Economic and Social Constraints in Establishing Sustainable Agricultural Systems in Hungary

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Regarding natural resources, Hungary can be considered as a country with medium level of supplies. We import most of the energy to cover our demands and we have small amounts of ores and water. However, we are relatively well off as far as the renewing and renewable resources are concerned. In Hungary the per capita agricultural area is over 0.6 ha, of which 0.48 ha is arable land. This is 38% more than the world average and is twice as high as the average of the West European countries /Table 1/.

Hungary is in a favourable position also regarding the quality of our soils and our other natural endowments, primarily the climatic conditions favourable to high standard agricultural production. Our country has so far managed these natural conditions well, and agriculture has always played a significant role in Hungary's economic life.

In addition to our favourable natural endowments and geographic location, our social conditions are of decisive significance in achieving our good results: these include proper agricultural policy and long-standing traditions in production. Agricultural development has been steady in recent years. The rate of growth has come to 3.0 to 3.5 per cent annually over the last 20 years, second only to the progress made in the Netherlands in the seventies. The development is even more impressive if the data of the last pre-war year are compared to the results of 1980. Table 2 shows the per capita production of major food items in 1938 and 1980.

In 1938 Hungarian agriculture produced the amounts required for the internal supply of the country of corn, potato, vegetables, wine. The meat, egg, and milk supply also covered the demands but the animal-protein-containing foods represented a smaller share within the consumption structure than at present.

Hungary has been a food-exporting country since 1980 with a simultaneous abundant supply of essential victuals in the internal markets. Although weather is a problem from time to time in certain crops, mainly in vegetables, this has no dramatic effect on supply. Food is an essential human need. Meeting the demand for food is an important component of social welfare. At present exactly 75% of the food produced is used for internal supply and 25% is exported. Fig. 1 shows the increase of food production and exports.

The significant increase of production has occurred on a steadily diminishing land area. Urbanization, industrialization and afforestation have removed significant areas from agriculture /Table 3/.

Significant changes occurred also in the number of people employed in agriculture. Between 1938 and 1980 the country's population increased from 10.1 to 10.7 million, and the work force increased, too, but the number of people employed in agriculture diminished markedly /Table 4/. Exactly 1.2 million workers left this sector while the total population grew by 600,000

Table 1

Per capita arable land in ha /in 1976/

World	All developing countries	Western Europe	Hungary
0.347	0.258	0.228	0.482

Table 2

Per capita food production in 1938 and 1980 /1980 = 100%/

Product	1938	1980	1938 relative to 1980
Corn, kg	712	1,308	54%
Sugar beet, kg	95	367	26%
Fruits, kg	30	164	18%
Wine, l	326	532	60%
Slaughter animals, kg	74	188	39%
Milk, l	150	230	65%
Eggs, pcs	83	409	20%

only. Agriculture released the labour required for the development of industry, services, and infrastructure, and in this way it acted as the reserve of human resources.

The above data show that the main factors of production growth were not the extension of land area or labour but the enhancement of the genetic potential of plants and animals, mechanization, the use of chemicals, better organization of work as well as a growing social role of agriculture. The growth of production also presented several problems. Intensive plant production promotes the degradation of soils, the nitrification of groundwaters, the eutrophication of surface waters, etc. The sales possibilities of the large volumes of produce marked out for exports always depend upon the absorption capacity of the international market, and so the country is exposed to its changes.

And the question may be posed at this point: is it necessary for Hungary to conduct such an intensive agriculture? Would it not be enough to change to self-sufficiency, which could perhaps also diminish the dangers

facing the environment? The answer is not easy, and can be given only after the joint assessment of all the social and economic factors.

Let us start from the point that today in the heart of Europe every citizen has the natural human need to live in peace, safety and welfare.

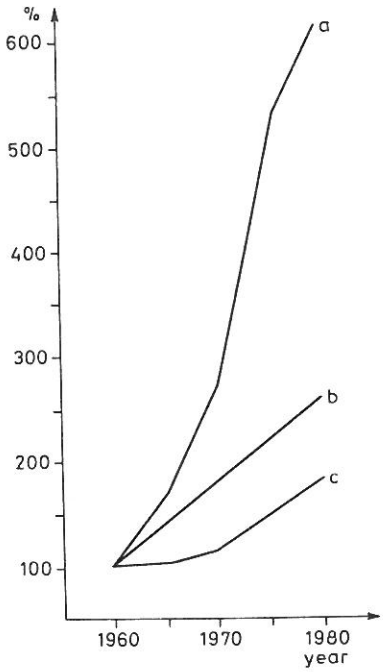

Fig. 1.

Increase of food production and export. a/ Food export; b/ Food production; c/ Agricultural production

Table 3

Agricultural land in 1938 and 1980
/in thousand hectares/

	1938	1980	Decrease
Agricultural land	7,557	6,627	12%
Arable land	5,618	4,735	16%

/Welfare means not only natural properties, e.g. proper housing, car, holiday home, garments, food etc. but also cultural life, education, health care and a pleasant natural environment as well./ In every country the welfare complex of the average citizen develops for each era according to specific historical and traditional reasons and these may be different from

country to country, but many features are in common as the essential biological requirements of human beings are identical.

The country's economic situation, the per capita amount of social product, the level of GDP /gross domestic product/ have a decisive effect on the welfare of the society, the morale of people. The welfare of society is

Table 4

Total and agricultural employment in 1938 and 1980

	1938	1980
Active workers	4,000,000	5,000,000
Agricultural workers	1,970,000 /49%/	765,000 /15%/

a function of material production. As it was already pointed out, Hungary is not rich in non-renewable resources. As much as 80% of oil consumption and 50% of gas consumption come from imports. We are self-sufficient in coal but do not export it. Iron ore comes fully from imports. Bauxite required for aluminium production is available in amounts permitting the export of aluminium products. Hungary's industry can be regarded as a sector of medium development. Bus manufacture, pharmaceutical industry, aluminium industry, machine tool industry, and a few areas of light industry are more advanced than the average. Technological renewal has slowed down in the industry in recent years, and microelectronics, computer science and telecommunication techniques are still in an early stage of evolution.

A significant part of our industrial products are not competitive in the world market. The crises over the last 10 years, such as the oil crises in 1974 and 1978, economic recession etc. have had a severe impact on Hungary as well. With some simplification it can be stated that the price of goods exported by Hungary rose only slightly while the items which are imported by our country became significantly more expensive. In other words, the change of the price structure has caused huge economic damages to Hungary. One of the many examples: oil price had a 9.4 fold increase between 1973 and 1983 while the price of food increased only 1.4 fold on the average. As a result the rate of economic growth has diminished. During the last five years the GDP rose once by 2.9%, twice the growth rate remained below 1%, and twice it was between 1 and 2%. The political leadership and the government set the aim of keeping the standard of living on the previous level in these years. This aim could be attained essentially, although in families with many children and in the group of pensioners the standard of living diminished noticeably. The balance of exports and imports was negative earlier and it has been positive in the last two years. Repayment of foreign debts accumulated earlier has started and in spite of all the difficulties the solvency of the country could be retained.

Now a few words about Hungarian foreign trade.

Of the imports 52.4% is transacted in convertible currencies and 47.6% in roubles. Of the export 57.2% is sold in convertible account markets and 42.8% in rouble account markets. Almost one third of the export revenue comes from convertible account markets through selling the products of agriculture and food industry or other goods of biological origin. Should this amount of foreign exchange be lost suddenly, the country would be in

a grave economic situation that could be countered only through stringent import restrictions and the reduction of consumption. The knowledge of this fact is extremely important for understanding and assessing whether a drastic reduction of agricultural production would be a reasonable action. Today there is no alternative way to obtain the missing foreign exchange.

Hungary's population is in close contact with the peoples of other countries. Last year exactly 10 million foreigners - as many as the country's population - visited Hungary, including three million from Western Europe and the USA. Of the Hungarian population 44% travelled abroad last year, over half a million in the West European countries. Hungarians face economic difficulties with discipline and understanding, and even with a good sense of humour; they are not isolated from the outside world and are fully aware of both the achievements and the problems. Hungarians demand the further increase of social and economic welfare, therefore they can adopt only a progressive outlook.

The long-term economic plan of the country has been completed recently, outlining the possible routes of development until the year 2000 in the case of various scenarios. The representatives of the scientific community actively participated in this work. During the final assessment it was found that no development alternative can be suggested realistically for the next 15 years without demanding a further increase of agricultural production. The bottom range of the planned growth paths demands 1.8% annual growth rate of agriculture while the top range aims at 2.3%. This means that we must develop agriculture and increase exports in this way or else the general standard of living may not be raised, education, healthcare, general services and the living conditions of pensioners may not be improved. Even in this case it will be possible for Hungary to reach the present per capita welfare indices of the industrialized West European countries only by the end of the century. It would be difficult to tell Hungarian youth that there is no further progress for them any longer and that they should be happy with what they have got.

What will be the price of this development? Will it not impose more hardships on future generations than lower production and consumption would inflict on us?

Unfortunately, we have experienced quite a few unfavourable phenomena in Hungary in recent years. The extent of arable land diminished and its quality deteriorated in almost a third of the country. Erosion losses are increasing. Potentially the gravest danger lies in the acidification of soils caused by high rate fertilizer application and the neglect of liming. Fig. 2 shows the proportion of soils with unfavourable characteristics.

The quality of waters has also deteriorated. In exactly 600 smaller settlements the water of the wells is not suitable for drinking any more because of high nitrate content. Partly high rate fertilizer use, partly the lack of canalization and sewage treatment in these areas are responsible for this. The eutrophication of our national treasure, Lake Balaton noticeably accelerated already in the mid-sixtees and by the end of the seventies some parts of the lake were affected to such an extent that swimming became unadvisable. The government introduced energetic measures for the regeneration of the lake, imposing a five-year-ban on construction, and constraints in later constructions, as well as launching large projects of chemical sewage treatment and the development of biological protection. In the last two years some improvement has been noticeable but it would be too early to draw a conclusion because these years were dry ones and there was less runoff from the catchment area into the lake than before.

The atmosphere is also polluted in Hungary. Of the fuels used in electric power generation coal and lignite account for 52%, and in further development this proportion will grow because the share of crude oil and natural gas must be diminished. For the time being coals are not yet desulfurized in Hungary, consequently, significant fly ash and sulfur dioxide

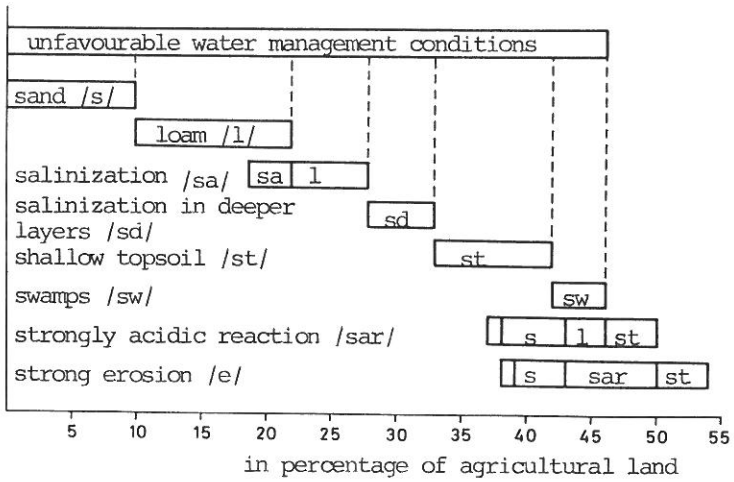

Fig. 2

The distribution of unfavourable soil characteristics

emission takes place. We have acidic rains and pollution gets to Hungary also from several European countries. In the forests tree losses have started, particularly in the case of pine and oak.

In addition to environmental problems there is another factor which must be noted in the assessment of intensive agriculture: the amount of materials and energy agents used in agriculture has grown dramatically. At the present production level materials and products of industrial origin account for 60% of the input. In the country's energy balance agriculture uses directly 7.9% only, but indirectly - if the energy needed for the production of fertilizers, machines, packaging materials etc. is also calculated - the figure comes to over 20%.

Consequently, the full system of agricultural production is to be reassessed. Sustainable systems must be devised which permit the maintenance of the production level, or even its increase, but, at the same time, exercise smaller direct impact on the environment and the applied processes consume less material and energy.

Sustainable agriculture is frequently regarded tc be equivalent with agriculture using no chemicals. We believe this is a gross oversimplification of the case. Chemical materials are different and we may not speak of chemicals in general. Plastics, for instance, do not deteriorate water or soil quality. Among the fertilizers potassium caused no problem and phosphorous presents a difficulty only if runoff takes it into shallow lakes and eutrophication is accelerated. Phosphorus is a component of the soil. Nitrogen fertilizers indeed may have deleterious effects. Of the plant-protecting chemicals the unfavourable effect of herbicides is not signifi-

cant either. Among the insecticides, however, there have been and are several preparations which cause drastic changes in the fauna of the ecosystem. That is, chemicals are not harmful in general but the use of some of them may really present environmental problems.

The use of herbicides may not be given up because of the restructuring of labour today, as it is indicated by the following example.

Maize is a leading crop in Hungarian agriculture. It is grown on 23 to 24% of the arable area and accounts for almost one half of the corn production. Maize provides the essential feed base for pig and poultry breeding. We can achieve 5 to 6 tons of grain yield per hectare only if the field is free of weeds. With the present technology - that means the herbicide treatment of the full area - 1.1 million manhours are used for weed control, and 16,700 people carry out this operation. In the case of manual hosing 287 million manhours and 1.5 million workers would be needed. As mentioned before, at present 765,000 people are employed in agriculture, and as there is a shortage of labour in Hungary, it would clearly be impossible for us to propose today giving up the use of herbicides in maize production.

We would like to treat briefly the questions of fertilizer use, yield increase and the environmental impact. Fig. 3 shows the average yields of wheat, maize and alfalfa in Hungary from 1895 up to the present.

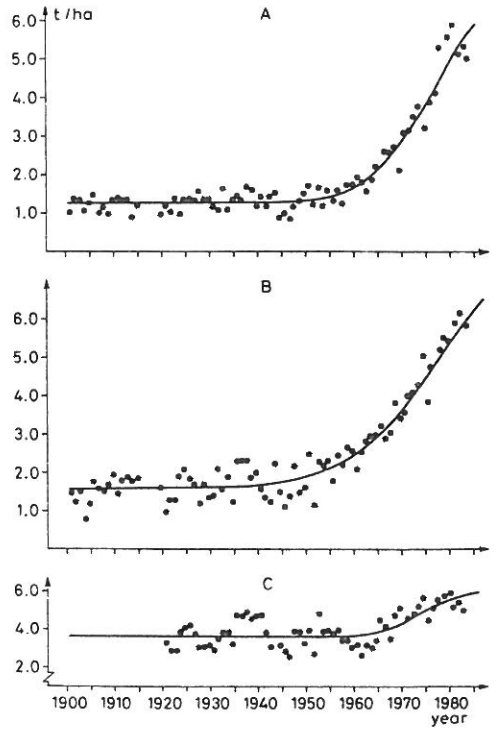

Fig. 3

Average yields of wheat /A/, maize /B/ and alfalfa /C/ in Hungary

Dynamic yield increase of wheat and maize can be observed after 1960. One hectare area of arable land, garden and orchard received 30 kg of fertilizer in 1938, 49 kg in 1960, 150 kg in 1970, and 270 kg in 1980. Naturally, other yield-increasing factors also acted, such as the introduction of new, improved plant varieties, mechanization /permitting tillage at the proper time/, the use of herbicides etc. Nevertheless there is obviously a very close correlation between yield and fertilizer use /Fig. 4/. The same trends were observed in other countries of the world.

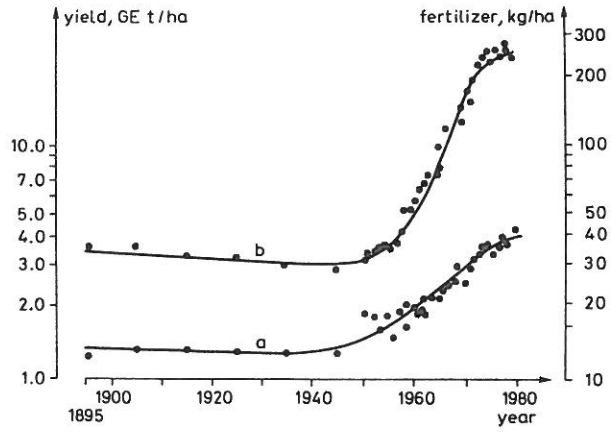

Fig. 4

Average yields /a/ and fertilizer inputs /b/ in Hungary between 1895 and 1980

Fig. 5 shows that at a higher production level ever-increasing amounts of fertilizers are needed to grow a unit amount of products. This phenomenon is unfavourable for the environment and also reduces cost-effectiveness.

The plants receive nutrients from several sources. Hungarian agrochemists prepared the national nutrient balance in 1980. Approx. 2 million tons of nitrogen, phosphorus and potassium /active ingredients/ were taken up by the cultivated plants. The proportion of the various nutrient sources are given in Table 5. In the calculations we started from the amounts of nutrients that can actually be taken up by the plants. At present manures, by-products, legumes etc. supply 30% of the nutrient requirement of cultivated plants in Hungary. Fertilizers as an input represent 70% of the nutrient supply.

Naturally, this 70 to 30 ratio can be changed by increasing the share of nutrients originating from organic matter. We would like to enhance this trend by all means. Last year an interdisciplinary study was completed on the possibilities of the complex utilization of biomass in the long run in Hungary. An important finding of this study indicates the necessity to increase the amount of organic matter returned into the soil. It is recommended to plough in 2/3 of all the plant by-products produced in the field either directly or in the form of manure.

So the proportion of nutrient sources is expected to change in the future. It may even come to a 60:40 ratio, that is 60% fertilizers and 40%

from other sources. Using exclusively organic matter the nutrient requirement of the plants in the whole country, permitting the present production level, cannot be met. Naturally, in smaller regions, in individual farms it is possible to conduct high-level farming with organic matter only. If there

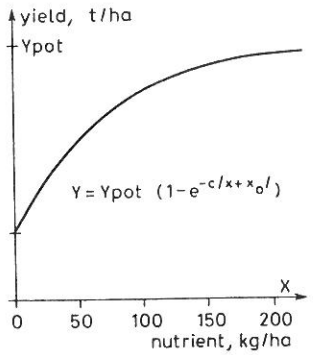

Fig. 5

Functional relationship between yield and nutrient requirements

Table 5

Nutrient supply in plant production in 1980
/100% = 2 million tons/

Source	Relative to total amount
Fertilizer	70%
Livestock manure	11%
By-products	10%
Legumes	2%
From the air	4%
Liquid manure	2%
Sewage-slime	1%

is a demand in the markets for produce not treated with chemicals, this demand must be catered to. In the family gardens, of which there are over 2 million in Hungary, it is right and preferable to urge production with minimum amount of chemicals or completely without chemicals, as the labour expenses are regarded here in a different way, and sufficient compost can be made from waste and by-products.

Calculations were made to see what would happen in Hungarian agriculture if overnight we would stop using fertilizers. In two years crop yields would diminish by 33% at least resulting in the reduction of stock-breeding output at an even higher rate. National income lost in this way would be equal to the amount that is at present spent by the country on health care

and education. At the same time food exports would have to be discontinued, what is more, imports would become necessary. Obviously, we cannot go this way as this would lead to economic disaster.

After this brief treatise the question is posed: is there a way out of the situation? If the present practice is continued, it may have far-reaching consequences in the future. If drastic limitations are introduced in the use of chemicals, it may lead to the loss of social and economic equilibrium.

Many possibilities for solutions exist. I wish to sum up briefly the ones that are regarded as realistic and feasible. Five main trends will be listed, which are not exclusive but complementary alternatives.

1. Changing the genetic potential of plants without exclusively aiming at the increase of quantitative indices but concentrating increasingly on qualitative factors and the ecclogical adjustment possibilities of plants. One of the tasks of plant improvement is to achieve better relations between genetic properties and nutrient utilization.

2. More-enhanced utilization of biological uptake of nitrogen in plant production. Extending the area under legumes is limited by several economic and agro-engineering factors but the biological reserves are not yet fully exploited, even at the present level of expertise. Genetic engineering methods are expected to result in a breakthrough perhaps already in this century.

3. The complex utilization of biomass is an essential factor in the sustainable agricultural systems. Vast amounts of organic matter are wasted in agriculture, food industry and human settlements. Economic incentives and subsidies must be provided to urge more efficient utilization. Biogas production has again been put on the agenda, and it is hard to tell what is more valuable, the gas as an energy source or the technology which is friendly to the environment. Most probably the two should be regarded together.

4. The application technology of chemicals must be improved continuously to minimize the negative impact on the environment.

5. Large reserves exist also in the field of ecological optimization. In plant production this means a sowing structure adjusted to the ecological conditions in an optimum way, permitting the raise of production level, and, at the same time, the reduction of nutrient need per unit production. This way high yields could be maintained with lower fertilizer input or increased with the currently used amount of fertilizers through the better utilization of ecological possibilities.

The feasibility of this approach is proved by the results of an actual model designed to evaluate both farm conditions and the various nutrient sources. Regarding soil science and agrochemistry significant professional assistance was received from J. SARKADI and his associates /Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences, Budapest/. The model included the three most important field crops: maize, wheat, and alfalfa cultivated on 2/3 of the arable land in Hungary. Soils were classified according to productivity and nutrient supply potential. Altogether 26 production area types were distinguished. According to the Mitscherlich equation the nutrient requirement was calculated for each type of production area on the basis of data obtained partly from the literature and partly from empirical findings. The following sources of nutrients were taken into account: fertilizer, manure, organic by-products, N-fixation by legumes, as well as the natural nutrient supply potential of soil and air.

In the planning of fertilization one of the most frequently ignored factors is the after-effect. This means the following: for a given amount of production a larger amount of nutrient is applied than what is taken up by the plant. The nutrient not taken up by the plants must be taken into account. One part of it will be accumulated and must be considered when planning the nutrient need for the year after, another part is leached out and lost. If the accumulated available nutrients are not taken into consideration, then the excess may cause environmental problems.

Optimization has been worked out for various levels. An example is given below: It is assumed that 5.5 million tons of wheat, 6.5 million tons of maize, and 2.2 million tons of alfalfa must be produced. The total nitrogen requirement is 287,000 tons of which 159,000 tons are supplied by fertilizers in the first year. The demand for fertilizer will diminish to 126,000 tons by the fourth year if the sowing structure and nutrient supply are planned for a longer period, say for 5 years in this case. The fertilizer saving is exactly 20%. For this example the N requirement as well as the composition of inputs are shown in Table 6.

Table 6

N-requirements for a given amount of crops produced in 4 years, and the structure of supply

N-source	Total N requirement	
	in the first year 287,000 tons	in the fourth year 276,000 tons
	Structure of supply in per cent	
Fertilizer	56 /159,000 tons/	46 /126,000 tons/
Manure	18	19
By-product	4	4
Legumes	4	4
After-effect	18	24

The results clearly show that in addition to fertilizers other nutrient sources must also be taken into account, as one half of the full need can be covered from these additional sources in the present case. Significant nutrient savings can be achieved if the sowing structure and nutrient supply are planned for a longer period of time.

In conclusion I wish to emphasize that a sustainable system of agriculture must be developed and applied in each country according to its specific economic, social, and technological conditions. There are correlations valid for several countries that can be generalized, and there are also numerous local features. The international exchange of experience may help a lot in identifying the proper methods. In Hungary we are taking the first steps in this work, and we would willingly consider the adoption of all useful methods.