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Ban, I., Forgacs, C. and Jablonkai, Z.

IIASA Collaborative Paper
November 1982

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Istvan Ban
Csaba Forgács
Zoltan Jablonkai

November 1982
CP-82-79

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
2361 Laxenburg, Austria

FOREWORD

The Forest Sector Project of the International Institute for Applied Systems Analysis (IIASA) commenced in September 1981 after a pilot study. The aim of the project is to identify the policy options which are likely to produce a benign future beyond the year 2000 for the forest sector (forestry and forest industry) both at a national and global level.

Policy analysis will be carried out by implementing forest sector models which will be constructed by the international collaborative network. Each collaborative team will build their own national model with the help of the core team at IIASA. The simplified versions of the national models can be linked to a global forest sector model which is being developed at IIASA.

Hungary is one of the countries collaborating with IIASA's Forest Sector Project. This paper describes the outline for the Hungarian national forest sector model.

Risto Seppälä
Leader
Forest Sector Project

ABSTRACT

The model presented in this paper describes the structure of the Hungarian forest sector. The planning of the sector at a national and company level as well as the mechanism of regulation concerning production, investments, and consumption are also investigated and the exports and imports linked.

One of the most important objectives is to create this model in order to study the behavior of the system so as to aid the decision making both in strategic and tactical areas. Apart from forestry the model also includes the wood processing activities.

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INTRODUCTION

Hungary is poor in raw materials. Complying with an increase in production is only possible by importing considerable quantities of raw materials, one of the major ones being timber. The annual consumption of timber excluding wood fuel is some 7 million m^3 of which 50 percent is imported. Conifers are the major import because local production is very small.

Poor timber resources make it necessary to rationalize consumption. This can only be realized if harmony between timber processing and forestation is guaranteed according to the current interests of the national economy.

The present forestation determines the cuttings in 10 to 120 years, while the quantity of the actual forest cuttings is limited by the stands now available. Consequently, the time factor plays an important role in forestry, implying the need to formulate well-founded strategies and tactics.

The model of the Hungarian forest sector model would be important as a method of

1. substantiating decisions to be made by analyzing the development of the sector, of forestations, of timber processing, of economic policies concerning the import and export of timber, as well as to revise the results of earlier calculations
2. studying the system of complicated relationships with the world market
3. modeling the economic regulation system of the forest sector

The targets mentioned above can be reached by using different models. The proposed model has the following characteristics:

1. It is a descriptive and not an optimization model;
2. It is dynamic (recursive);
3. It contains the most important forestry subsystems;
4. It considers the forest sector as a closed system, one that is, however, an organic part of the national and world economy;
5. The model is based on simulation techniques.

The development of the Hungarian forest sector model has two purposes. It must help test the concrete method evolved within the framework of international research, by applying the methodology elaborated by IIASA's specialists for modeling the international trade of forest products. On the other hand, the aim is to create a simulation model to forecast over a long time span, the production of the Hungarian forest sector. We can examine the coordinated economic strategies concerning the improvement of forestry over the next 20 to 30 years.

1. THE APPROACH

As it was mentioned earlier we intend to realize two objectives by building a Hungarian model. One of them is to provide a useful tool for Hungarian experts who help make strategical and tactical decisions on the economic plan. Therefore, those regulations could be improved which orient the activity of companies toward fulfilling the plans of the national economy. The other objective is to supply a model which can be linked with IIASA's world model of the forest sector. In order to fulfill this requirement we will use the experience gained by working on the IIASA Forest Sector Model and its modules.

2. THE MAIN ELEMENTS OF THE MODEL

The simulation model will make it possible to plan and regulate the production of forestry, to model the marketing of the products and the relationships with other sectors of the economy and the major financial processes.

The forest sector can't be looked at separately from the national economy. Consequently, there is a real need to model the rest of the national economy to define and quantify the interactions with the forest sector. Figure 1 illustrates the structure of the model.

We will utilize the possible methodical solutions, which are given by the Simulation Model for the Hungarian Food and Agriculture Sector, in modeling the forest sector.

In the case of centrally planned economies it is the government and the corresponding ministry which determine the central targets which orient and restrict the production, its structure and development. These global targets are defined exogenously and they appear in the *planning module*.

The *production module* simulates the total forest production — including both the primary and the secondary conversion — taking the rest of the economy into account. Forest products are supplied by the state owned companies and the cooperative farms. The state owned parts of the forest sector consists of different types of companies. These differences will be included in the detailed model, meanwhile the first version considers the sector as an aggregated unit.

The consumption of the yearly manufactured products is planned by means of the *exchange module*. The production is not necessarily equal to the consumption because it is possible to store the products for a certain length of time. Moreover, it includes accounting the monetary funds and dividing the resources of the company.

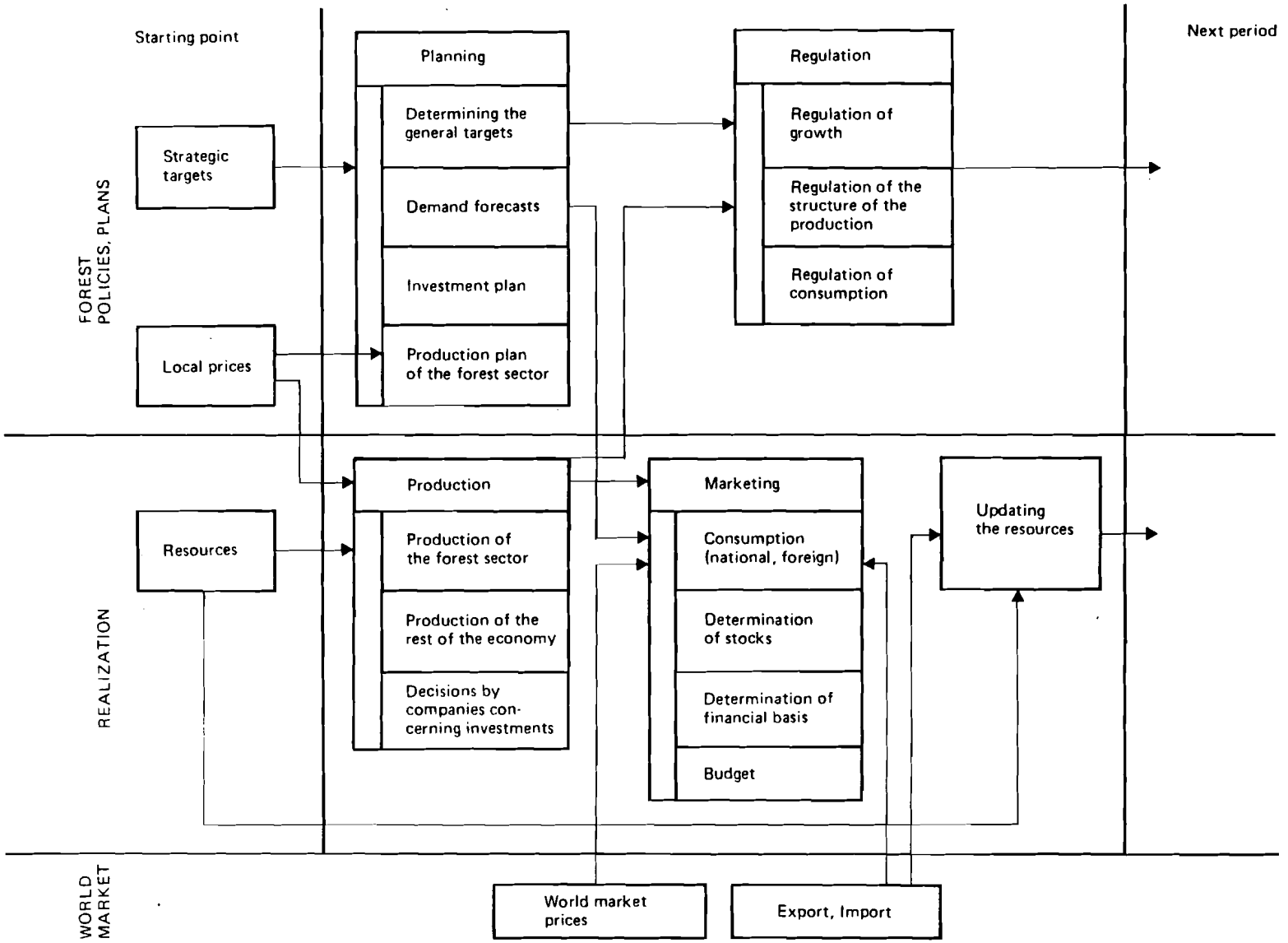

Figure 1. The structure of the simulation model of the Hungarian forest sector

The *regulation module* is an independent element of the model. Its purpose is on the one hand to promote the growth rate of the production and to orient the changes in the production structure – depending on world market prices, the manufacturing costs and the demand. On the other hand a favorable relationship between input and output must be insured. The subsequent target is to also adjust the forest cuttings and timber processing to the demand over a short and long term.

Considering the structure of the forest crop from the age and species point of view, the yield and cuttings change from one year to the next. The same can be said about the buildings and the machinery as a result of wear and tear. As a separate module of the model, the regulation should balance the yearly production with the available resources.

2.1 Planning Module

The defined planning indices represent overall targets. We have to determine these indices for the first year exogenously. Furthermore, the size of the yearly deviations must be depicted in an algorithm.

The central targets contain the following:

1. production targets
2. forecasting the demand
3. forming an equilibrium in international trade of forest products.

Foreign trade plays an important role in the production of the Hungarian forestry. Exports mainly include broad leaved species. Imports are considerable, mainly consisting of conifers. The major share of the imports comes from the socialist countries. We have to be aware of the

fact that this source of supply will become increasingly more of a burden in the long run. Moreover, the exports for capitalist countries could be increased. Consequently, separating the dollar and the ruble accounts seems to be well-founded. We have to consider using our opportunities which are provided by the substitution of timber in order to lessen the negative export-import balance.

In the course of planning the *consumption* we will forecast the probable demand for the products in the model, i.e.,

1. public consumption
2. consumption for the companies
3. demand for exports

It is very important to forecast the demand exactly in order to determine the correct figures of production and to regulate production. The forecast of demand must be properly detailed in order to be compatible with the structure of the supply.

Knowing the demand, we can complete the production plan. This plan includes a central conception, where the target function of the model represents the interests (targets) of the national economy. The model contains the available raw materials (local and imported) in a given year, the necessary capacities of production, the technologies that can come into question, the demand and the available stocks. The different restrictions, (imports etc.) are also defined.

The growth of the gross and net national production is first determined and the growth of the gross production of the forest sector is calculated.

2.2 Production Module

The production of a particular year is modeled in this module, sector by sector; i.e., the *forest production* and the *timber processing*. The production of these two elements are interdependent. The dependence is stronger for timber processing, because its production depends not only on the demand for the products of the secondary conversion but also on the timber harvesting and the imports of raw material. Anyway, the situation is a bit special because many of the timber processing firms produce part of the necessary basic materials themselves.

Knowing the demand, the production is determined by the following:

1. the exploitable volume of timber, which depends on the current structure-age, rotation age, species and felling site of the forest crop, and on the available resources
2. the amount and structure of the stocks of raw material remaining from the previous year
3. the opportunities of importing raw materials

The import opportunities can also be limited by the general targets in a given year or period. There can appear, for instance, as an intention, that only a restricted amount of foreign currency can be used for buying timber from abroad and the available funds can't be increased later on. This implies a decrease in imports because the prices will increase on the world market. In this case, either the local production should supersede the decreasing amount, or, if it's insolvable at a reasonable price, we have to take substitution into account. All these questions can also affect the forestations in the long term forecasts. By running the model for each

year, the necessary policies of forestations, harvesting, timber processing and substitution can be analyzed in the interest of the national economy.

In case the supply of some species exceeds the demand, the question could arise whether to reduce local cuttings while leaving the imports at the planned level, because a larger decrease of imports could be more advantageous for Hungary by harvesting the accumulated growing stock.

The cuttings can also be limited by the interests of certain companies. If the appropriate companies and cooperative farms are properly motivated and they have enough capacities to do it. The annual volume of cuttings can be limited by the level of the annual yield.

The equilibrium of supply and demand could be achieved by formulating pricing and stockpiling policies. Consequently, if world market prices tend to be so unfavorable that the deviation from the trend exceeds a definite measure, exports will be reduced and the products will be stockpiled, up to the highest possible level of stocks. The accumulated stocks could then be eliminated by freeing them for local consumption. If this does not work, then we should restrain production by reducing prices.

In the case of growing demand — if it exceeds the production of a given year — the stocks can be used in order to re-establish the equilibrium. If equilibrium is not reached in the next year, the production of the substitutes will be increased to meet demand. The necessary supplement of the means is given by supporting investments, where the different processes of the forest sector would compete for the resources. The question of how to order the claims for the resources according to

their priority must be solved.

2.3 Exchange Module

The products of forestry are either sold on the local or world market or used to increase stocks. There is a condition posed on increasing production, that the returns from the sales of forest products must exceed the costs of production. The difference is the net income of forestry in a given year. It is calculated as follows: the values of the sold and stocked products are summed up on the one side. On the other side, the costs of stockpiling are added to the costs of production and maintenance.

The centralized depositing of money by the forest companies, cooperative farms and the rest part of the economy is calculated by means of this module. Then income taxes, wages, premiums and public insurance are calculated. The total development fund consists of the appropriate share of the remaining profit after paying taxes and the proportion of the amortization which is available to the company.

The income of the people consists of the following: wages, rewards, premiums, pensions and incomes of the production in households.

Consumption is determined by the demand functions. Forecasting the demand for commodities will enable to determine the relationship between production and demand. If production is larger, the difference will increase the stocks. One task is to satisfy local demand. The connection to the world market also must be solved in this module.

The public revenue and expenditure as well as the balance of foreign trade in dollars and in rubles are included in this element of the model.

The real amount of public savings is also revealed.

The public revenue consists of exports, imports, the value added tax (V.A.T.), income taxes, public insurance, the contribution for forest maintenance, and the centralized amortization. The components of public expenditure are export subvention, the import subsidy, public consumption, subsidies of consumer prices, social allocations, pensions, expenditures for large state investments, government subsidies, and the deficits of the producing sectors.

2.4 Regulation Module

The module checks whether the targets which are drawn up in the planning module have been realized at the end of each year. To perform this, we check the following:

1. the growth of the forest sector
2. the evolution of the production structure
3. the actual consumption

The growth of the national economy is first determined, then that of the forest sector and of the rest of the economy. If the growth happens to be above the upper limit or below the lower limit, then it has to be kept in mind what sort of disproportion should be eliminated. It is possible to scale this disproportion by comparing the forest sector to the rest of the economy.

In case the proportions differ from the desirable ones, stimulation will be applied to fulfill the central plan targets. This can be achieved by modifying the tax rates, or the part of amortization which has to be paid

to the central fund, or the relationship of accumulation to consumption, thus changing the proportion of accumulation in the forest sector and in the rest of the economy. Regulating the structure of production aims at adjusting the structure fixed by the plans made for forestry, promoting by the distribution of the investment allocations.

The consumer prices of specific commodities can change from year to year to a varying degree.

The regulation of producer prices are hoped and expected to have the following effects:

1. stimulate the structure of production according to the plans,
2. fix the prices close to production costs

The producer prices can only satisfy these requirements if they are revised annually and changed according to the needs. This kind of pricing system is necessary in the model because it promotes the assertion that the national interests are reflected in the central plans. Apart from the pricing system, the following act as regulators:

— tax policies
— the subsidy system
— the amount and the distribution of investment resources

In the case of the rest of the economy, changing the producer prices means modifying the price-indices according to the world market.

As to the consumption, the total amount and the structure is regulated, while enabling to guarantee harmony between income and consumption by means of wage regulations.

2.5 Updating Resources

This module updates the main resources of the forest sector:

- natural resources
- labor
- plants (machinery, equipment, buildings, etc.)

Both the forest area with its variety of species and the growing stock with its age structure are included in the natural resources. A steady increase in population — as the source of labor — is taken into account. The trends in labor within the sector are also modeled. The production level of plants will be reduced by scrapping old equipment while new investments will increase capacity.

3. THE TWO STEPS OF BUILDING THE MODEL

The simulation model of the forest sector will be worked out in two steps. The first step aims at developing the first version of a more aggregated model. What is stressed in this phase is to identify and model the behavior of the system as realistically as possible. The details of the model are not such a relevant issue here. First of all, the correlations an interactions between the elements will be depicted and mathematically described.

The model will be furnished in this first period with a module that will link it to the IIASA global forest sector model.

In the second stage of the job on the basis of the experience gained we will begin to work out the detailed simulation model of the Hungarian forest sector. Not only the relations and interactions will be modeled in

greater details in this second phase, but the number of commodities will be expanded as well.

The work will continue in two directions after finalizing the simulation model of the forest sector. On the one hand, the character and internal structure of the more detailed national model will be worked out. On the other hand, the operational version of the aggregated model will be developed — parallel with the first stage. The operational aggregated model will provide the basis of formulating the operational version of the detailed national model.