establishment of a paper industry.

The study was divided into sections on the market, forestry, technology, water, a pulp and paper mill, economic aspects, a pre-investment survey of a pulp and paper mill and the results of laboratory tests.

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The market

The market survey deals with paper, staple fibre and other wood-based products, which are of commercial importance.

With the total paper demand estimated at 217,000 tons for 1970/1971 and 410,000 tons for 1975/1976, it is evident that domestic paper production should be a major objective of the Iranian economy, particularly printing and writing paper of various grades which will be required for the country's campaign against illiteracy. It is estimated that the Pars Paper Company in Southern Iran will produce 35,000 tons per year of printing and writing paper in 1975/1976 by utilizing bagasse as fibrous raw material. However, a significant gap remains between the production of 35,000 tons of paper per year, and the country's future needs. As the Caspian forests yield the most appropriate raw material for the wide range of paper required, a second mill in the north of the country seems needed with an output capacity of 100,000 tons of bleached and unbleached paper per year.

As far as timber and timber-based products are concerned, there is a growing demand for roundwood, sawnwood, veneers, plywood, fibreboards and particle boards. The market appraisal of commercial wood-based products shows that the total consumption of 460,000 m^3 in 1967/1968 will increase to an estimated 660,000 m^3 in 1975/1976. The new wood-processing industries established as a result of market demand will have to take into account the types of wood required as raw material which must correspond to the yield from timber grown. Market fluctuations should be borne in mind with regard to the possible uses of various species of trees and the technological processing methods that have to be applied.

Forests

The Caspian forests cover the northern slopes of the Elburs mountains where beneficial soil and climatic conditions favour growth. Most of these are virgin forests. The marginal areas, however, are exploited or even devastated and suffer an annual diminution of about one per cent. As far as the devastated regions are concerned, they cannot be reconverted economically into natural forest, but they can be changed into plantations for the production of poplar and coniferous wood.

An idea of the scale of the Caspian wood resources is given in table 1.

Table 1

Commercial forest area	1,180,000 ha[a]
Average annual growing stock increase	2.0 m^3 per year and per ha[a]
Annual increase	2,360,000 m^3
Future plantation area available	130,000 ha[a]
Possible yield of present plantation's species of trees	1,305,000 m^3 per year
The devastated forests must be clear-cut before plantations can be established. That clear-cutting will yield	5,800,000 m^3

[a] ha = hectare

The production of railway sleepers at the Asalem sawmill

A characteristic of the Caspian forests is the abundance of the broad-leaved species of trees and the lack of indigenous conifers, the main species being beech and hornbeam which together account for over 60 per cent.

Although the Ministry of Natural Resources was only established recently, it has already drawn up and executed many sound economic projects on forest utilization and initiated forest industries. However, inadequate attention has been paid to the need for integrated forest utilization. This is demonstrated in table 2 which gives a breakdown of the estimated annual yield of the Caspian region.

The result of exploitation and devastation of the marginal areas

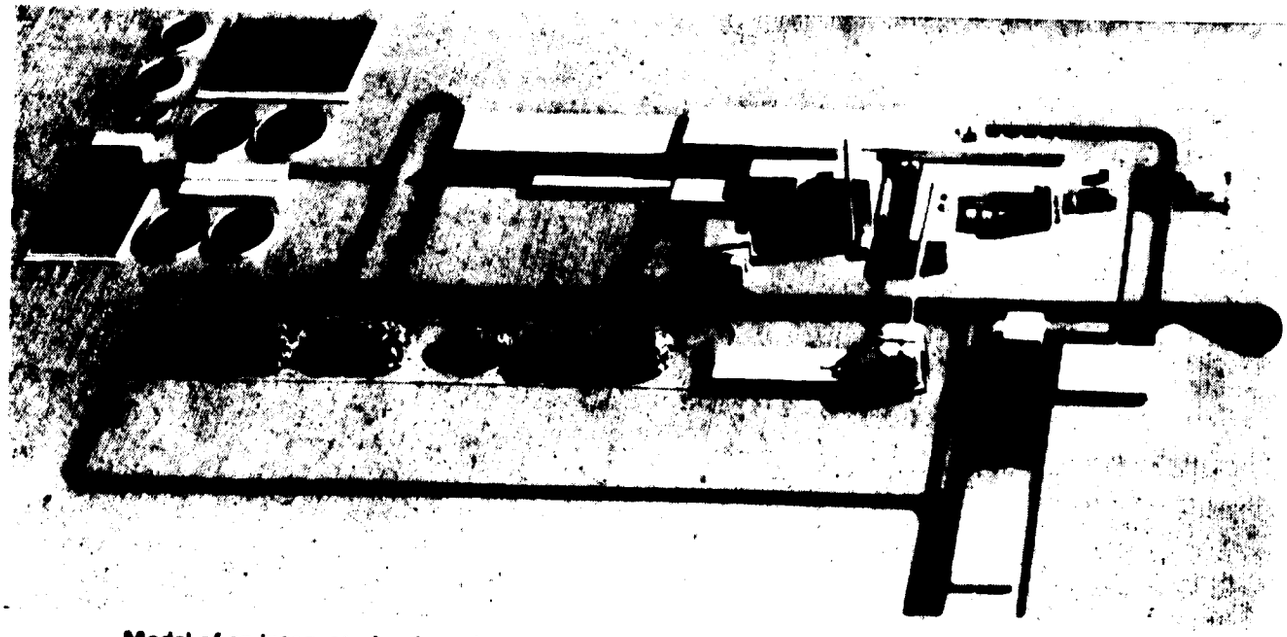
Table 2

Type of wood	Percentage
Timber	25
Veneer logs	4
Poles, mine timber, industrial wood	20
Pulp wood	30
Fuel wood	15
Losses	6

The city of Chalus lying approximately halfway in the 1,000 kilometre forest belt, divides the Caspian area into the western Rasht influx area with a total of 497,500 hectares, and the eastern Sari influx area with a total of 682,500 hectares.

which will provide furniture and millwork. As it seems unlikely that the Iranian market will absorb the total amount of secondary wood products, a large part is earmarked for export to Romania, which is to establish and finance the industrial complex. The pulp wood of the Sari influx area is destined for the pulp mill that is planned for the second phase.

Systematic forest utilization requires an efficient wood extraction system. Although various methods of transporting wood such as by chutes and slides, ropeway and suspension railway, railways, pipelines, rafting and helicopters were considered, forest roads should have preference over all other transport systems in the Caspian region. A forest road system, well planned and well built, converts forests into forest areas. An important factor for planning such a road network is the determination of the density of the



Model of an integrated pulp and paper mill planned for the vicinity of Rasht in Northern Iran

Development of the areas will be carried out in two steps, the first step will bring under development 232,000 hectares of the Rasht influx area and 72,000 hectares of the Sari influx area. The second step will concern the remaining forests in the Rasht und Sari influx areas.

The development of the total Caspian region will take decades. In the first phase, which will last ten years, only areas with the best yields will come under management. At the same time, the setting up of two industrial complexes is envisaged.

In the Rasht influx area the forest industries complex will be initiated and headed by the pulp and paper industry, incorporating the existing industries, in particular a sawmill.

In the Sari influx area, the "Sari industrial complex" will integrate a particle board, plywood and veneer and sawmilling industry, and a secondary converting industry,

forest. The Caspian forests will require densities between eight and sixteen metres per hectare in order to arrive at a minimum price for the wood when delivered. The road network for the initial forest management phase of the Rasht influx area (wood procurement for a 100,000 tons per year pulp and paper mill and its integrated industries) will have approximately 3,300 kilometres of road.

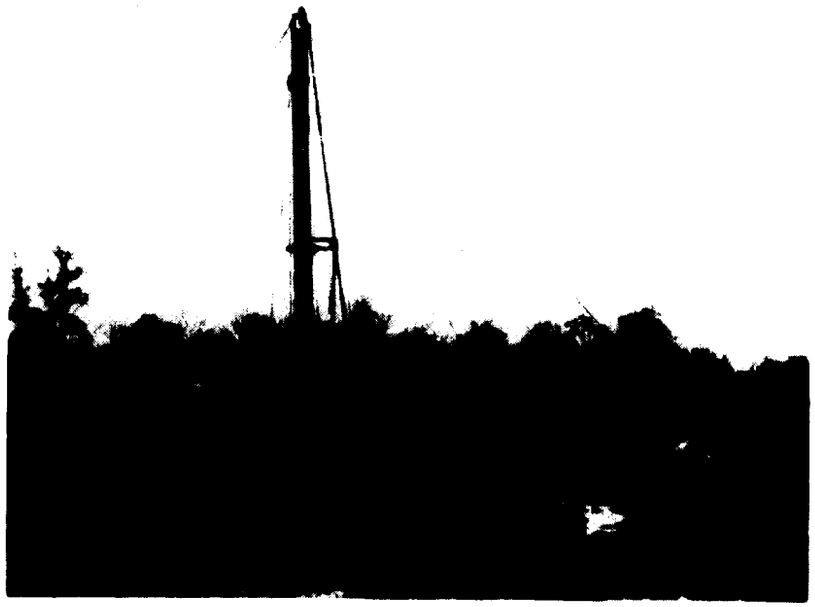
It is recommended to start the development of plantations together with the initial phase of the Rasht influx area. Plantations of 10,000 hectares of poplar would yield 150,000 m^3 of pulp wood as a substitute for 80,000 m^3 of naturally grown hardwood, leaving higher qualities of wood for other industries. Another 10,000 hectares of coniferous plantation would supply the pulp and paper industry annually with 80,000 m^3 of coniferous wood which would amount to the quantity of softwood admixture necessary for the production of paper.

Technology

Technological aspects of wood in the study dealt with the kinds of wood products (roundwood, sawnwood, veneers and plywood, wood composition board and mineral bonded products), wood-based manufactures (millwork and furniture, prefabricated houses, flooring, containers, shingles) secondary wood products (pencils, matches) and wood residues (waste and sawdust). (Wood technology is also concerned with chemically derived products such as pulp and paper, staple fibre, charcoal and a wide range of industrial by-products such as alcohol, yeast and furfural.) As a result of the considerations it was decided that the broad-leaved species of trees of the Caspian region are suitable for a wide range of products. Consequently, a method was evolved for building up an integrated industrial complex to make the best possible use of the wood of the region. Other important findings of the feasibility study were the necessity of wood treatment and the problem of charcoal production.

The Caspian region has an extremely humid climate; the average moisture content of the air is 80 per cent. Hence, during most of the year it is impossible to dry wood to 20 per cent moisture content by simple air drying. Because wood of good quality and wood destined for impregnation must be dry, the moisture of the region presents a serious problem. Railway sleepers, for instance, which are at present the most important sawmilling product in Iran, last only one third of the time they should because the wood used in them was not properly dried before impregnation. Because of the humidity problem, the building of an air seasoning yard in the neighbouring arid zone was recommended.

With the more valuable trees no longer available for charcoal burning, the portion of the annual sustained yield allotted for charcoal is insufficient to cover the present demand. The present demand requires from 1.0 to 1.5 million m^3 of fuel wood for charcoal production, whereas only 400,000 m^3 of fuel wood can be expected from the properly managed Caspian forest region. The greatest efforts will have to be made to replace charcoal gradually by fuel oil, gas and fuel wood.



Exploratory drillings being carried out for the location of water supply

Water

For pulp and paper making, water is the most vital raw material. A mill with an output of 100,000 tons of paper per year uses 1 m^3 of water per second.

Various sources of water supply were considered but it appears most advisable to supply the pulp and paper mill with infiltration groundwater from the Sefid Rud, the largest river of the region. The direct use of the Sefid Rud riverbed water is impossible because of its low discharge during the dry season. During high discharge periods the cost of silt removal makes the use of this river uneconomic.

The quality and quantity of water available to meet present and future demands is extremely important in the selection of a mill site, as important as the method of waste water disposal, because 100 per cent of the water entering the plant leaves as effluent. The contaminants of waste water in the pulp and paper industry may be described generally as organic and inorganic solids and dissolved organic and inorganic solids. For the purification of this quantity of water, large lakes or rivers are required. In other words,

Work being carried out on the preparation of a forest road

flowing water of 25 to 30 m^3 per second is needed to guarantee a sufficient supply of oxygen for biological purification. Unfortunately there is no river with this capacity in the region.

Because the Sefid Rud is the spawning ground for sturgeon, any change in the composition or quality of the water by the introduction of waste disposal could infect the spawn of the sturgeon and thus be harmful to the famous Iranian caviar industry. The purity of the Sefid Rud water therefore has to be guaranteed under all circumstances.

Only by the treatment of industrial sewage can the necessary purity of the water be achieved. As a means of purification a continued mechanical-biological treatment will have to be applied.

Pulp and paper mill

The establishment of a pulp and paper mill near Rasht for the manufacture of 100,000 tons of paper per year is recommended. Printing, writing and wrapping paper and corrugated medium stock (fluting) were the suggested products. The scale of operation and the product specification were based on market demand, available wood pulp and the most appropriate technological processing.

A production programme that included the application of sulphate pulping (for printing, writing and wrapping stock) in association with neutral sulphite semi-chemical (NSSC) pulping (for corrugated medium stock) appeared suitable. Two paper machines were considered adequate. The mill was planned to be self-sufficient with respect to integrated pulp and paper making, steam and chemical recovery, bleach chemical preparation, steam and power generation, water supply and the treatment of waste water.

Operation of the mill requires a labour force of 700. As a mixture of long fibred pulp is needed, more than 400,000 m^3 of solid volume pulp wood must be procured per year of which 80,000 m^3 solid volume coniferous wood (or alternatively imported coniferous pulp) is necessary to guarantee the required quality standard. Consumption will be 100 tons per day of chemicals and 180 tons per day of fuel oil.

The full load capacity of the mill will be built up in phases, but the layout must provide for the possibility of expansion, particularly provision for the manufacture of kraft paper.

Results of laboratory tests

Laboratory tests were performed in order to support the technological input data used for the planning of production, and samples of the two main raw materials, water and wood, were analyzed.

It was recommended that the water supply come from groundwater resources. By means of two exploratory drillings with seismic and geoelectrical measurements the availability of sufficient sub-surface water could be confirmed. The analyses demonstrated the necessity of treating the natural water to meet the standard required for pulp and paper processing.

The pulp wood tests were designed to answer specific technological questions of pulp and paper manufacture. Ten tons of Iranian wood samples were processed in a trial run.

Economic aspects

Studies concerning the economic feasibility of the infrastructure of the project were based on the calculation of the cost of the delivered wood, on the analyses of the economics of forestry based industries and on the elaboration of a pre-investment survey of the pulp and paper mill.

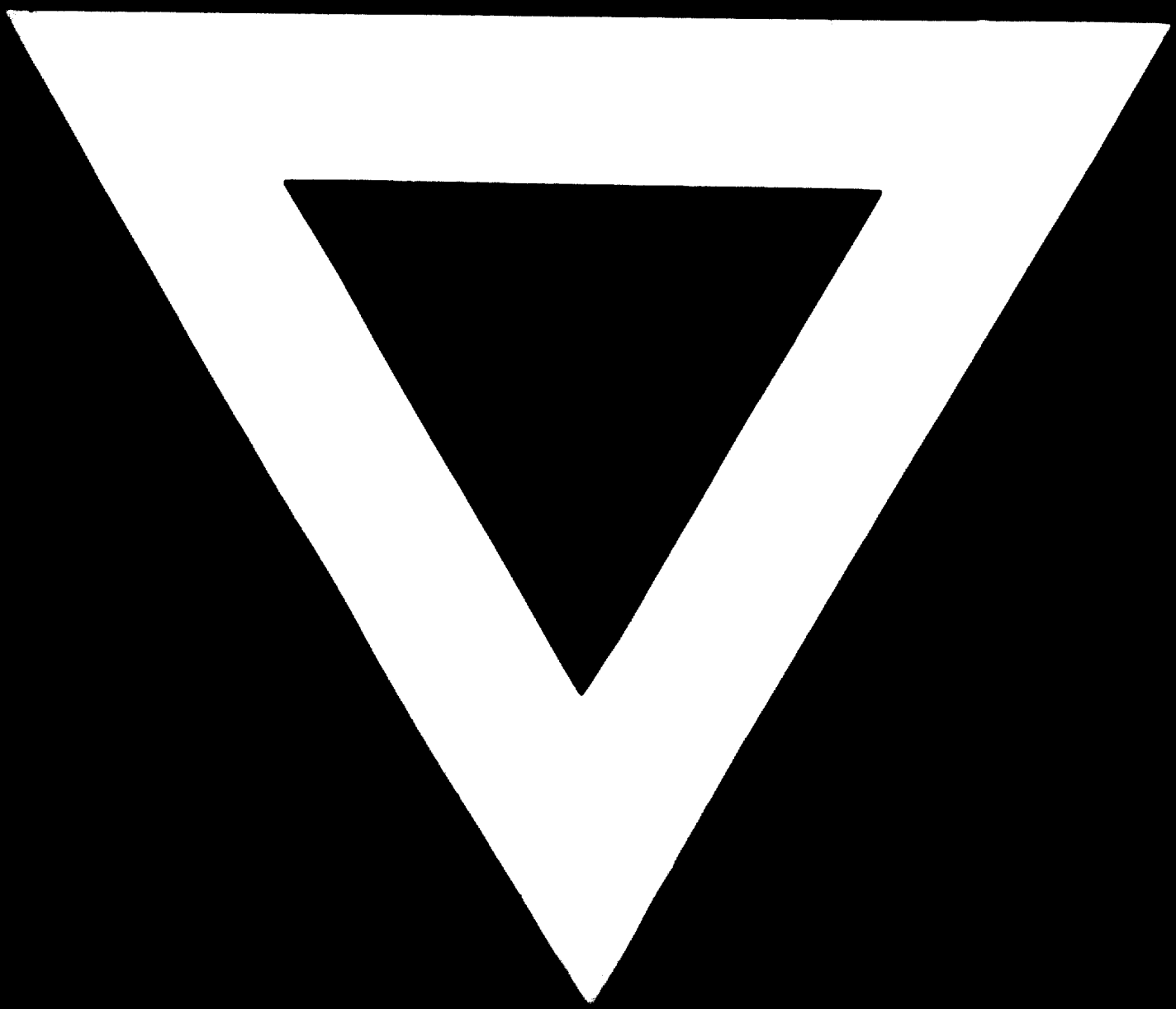
Prices of wood from natural forests and plantations were calculated on the basis of operational expenses, amortization of structures and equipment, and five per cent interest on capital invested as well as on the basis of the most economic utilization of the wood harvested. Deciduous pulp wood, debarked, whitepeeled, in lengths of one metre can be delivered free to the pulp and paper mill at US$12.00 per m^3; poplar pulp wood from plantations, unbarked, full tree length can be delivered at $7.50 per m^3 free to the mill. Logs for timber, and veneer logs, to take another example, can be delivered free to the Asalem sawmill at $32.00 per m^3.

The total investment cost of converting the Caspian forests into productive forest areas was estimated at $130 million, excluding the cost of the establishment of plantations.

The capital investment for the implementation of the initial phase of forest management of the Rasht influx area (i. e. the influx area of the pulp and paper mill: 232,000 hectares of natural forest, 10,000 hectares of poplar and 10,000 hectares of coniferous plantations to grant a sustained raw material supply to the pulp and paper mill, the Asalem sawmill, a plywood and veneer factory near Asalem, and to other forest based industries in the Rasht area) will amount to $30 million, more than two thirds of this amount to be invested in 3,300 kilometres of forest road construction. For the permanent management of the influx area of the pulp and paper mill, a labour capacity of 10,000 will be required.

An assessment of the industrial investment to be generated concurrently with the development of the Caspian forestry resulted in an amount of over $120 million, of which the total financial requirement for the realization of the 100,000 tons per year capacity pulp and paper mill amounts to $55 million.

The paper mill's annual sales at full operation are estimated at $24 million and the average annual production cost per ton of paper was found to be $165. The foreign exchange savings during the first ten years of operation would amount to more than $60 million.



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