A SYSTEM - DYNAMICS EXAMINATION OF THE EFFECTS OF THE MAHAWELI - PROJECT IN SRI LANKA

by

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1. ABSTRACT :

The following System - Dynamics model simulates the effects of a development aid to a certain project on social and economic sectors in a development country.
The project, which has been started in 1980, treats the damming up of the Mahaweli - Ganga in Sri Lanka. The advantages of this great project can't be assessed applying only classical measures of yield.
Using System - Dynamics it is possible to analyse the effects of the project on sectors like the labour market, agriculture and the budget of Sri Lanka and to discuss changes of the values in this fields.
An improvement of the values of the 4.5 billion US$ project would create the foundation for further investments.
Moreover, the effects from the building of hotels and possible direct investments of foreign enterprises in Sri Lanka are to consider.

2. INTRODUCTION :

Sri Lanka, independent since 1949, is an island in the south of India with nearly 16 million inhabitants. The democratic form of government is established in the constitution and includes also the well - known basic rights applied in the western countries.
The social institutions of Sri Lanka are ideal for a development country. This is also demonstrated by the following indicators:

- 20% of the budget are used for the education and social sector.
- Compulsory education begins at the age of five.
- Only 14% of the population are illiterates.
- The average life expectancy is 67 years.

The government follows a liberal and capitalistic economic policy.
The economy of the country is above all influenced by agriculture. The distribution of the active population among the economic sectors confirms this:

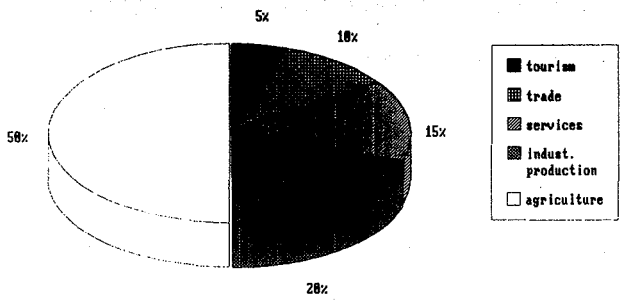

Fig. 1: Structure of the active population in Sri Lanka

Above all, Sri Lanka has considerable problems in two fields:

(1) The economic crises pointed out as well in agriculture as in industry:

- Sri Lanka, once the rice store of Asia, had still to import 10% of its rice demand in 1980.
- Many districs of the island, above all in the north - east and the central highlands, are too dry to use them for agricultural purposes.
- The industry of the country is still at its beginnings; so far, there exist only a few greater enterprises. The unemployment quota is about 18%.

(2) The civil war between Singhaleses and Tamils:

The two groups of the population, different in origin, religion and language, are fighting against each other increasingly since 1980.

In front of this background stands the Mahaweli - project:

The Mahaweli - Ganga, the greatest river of the island is to be dammed up in several barrages. This allows the cultivation of new arable land and on the other hand the gain of electricity, which contributes to the solution of the economic problems.
The following figures show the purposes which shall be realized by the Mahaweli - project:

- The irrigation of 3600 square kilometers ground; from this, 2600 square kilometers for agricultural purposes.
- The production of 540 megawatt power each year.
- The colonization of one million people in this district.
- The creation of 500000 new jobs.
- The distribution of 10000 square meters irrigated arable land and 2000 square meters garden ground to each settler family.
- The planning and structure of new settlements (proximity to schools, hospitals and so on).
- The economic independence of the island by means of an extended rice production.
- The settlement of domestic and foreign enterprises as a result of better conditions; the creation of three free trade zones may support this.

The following System - Dynamics model has to point out which developments in Sri Lanka are imaginable under certain conditions in the several sectors.

3. THE SYSTEM - DYNAMICS MODEL :

The structure of the model will here be explained by a few main loops.

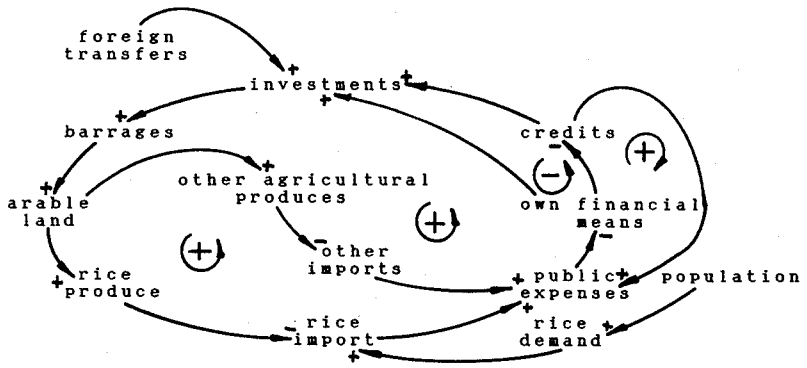

Fig. 2: Loop of the agricultural production

The model is based on an irrigation project which is financed by three resources:

- foreign transfers
- disposable credits
- own financial means, if available.

The more barrages are financed, the more the whole produces increase as a result of new arable land. As a consequence, less food has to be imported so that the cancelled public expenses can be used for other purposes.

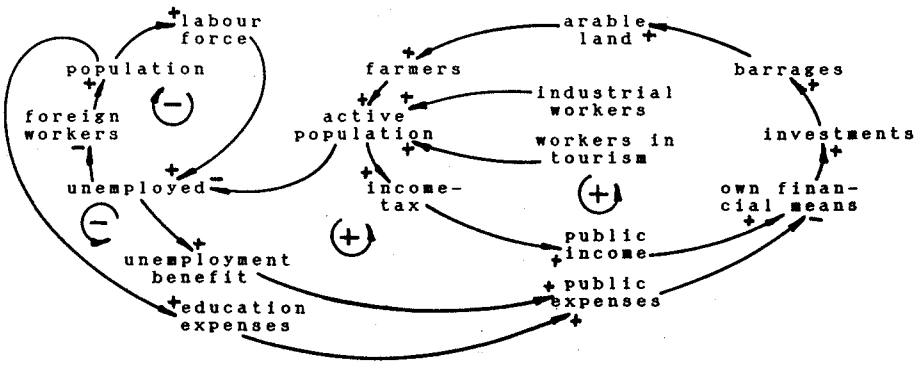

Fig. 3: Active population loop

More arable land furnishes an existence base to a greater number of farmers. As a consequence, benefit payments of the state can be cancelled and it becomes possible that public income in form of taxes increases. This income gain can be used for the building of new barrages. Moreover, an increasement of the number of farmers leads to less unemployed, more foreign workers and a greater population. By the increasement of the population, the education expenses and consequently the whole public expenses increase.

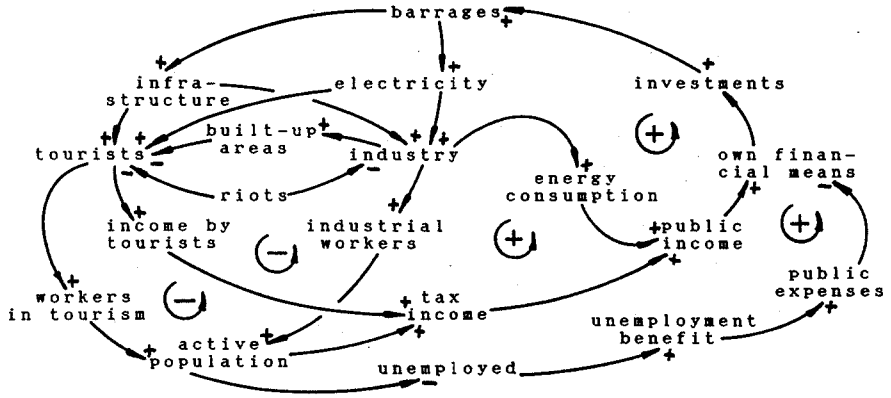

Fig. 4: Tourism and industry loop

The barrages can create good conditions for industrialization and tourism. The higher the barrages, the higher are infra - structure and electricity in Sri Lanka. This leads to more tourists and industrialization as well as to an improvement of the budget by a higher tax income.
On the other hand, the riots have a negative influence on tourism and industrialization.
A higher industry growth builds up more areas and lets decrease tourism.

4. RESULTS FROM THE BASE RUN :

The constants and initial values in the model were supported by authentic figures from Sri Lanka.

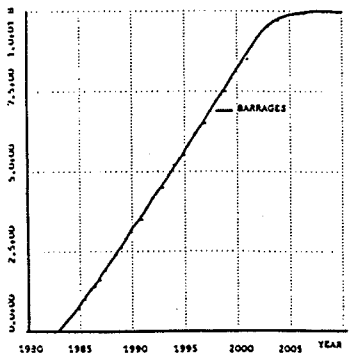

Fig. 5: PLOT BARRAGES

This plot shows the number of the built barrages. With the help of the financial resources it was possible to build the ten planned barrages continuosly in 25 years.
The western countries contribute 2.25 billion US$ to the costs of the project.
In the base run, the rest had to be financed by credits, because own financial means were not available.

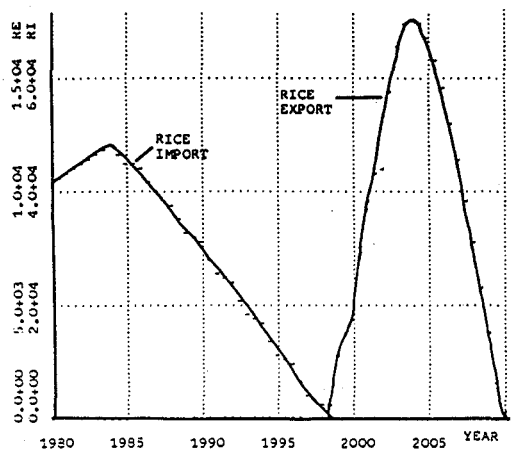

Fig. 6: PLOT RICE EXPORT, RICE IMPORT

In the beginning of the simulation time (1980 - 1984), rice had to be imported. This resulted from an increasing population and a constant rice production.
In the second period since 1984, it is possible to irrigate ground with the help of the Mahaweli - project. This leads to the creation of new rice fields.
The following produce increasements cause less rice imports.
The result shows that it is possible for Sri Lanka to export rice from 1998 because of the increasing produces.
In the year 2004, the curve turns again, the exports decrease and from 2010, Sri Lanka has to import rice again.
The maximum of the curve coincides with the finish of the last barrage. After that, the rice produce can't be increased more. The constant rice supply contrasts with a steady increasing demand, which is an effect of the increasing population.

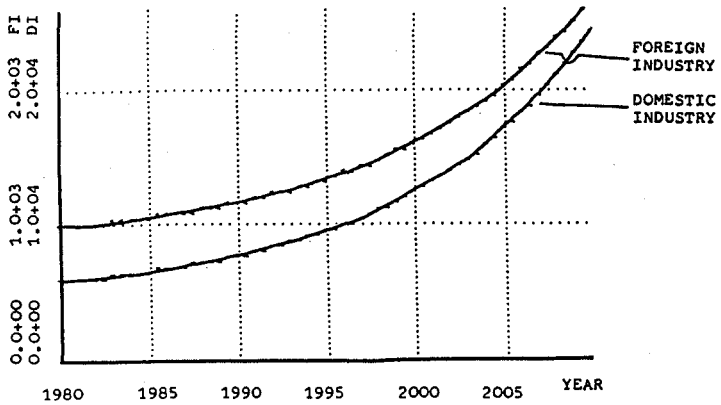

Fig. 7: PLOT FOREIGN INDUSTRY, DOMESTIC INDUSTRY

This plot shows that the number of enterprises increases more and more.
In the model, a growth of 2% for the domestic and 2.6% for the foreign industry each year was given by figures from the past.
The course of the curve is also influenced by variables of infra - structure, electricity, riots, different wages between Sri Lanka and Europe as well as a greater number of qualified workers as a result of increasing education expenses.
The constellation of the described variables leads to an industrial growth between 0.3% and a maximum of 5.7% each year.

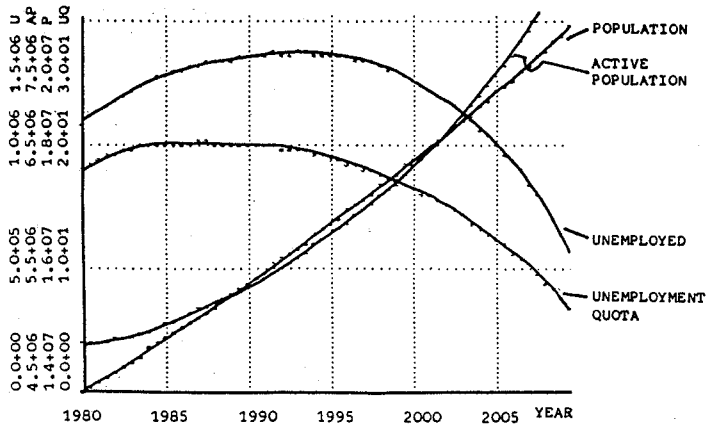

Fig. 8: PLOT UNEMPLOYED, ACTIVE POPULATION, POPULATION, UNEMPLOYMENT QUOTA

Here it becomes evident, how the population increases. The active population (farmers, industrial workers and workers in tourism) are also increasing.
The growth of the industrial workers results from the above described industrial growth.
By the building of new barrages it is possible to enlarge the arable land and to settle more farmers.
The tourism sector is much more influenced by infra - structure and electricity supply than by riots and by the industry built - up areas, so that new jobs can be created there.
But the growth of the population and by it of the labour force is much greater until 1993 than the growth of the active population, so that the unemployed increase until that date. It is not until 1993 that the increasement of the active population in each period is higher than the increasement of the labour force. Consequently, the unemployed and the employment quota are decreasing.

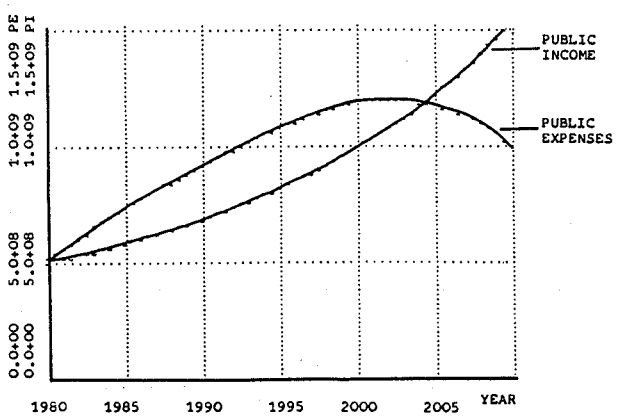

Fig. 9: PLOT PUBLIC EXPENSES, PUBLIC INCOME

The considered expenses of the state are first increasing . This can be explained by a higher repayment of credits as a result of the Mahaweli-project. When the project is finished, no more credits are necessary and the repayments are decreasing slowly. In addition to that, the state has to pay less unemployment benefits, because the unemployed are decreasing since 1993.
On the other hand, the increasing industrialization and the greater number of active population leads to more tax income.
Since 2004, the public income is even greater as the public expenses. This surplus may be used for other things.

5. SCENARIOS :

After the base run of the model, two scenarios were simulated, where first positive and than negative conditions for the Mahaweli - project in Sri Lanka were created.

a) The positive scenario:

Sri Lanka has, like the most development countries, a great population growth, which amounts at this time to 1.2% every year. The possible consequences of this growth are well - known since the report of the Club of Rome in " Limits of Growth ".
In the positive scenario, the death - rate is equal to the birth - rate, so that the population is stagnant and amounts to 14 million inhabitants.
The most important developments can be noticed in the rice import and the rice export. By the stagnation of the demand it is possible to export rice earlier and in a greater quantity.
But the number of unemployed as difference between labour force and active population can be reduced earlier by the stagnation of the population, although the number of the active population and the industrial growth are not as great as in the base run. This depends on the constant education expenses which reduce the number of qualified workers and consequently the industrial growth.

b) The negative scenario:

In the negative scenario, the development aid of the western countries of 50% of the Mahaweli - costs were cancelled.
Sri Lanka is left alone with its problems.
During the whole simulation time it is impossible to build a single barrage; credits which are necessary to finance the project are not available.
The rice production is much lower than in the base run because no arable land can be irrigated; the rice import increases more and more.
Because no new infra - structure and electricity are created, the industrial growth remains behind the values of the base run.
Less farmers, industrial workers and workers in tourism mean at the same time less active population and consequently essentially more unemployed, benefit payments and by that more public expenses.

The main results of the two scenarios are shown again in Fig. 10 using diagrams:

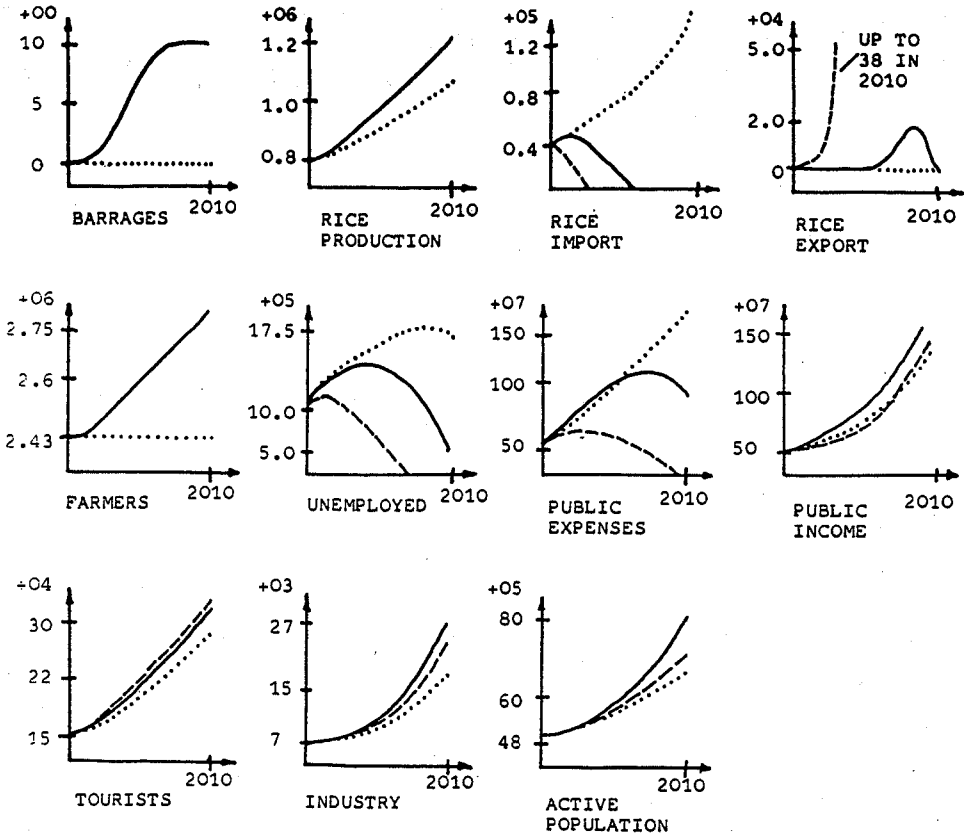

Fig. 10: Results of the base run

6. CONCLUSION :

The Mahaweli - project is of great importance for the state of Sri Lanka. If the project comes to its end, the country will get decisive advantages until the year 2000 and further.
If the project fails, it will be extremly difficult for Sri Lanka to solve its problems. For this reason, the western countries should absolutly provide the financial means. This has become evident in the negative scenario.
Sri Lanka can help itself by starting a program of birth - regulation. This has become obvious in the positive scenario.
Moreover, the model shows that in the time after the Mahaweli - project, Sri Lanka will get serious problems. This should be considered in the modern plannings.