BACKGROUND AND REQUIREMENTS FOR THE SOVAM: SOVIET AGRICULTURAL MODEL

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FOREWORD

Understanding the nature and dimensions of the world food problem and the policies available to alleviate it has been the focal point of the IIASA Food and Agriculture Program since it began in 1977.

National food systems are highly interdependent, and yet the major policy options exist at the national level. Therefore, to explore these options, it is necessary both to develop policy models for national economies and to link them together by trade and capital transfers. For greater realism the models in this scheme are kept descriptive, rather than normative.

Over the years models of some twenty countries, which together account for nearly 80 percent of important agriculural attributes such as area, production, population, exports, imports and so on, have been linked together to constitute what we call the basic linked system (BLS) of national models. One of the models is a model of the European member countries of the Council for Mutual Economic Assistance (CMEA) treated as one nation.

For analyzing a number of policy issues of interest to these countries we need to develop detailed national models for the CMEA countries. A model for Hungary is already developed and work is in progress for the development of models of Bulgaria, CSSR, Poland and the USSR – with the help of collaborating groups in these countries.

A first step in the development of the agricultural model of the USSR was a review of the background for the development of agriculture in the USSR and an assessment of the requirements that a model useful for policy analysis should meet.

Dr. Vladimir Iakimets presents here such a review and assessment.

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Vladimir N. Iakimets.

1. Introduction

The development of a set of linkable national models for agricultural policy analysis begun at IIASA, in 1977 within the framework of the Food and Agriculture Program (FAP) in collaboration with a network of institutions from different countries and international organizations. The main purpose of this work from the beginning was to create a tool for studying the effects of a country's governmental policy measures on the national and international food and agriculture situation and inverse effects of other countries governmental decision and measures undertaken by international organizations on the domestic food situation in each country. For a more detailed description of the FAP objectives, see for example (K. Parikh and F. Rabar (eds), 1981; K. Parikh, 1981, M. Keyzer 1980, G. Fischer and K. Frohberg, 1980).

The current state of the art of the FAP activity can briefly be evaluated as follows:

- the methodology for the construction of national models with a common structure was created;
- the approach for linkage of these models on the basis of the general theory of economic equilibrium was developed;
- the software for implementation of calculations was originally developed;
- the simplified and some detailed versions of national models and models of groups of countries were developed by the FAP and the network of collaborating organizations;
- the development of reference and some policy scenarios was made;
- a number of runs for study of trade liberalization scenarios with the help of created system of models was made.

The aims of this paper are:

- to characterize the common requirements that a national agricultural policy model should meet so that it may be linked to other national models used at IIASA.
- to give a short description of the current state of Soviet agriculture and tendencies in its development, and

- to determine the specific requirements for the Soviet Agricultural Model (SOVAM) from the point of view of their correspondence to the main directions of the country's agro-food complex development and to outline the conceptual framework for the SOVAM.

2. Common requirements of national agricultural policy models

In order to organize the interaction of different countries agricultural policy models these must meet several general requirements. Each national policy model has to reflect, by definition, the specifics of the country's food and agricultural system and their own government's measures. Furthermore, some common requirements generated mainly by a general equilibrium approach which had been accepted and adopted for the global linkage are imposed on each national model.

These requirements are the following:

(1) The national models commodity list must be the same as that of IIASA. It means that the national statistics on the wider list of commodities must be transformed from the initial data to the aggregated one in order to meet the classification of the FAP commodity list. The implementation of this requirement leads to the execution of enough hard work to prepare the aggregate files. The main steps of this work have to follow the aggregation procedure developed by G. Fischer and U. Sichra, 1983. It should be noted however that each country's modelling team can use a wider list of commodities than there is in the FAP commodity list. A wider list may be required for example in order to reflect the specifics of the country's agricultural sector. But in that case it is necessary to develop a number of additional procedures to aggregate and disaggregate the commodity list, because each model participates in international exchange within a framework of the global linkage with the same commodity list.

(2) Each national model must work within a 15-20 years time horizon and the time increment is one year. This requirement means that each model must describe the long-range perspective of the agricultural sector's development and each year's changes in the domestic production, consumption and government measures should interact within the accepted approach. It should be pointed out also that the requirement of a common time increment has to be accepted in order to meet the condition of the equilibrium world price calculations.

(3) It is also assumed that agricultural production is given at the time point for exchange. In other words it means that at the time of making the production decisions information is available from the exchange of previous years only and that during exchange these production decisions, and hence supply, cannot be revised. This requirement is determined mainly in order to reduce the computational complexities and provide the flexibility in each model's supply module conceptualization.

(4) Each country's agricultural policy model has to be closed. It means that the behaviour of the whole economy must be described. For the sake of simplicity this requirement led to the representation of the rest of the economy of each country with the help of one aggregated commodity. For instance, the rest of the economy may be modelled by a Cobb-Douglas production function but need not be so modelled.

(5) A very important requirement for the national model is that the country's governmental decisions influencing the agricultural sector's development and the trade in food and agricultural commodities must be explicitly formulated. It means that the policy module of each national model must describe at least two types of governmental decisions: concerned with internal production and exchange of commodities both domestically and internationally.

(6) Net export of each commodity must be a function of world market prices. The country's net excess demand function for each commodity has to be homogeneous of degree zero in world market prices and its trade deficit. Thus inflation, which affects all prices by the same proportion, has no impact on the net exports of the country.

All abovementioned requirements imposed on the national model must naturally be adjusted to the specifics of the country's economy.

3. Specific requirements for the SOVAM and its conceptual framework.

It is clear that apart from all the abovementioned general requirements, national agricultural models have to meet a number of special requirements in order to reflect the peculiarity of the country's agro-food sector, its potential and tendencies for development.

This section is devoted to the description of the current state and main directions of development of Soviet agriculture. On the basis of such a description some conceptual points for the SOVAM construction are formulated and specific requirements which have to be met are identified and how they will be met are outlined.

3.1. General Indexes

In accordance with the decisions of the 26th CPSU Congress the USSR Food Program was elaborated and adapted in May 1982. The period of this program ends in 1990.

The main objectives of the Food Program are:

- to raise the standard of living of the agricultural workers and to improve living and working conditions in the countryside;
- to ensure a stable supply of the various types of foodstuffs for the country's population and agricultural raw materials for industry;
- to increase the consumption of high-quality food commodities on the basis of scientifically determined norms.

These goals are formulated in order to implement the strategic plans for the further growth of the national economy. Success in accomplishing the tasks of USSR social and economic development is currently dependent on accelerating the rates of development of the country's agro-industrial sector.

To attain these objectives the following directions were determined:

- proportional and balanced development of the USSR agro-industrial complex, improvement of management, planning and economic stimulation in all its branches with maximal orientation of production for the attainment of a high final result;
- provision of high growth rates of agricultural production on the basis of step-by-step intensification, effective utilization of land, every kind of strengthening of the material and technical basis, speeded up introduction of advanced methods of work and scientific achievements;

- every kind of improvement in the utilization of industrial and technical potentials of the agro-industrial complex, considerable increases in returns from capital investments and material resources, development of specialization and concentration of production on the basis of a broadening cooperation of different branches;
- reduction of losses and increase of quality of agricultural commodities on the basis of wide application of progressive agricultural technologies and technologies of processing and storage of products;
- further improvement of living conditions in the country-side.

The Soviet Union has achieved much in the development of its industrial output. If we compare the growth of output in the key industries yearly since 1940, then we can observe these achievements (Table 1).

Table 1. Growth of output in basic industries (1940 = 1)

	1940	1965	1970	1975	1980	% annual growth rate 1970-80
Total industrial output	1	7.9	12	17	21	5.76
Power industry	1	12	18	26	33	6.25
Fuel industry	1	4.8	6.4	8.5	9.8	4.35
Ferrous metalurgy	1	7.0	9.3	12	13	3.41
Chemical and petrochemical industry	1	15	27	44	58	7.95
Machine building and metal working	1	16	28	49	72	9.90
Light industry	1	3.1	4.7	5.9	7.0	4.06
Food industry	1	3.5	4.7	6.1	6.5	3.30

Source: The USSR economy in 1980, pp. 37, 126

Comparative estimations of such main indices of the USSR economic development such as national income, industrial and agricultural output, production of producer and consumer goods, and labour productivity for the period 1940-1980 are given in Table 2.

Over the past twenty years, the living standard of the Soviet people have significantly improved. The average monthly earnings of workers have more than doubled between 1960 and 1980 in the USSR. There have also been increases in various payments and benefits from the social consumption funds and increases in pensions. This had lead to increasing demands by the Soviet people. For example, from 1965 to 1980 the per capita consumption of meat and meat products went up by 41 percent, milk by 25 percent, vegetables by 35 percent, and eggs by almost 100 percent (P. Paskar, 1983, p.6). The population grew by 35 million in the same period.

Soviet agriculture for this period made considerable progress (see Table 3). For instance, the average annual production of grain rose from 130.3 million tons in the 7th five-year plan period to 205 million tons in the 10th period (1976-1980).

Table 2. Development of the national economy (1940 = 1)

	1940	1960	1965	1970	1975	1980	1980/ 1960
National income	1	4.4	6.0	8.7	11.4	14.1	3.20
Industrial output	1	5.2	7.9	12	17	21	4.04
Producer's goods	1	6.6	11	16	23	29	4.39
Consumer goods	1	3.2	4.4	6.5	9.0	11	3.44
Labour productivity	1	4.0	5.3	7.4	9.2	10.8	2.70
Agricultural output	1	1.6	1.8	2.2	2.3	2.4	1.50

Source: The USSR economy in 1980, pp.37-38

Table 3. Dynamics of the Soviet Agricultural Output

Indexes	7th five-year period 1961-1965	8th five-year period 1966-1970	9th five-year period 1971-1975	10th five-year period 1976-1980
	annual average			
1. Gross farm output (in comparable 1973 prices) 1,000 million roubles	82.8	100.4	113.7	123.9
2. grain (mill. tons)	130.3	167.6	181.6	205.0
3. raw cotton (mill. tons)	4.99	6.10	7.67	8.93
4. sugar beet (mill. tons)	59.2	81.1	76.0	88.7
5. vegetables (mill. tons)	16.9	19.5	23.0	26.3
6. meat (slaughter weight) (mill. tons)	9.3	11.6	14.0	14.8
7. milk, (mill. tons)	64.7	80.6	87.4	92.7
8. eggs, 1000 million	28.7	35.8	51.4	63.1

Source: The USSR economy for the period 1922-1982, p. 227

Despite these facts the steadily increasing demands of the Soviet people require further growth in agricultural output and further improvement in the structure of their diet.

It should be noted that growth rates of agricultural output in the Soviet Union could be higher. However in the first post-war decade the main efforts were devoted to the large scale rehabilitation work.

At present Soviet agriculture is a highly intensive sector of the economy. As was seen in Table 3, agricultural output has been boosted over the past 20 years. The high rate of intensification in Soviet agriculture is due to sizeable capital investments. The scale and pace of intensification are determined by

the agricultural enterprises in collaboration with Government. For these years a system of state measures for stimulation of agricultural production was created in order to help the farms in the intensive development of cropping and stock breeding. The high rate of intensification in USSR agriculture is illustrated in Table 4.

Table 4. Intensification of the USSR Agriculture (1940 = 1)

Indexes	1940	1965	1970	1975	1980
1. Area under crops	1	1.39	1.37	1.45	1.44
2. Value of agricultural production assets including livestock (at the end of year)					
–total	1	4.59	6.61	10.87	15.81
–for 100 ha of farmland	1	4.08	5.85	9.56	13.81
3. Gross farm output	1	1.8	2.2	2.3	2.4

Source: The USSR economy in 1980, pp. 37, 212, 224

As can be seen from Table 4, the sown areas for this period increased by 40 percent and total gross farm output by 140 percent. To ensure further accelerated intensification of agriculture during the 1980s, the Soviet state will continues to concentrate funds and resources in order to tackle the problems arising from the targeted growth of agricultural production. Within the framework of the agro-industrial complex, the problem of further intensification is formulated in order to increase crop yields and livestock productivity and intensify the utilization of input resources (labour, capital, fertilizers and so on) to improve the diet structure of Soviet people, etc.

It was stressed at the CPSU Central Committee's plenary meeting in May 1982 that adopting this Food Program has both economic and political significance. According to this program in the 12th five-year plan period (1986-1990) the state shall allocate, for the national agro-industrial complex, capital investments amounting to 33-35 percent of the total capital investments in the national economy (and including 27-28 percent of the total for agriculture).

The diet of the Soviet people is quite sufficient now in terms of calories. The diet pattern has improved considerably over the period from 1950 to 1980. These changes in the per capita consumption of foodstuffs are given in Table 5.

Table 5. Per capita annual consumption of foodstuffs (in kg)

	1950	1965	1970	1975	1980	1990* (planned figures)
Meat and meat products (including animal fats and byproducts)	26	41	38	57	58	70
Milk and dairy products (in terms of milk)	172	251	307	316	314	330-340
Eggs (pieces)	60	124	159	216	239	260-266
Fish and fish products	7	12.6	15.4	16.8	17.6	19
Vegetable oil	2.7	7.1	6.8	7.8	8.8	13.2
Potatoes	241	142	130	120	109	110**
Vegetables and melons	51	72	82	89	97	126-135
Fruits and berries	11	28	35	39	38	66-70
Breads and cereal products	172	156	149	141	138	135**
Sugar***		34.2	38.8	40.9	42.2	45.5

Source: N. A. Tikhonov, p. 180
* The USSR economy for the period 1922-1982, p. 73
** K. Bogolyubov, p. 113
*** The USSR economy in 1980, p. 405

The data in Table 5 shows us that the consumption of high-quality protein rich food products has been increasing for the period under consideration. The last column of this table contains the data for the desired level of the per capita consumption of these foodstuffs, determined in the USSR Food Program. The problem is to improve the structure of the diet, particularly to increase the share of meat, milk and vegetables in it.

At present bread and cereals satisfy 30 to 50 percent of man's energy requirements, 30 to 40 percent requirements in protein, 50 to 60 percent in vitamin B and up to 80 percent in vitamin E. (P. Paskar, p.14) The aim of the Food Program is to improve the diet by increasing the share of protein consumption. According to the Food Program the per capita consumption of stable foodstuffs will be: meat and meat products - 70 kg, fish products - 19 kg, milk and dairy products - 330 -340 kg, eggs - 260-266 units, vegetable oil - 13.2 kg, vegetables and melons - 126-135 kg, fruit and berries - 66-70 kg, potatoes - 110 kg, sugar - 45.5 kg and bread and bakery products - 135 kg.

According to the Food Program the functioning of the whole agro-industrial complex in the country needs to be improved. In order to achieve this it will be necessary to implement corresponding changes and establish a new correlation of intersectoral ties, because now an imbalance exists in development rates among the branches of industry which are connected with agriculture: transport, processing, services and so on. Implementation of these tasks should lead eventually to qualitative changes in the national economy and to the creation of new economic mechanisms.

During the current and the next five-year plan period, the question of investment efficiency, increases in the agricultural productivity of soil

utilization, production capacities in agriculture, labour, and material resources, better coordination of links between agriculture and other branches of agro-industrial complex must be addressed.

The main goals for the next decade are:

- increase labour productivity 1.5 times
- increase agricultural output per hectare by 30 percent
- reduce considerably the expenditure of resources per unit of agricultural output
- reduce losses of all types of agricultural products (for example by improving the protein balance in feed).
- reduce expenditures of feed per unit of livestock output 5-7% in 1990 compared to 1980.
- increase return on mineral fertilizers by 12 - 15% through rational allocation and utilization.

It is clear that these main directions and tendencies for the future development of the USSR agrofood complex determined in the Food Program have to be taken into account during the SOVAM construction.

3.2. Natural conditions and weather factor

The natural conditions are not very favourable for agricultural activity in the Soviet Union. More than 60 percent of the farmland lies in too dry or too moist areas. (For comparison this figure is only 1% in the USA). Only 1.1 percent of the plowland in the USSR lies in zones with 700 mm annual precipitation level (this level provides favourable conditions for guaranteed big harvests). For comparison in the USA 60 percent of plowland lies in such favourable zones (N.A. Tikhonov). In addition more than 50 percent of the total plowland of the USSR (~ 100 million ha) are poor in phosphorus.

The weather is a very important factor influencing the agricultural output in the USSR. Vast damage is caused to agriculture by droughts which periodically hit main agricultural regions. The analytical data of climatic conditions on the territory of the USSR given by Yu. A. Izrael (On measures for the country's Food Program implementation, Planovoe Khozyaystwo, V.4. 1983) is given in Table 6.

Table 6. Data on the droughts

Type of droughts	Decrease in grain yields in %	Occurence of droughts, 1 time	Years
extraordinary	30-40	in 100 years	1975
extreme	20-30	in 10-15 years	1963,1965,1981
severe	10-20	in 5-7 years	1954, 1955, 1957, 1967 1972, 1973, 1980
moderate	5-7	in 4 years	1951, 1964, 1969 1974, 1982

The grain output of the Soviet Union strongly depends on weather conditions. In Table 7 one can see the yearly variability in the range of outputs of grain crops. Taking into account that the total acreage for the period under consideration had slight changes we can say that approximately the same variability in grain yield had occurred. It should be noted, however, that due to intensification of agricultural production the general tendency to the grain output growth is observed. The huge capital investment planned for agriculture will also be oriented towards the development of new agricultural technologies to reduce the dependency of output on weather conditions.

Table 7. Dimensions of variability of crop production

	Grain Output, mill. tons			Variability amplitude	
Five year period	in average annual	max	min	max-min, mill.t	in percent to average
7th (1961-1965)	130.3	152.1	107.5	44.6	34.2
8th (1966-1970)	167.6	186.8	147.9	38.9	23.2
9th (1971-1975)	181.6	222.5	140.1	82.4	45.4
10th (1976-1980)	205.0	237.4	179.3	58.1	28.3

Source: J. Yakunin, p. 69.

It is evident that the specific character natural conditions of the USSR and the weather factor have to be reflected within the framework of the SOVAM.

3.3. Capital Investment

The next important feature of the SOVAM is its capacity for considering governmental decisions determining the different variants of transformations in capital investments, acreage distribution, fertilizer application and so on.

Let us describe briefly the recent situation with the main input resources listed above in order to understand what kind of decisions we need for improvement of the resource utilization.

For the last 15 years the Soviet state implemented essential redistribution of resources and capital investments in favour of agriculture. In N.A. Tikhonov the following figures are given: between 1918 and 1982 investments in agriculture made up 565.000 million roubles. More than 80 percent of it (458.000 million roubles) were spent between 1966-1982. For this period (three last five-years) the main fixed capital and material circulating capital in agriculture were increased by a factor of 2.5. It provided for an increase in agricultural output of 7.7 times in spite of unfavourable weather conditions in several years during this period. Up to the beginning of the recent five-year period the capital fixed for agricultural equaled 217.000 million rubles. It should be noted that these investments were of a long-range nature. They were connected with expenditures for increasing fixed capital (buildings, machinery, productive livestock and so on). Such strategy in capital investment provided essential strengthening of the material base of Soviet agriculture.

For example, before 1980 virtually full provision for housing of livestock was achieved. The previous capital investments structure could be described as

extensive. To increase returns on capital investments, it has been suggested to increase part of the circulating capital (seeds, fertilizers, pesticides, feed and so on).

According to N. Borchenko, (p. 36) the bases for increasing the growth rates of agricultural output is to improve the utilization of circulating capital under moderate growth rates of fixed capital, stabilization of acreage and slight increases in the livestock population. In the above cited paper it is noted that during the period of the Food Program, considerable changes will be made within the framework of production. The part of capital investments directed to soil improvement will be increased, the crop production output (mainly feed output) and livestock production output will be increased and storage facilities will be improved. Improving the safety of products, enlargement of facilities for treatment and packing of food commodities etc, will be a major concern. For the 11th five-year period (1981-85) 190,000 million roubles will be provided for the development of agriculture. And the structure of these investments is different compared to that for the previous five-year period. Let us note that almost the same amount (190,000 million roubles at constant prices) was spent in the agricultural sector between 1918 and 1970.

The recent strategy and future tendencies in capital investments for USSR agriculture have to be reflected by corresponding means within the framework of the SOVAM (for example by different scenarios).

3.4. Fertilizer production and application

One of the more important input resources in crop production is fertilizer. It is estimated by agricultural scientists that 50 percent of crop yield increase is provided by mineral fertilizer application (N.G. Peshev, p. 6). For comparison (I. Chrulev, 1972) specific weight of meteorological factors is estimated to be 15 percent, hybrid seeds - 8 percent and irrigation - 5 percent. Then according to the Food Program one of the main factors for the intensification of the agricultural production is the further development of utilization of chemicals. For the period from 1965 to 1980, in the USSR there was a rapid growth in mineral fertilizer deliveries to farms. The figures are the following: deliveries of mineral fertilizers from 6.3 million tons (in terms of 100 percent content of nutrients) in 1965 increased to 18.8 million tons in 1980 (3.3 times); deliveries of feed chemical additives from 16 thousand tons to 520 thousand tons (32 times) and farm chemicals from 350 to 658 thousand tons (1.9 times).

Organic fertilizer application for this period increased 2.2 times from 359.2 million tons in 1965 to 803 million tons in 1980.

In 1980 the average per hectare fertilizer application in the USSR was 76 kg (in terms of nutrients) including 51 kg for grain, 215 kg for corn, 417 kg for cotton, 438 kg for sugar beets, 190 kg for flax, 59 kg for sunflower, 294 kg for vegetables, 274 kg for potatoes, and 63 kg for feed crops, (O. Sokolov, p. 111). In the same year the average per hectare organic fertilizer application was equal to 3.9 tons including 2.1 tons for grain crops, 7.5 tons for cotton, 20 tons for sugar beets, 22.8 tons for vegetables, 46.1 tons for potatoes and 3.7 tons for feed crops (O. Sokolov, p.111).

Today the Soviet Union takes the first place in the world in total mineral fertilizer production. The comparative growth of mineral fertilizer production is given in Table 8 (extracted from N.G. Peshev, p.10)

Table 8. Mineral fertilizers production by years (in terms of 100 percent content of nutrients, mill. tons)

	1960	1965	1970	1975	1980
World	29.6	45.5	67.4	102.3	127.9
USSR	3.3	7.4	13.1	22.2	31.5
USA	7.4	11.0	14.6	21.9	

According to (P. Paskar, p. 26) an analysis of mineral fertilizer utilization shows that for the period 1976-1980, the average annual additional production owing to fertilizer was 32.2 million tons of grain, 3.3 million tons of raw cotton, 26 million tons of sugar beets, 9 million tons of potatoes, 5.5 million tons of vegetables, 120 thousand tons of flax fibre, 600 thousand tons of sunflower seeds

It is considered that in future Soviet agricultural crop production will require the provision of mineral fertilizer deliveries with average proportion N:P:K = 1:1:1 (N.G. Peshev).

For the period from 1950 to 1975, the share of nitrogen fertilizers within the total volume of production increased from 25 to 35 percent, and the share of phosphorous fertilizers decreased from 42 to 26 percent. The increase of the nitrogen fertilizers production was connected with the development of feed base, for livestock production.

Changes in deliveries of mineral fertilizers to farms by years are shown in Table 9.

Table 9. Delivery of mineral fertilizers to agriculture

	million tons in terms of 100 percent content of nutrients				Proportion		
Years	N	P_2O_5	K	Total	N	P_2O_5	K
1940*	0.16	0.35	0.22	0.73	1	2.19	1.38
1950**	0.31	0.53	0.42	1.26	1	1.71	1.35
1960**	0.77	1.08	0.77	2.62	1	1.40	1.00
1965*	2.28	2.09	1.89	6.27	1	0.92	0.83
1970*	4.60	3.13	2.57	10.32	1	0.68	0.56
1975*	7.34	4.73	5.18	17.25	1	0.59	0.70
1980*	8.26	5.6	4.9	18.76	1	0.68	0.59

Source:
* The USSR economy in 1980, p.237
** The USSR agriculture, pp. 137-143

Analysis of data from Table 9 shows that the total production and delivery of mineral fertilizers to agriculture increased 15 times from 1950 to 1980. However for this period the share of different fertilizers in total volume drastically

changed in favour of nitrogen fertilizers, and now we need to learn what structure of this production would be more preferable.

Another question related to the increasing efficiency of mineral fertilizer application requires the solution of the problem of a rational distribution of fertilizers for agricultural crops. Comparative data of actual and normative efficiency of fertilizer application for different crops are given in Table 10.

Table 10. Efficiency of fertilizers application

Crop	*gain in yield in metric centner per 1 metric centner of increase of fertilizer application		**Application (in 1980)	
	normative	actual	kg/ha (in terms of nutrients)	return per each ruble of expenditures on fertilizers, ruble
1. Potato	26	9	274	2.75
2. Vegetables	46	13	294	2.16
3. Sugarbeets	23	11	438	0.57
4. Raw cotton		2.7	417	1.86
5. Grain	4.4	4.9	51	0.88

* extracted from Planovoe Khozyaystwo, V.4. 1983
** O. Sokolov, 1982, p.111-112

These data show that industrial crops received the main increase of mineral fertilizers deliveries however these are characterized by low actual gains in yields in comparison to the normative gain. Then it may be expedient to redistribute fertilizer application to different crops over the period of Food Program implementation. According to O. Sokolov, 1982) almost 80 percent of the increase in fertilizer deliveries will be directed to grain and feed crops.

And so we need to take into consideration within the framework of the SOVAM the possibility of evaluating the various alternatives for redistribution of fertilizers between different crops. Another aspect of fertilizer application relates to their efficiency in different regions of the USSR. The following data on gain of grain output per 1 ton of fertilizer application is given by O. Sokolov (1982): 2.7 tons for the central region of the RSFSR (Russian Soviet Federative Socialist Republic); and
1.6 tons for the North-West region of the RSFSR,

The actual return from fertilizers is different from one region to another. It is therefore also necessary to determine ways to improve the distribution of fertilizers by regions too.

3.5. Land resources and their distribution

The Soviet Union occupies one sixth of the land surface of our planet. It possesses the largest territory in the world: 224,022 million hectares including areas of the White Sea (90 thousand square kilometers) and the Sea of Asov (37,3 thousand square kilometers). To the end of 1981, all agricultural land (arable land, orchards, long-fallow lands, vineyards, hay fields and pastures) make up 553.7 million hectares, including 226.6 million hectares of arable land,

34.9 million hectares of hay fields and 286.9 million hectares of pastures.

From the point of view of agricultural activities the most significant is the high latitudinal position of the territory of the USSR. For comparison, the Transcaucasia, the Soviet Asian republics and the Ukraine, have the same latitudinal position as the northern part of the USA and as the southern part of Canada, the major Canadian cities are further south than Moscow.

The major landscape zones of the USSR include tundra, taiga, mixed forests deserts, lowlands, and mountains. Vast areas of the Soviet Union are unsuited to agricultural activities and are marginal, mainly because of the high latitudinal and internal continental position. The greater part of the arable belt consisting of extensive plains lies in zones of risk agriculture characterized by frequent winter cold or summer drought. In addition, large areas of arable soil are poor in phosphorous.

Nevertheless, there are many ways to intensify the agricultural production and to improve the productivity in zones with more or less favourable climatic conditions. One of these is the recent implementation of scientifically well-founded system of agriculture. Such systems have been developed for several agricultural regions of the country. The term scientifically well-founded system of agriculture includes: rational crop rotations, regional structure of acreage with fallow lands, industrial seed growing, utilization of high-productive varieties and hybrids, application of industrial technology to crop production, effective utilization of reclaimed lands, mineral and organic fertilizers, of soil improvement. One of the examples of such a regional system of agriculture was developed for Stavropol (Nikonov A.A. (ed) 1980). According to V.K. Mesyats (1983), crop rotations all around the country were introduced for 77 percent of the arable land. For the last 2-3 years the cropping pattern was improved. For example the area of fallow land in 1982 equalled 18 million ha. The goal is to increase this area to 20-22 million ha (~9 percent of the country's arable land).

However, the improvement of the inland utilization and cropping pattern also requires the consideration of not only the possibilities of bioclimatic and natural potentials of the country's land, but the demand for various agricultural products and the provision of input resources and the material and machinery for their production.

For example, currently, the country needs to increase the volume of livestock commodities production. This requires that the production and utilization of feed must be increased and improved. The concentrates of grain and simple mixed feed used for livestock feeding currently are characterized by deficit of protein. In order to obtain a balance of mixed feed (and then to save 15-20 percent of concentrate feed ~ 25-30 million tons of grain annually), it will be necessary to reconsider the structure of the land under cultivation mainly by the enlargement of acreage for pulses, oil plants, corn and so on. The following desired structure is suggested as desirable for feedgrain balance. (L.S. Stefanyuk, Planovoe Khozyaystwo V.12. 1982): oats 35 - 40%, corn 16 -18 percent, pulses 12 -15 percent and wheat 20 -25 percent (instead of actual share - 50 percent). The production of roughage succulent and pasture feed must be increased. According to V.K. Mesyats Planovoe Khozyaystwo V.4 (1983) in 1983 the acreage for perennial herbs was expected to increase to 29 million ha. Another question to be considered is the regional location of different crops. There is the following data (Zagaitov, P.Polovinkin, p.50)

- One ha of irrigated land in the Low and Middle Volga region can produce the same volume of the grass meal as 2.5 ha of cultivated hay in the Belorussia.

- 2.5 ha of Belorussian land for grain is able to produce 1.8 times more grain than 1 ha of irrigated land in the Volga region.

After comparing these data and other factors, the authors concluded that the new areas of irrigated land between the rivers Volga and Ural should rationally be used for establishing a large specialized zone for the production of grass meal and seeds of perennial grasses.

It can not be an exaggeration to say that the problem of the rational location and specialization of various agricultural commodities production is one of the most important in the country. This problem becomes especially clear from an analysis of the wide variability of soil-climatic and economic conditions for agricultural production existing in different regions. These conditions influence the efficiency of production of some commodity from one zone to another. According to (G. Rudenko, G. Miloserdov, p.17) this efficiency varies almost 7 times from one administrative region of the country to another.

Large areas of farmland in the Soviet Union need to be constantly improved. According to P. Paskar (1983, pp 29-30) the most important problem is to insure sufficient moisture content of the soil, because nearly 70% of it lacks sufficient moisture.

We must also note that efficiency of fertilizers application is sharply reduced if it is applied without taking into account agrometeorological conditions. For example, reducing the amount of soil moisture in a 20 centimeter top soil layer to 20 millimeters leads to decreased uptake of soil nutrients by roots of plants (E. Ulanova, p. 69) and mineral fertilizers are in fact not absorbed by the plants. Besides such factors as precipitation and soil moisture, uptake of fertilizers is also strongly dependent on temperature. If the soil temperature is lower than 10 ° C then all processes of mineral elements utilization are depressed. (A.I. Korovin, 1972).

Taking into consideration such dependence of fertilizer application efficiency on agrometeorological conditions and weather fluctuations on the territory of the USSR (see section 3.2) it is necessary to make agriculture more independent of droughts. Comprehensive land improvement programs of the Soviet state envisage measures for land betterment. At present the total area of irrigated and drained lands is 31.6 million ha and the reclaimed lands produce a third of the gross output of the plant-growing sector (P. Paskar, p. 31). Under the Food Program by 1990 it is planned to expand these lands to over 70 million ha.

In other words, the SOVAM has to provide possibilities for comparison of various variants of land resources utilization.

3.6. Labour resources

To characterize in detail labour resources for agricultural production we can use several indexes such as: availability, structure of labour by sex and age, qualifications, employment, etc.

If we follow the same structure of production module for the SOVAM as for the FAP national model with common structure, then we must be able to determine the availability of labour for future periods taking into account the previous statistical data and main tendencies of the labour resources changes. The problems of quantitative and qualitative reproduction of labour resources in socialistic agricultural farms are discussed in (Yalas, J. Schwarzbach, P. 1984). Table 11 contains corresponding statistical data extracted from the Statistical Yearbook, "The USSR National Economy in 1980".

Table 11. Agricultural Labour Statistics (Sovkhoz)

Indexes	1965	1970	1975	1976	1977	1978	1979	1980
1. Average annual numbers, thousands	8928	9419	10521	10767	10999	11258	11381	11650
2. Growth rates of the average annual numbers (1940=100)	330	348	389	398	407	417	421	431
3. Average monthly wages, roubles including:	75.0	101.0	126.8	134.6	139.1	143.0	146.0	149.2
--workers	72.5	98.8	125.3	133.5	138.1	142.5	145.3	149.0
--specialists	136.3	162.5	180.2	182.9	186	186.1	186.9	185.7
--office workers	82.2	95.6	114.5	119.1	121.2	122.4	123.2	123.0
4. Specialists with higher and secondary education, thousands	626	973	1400					1856
5. Machine operators thousands	773	808	1234	1250	1318	1414	1442	1488
including:								
tractor operators	550	559	718	703	729	796	790	806
combine operators	84	63	118	118	146	152	147	164
car drivers	63	95	184	192	206	215	205	210

Source: The USSR National Economy in 1980.

3.7. Specific requirements to the SOVAM

This short essay of the current state and development tasks for Soviet agriculture allows note to be made here of the main specific requirements for the SOVAM from the point of view of its expected utility for the analysis of future strategies for production and trade. First of all the general requirement is to take into account the main directions and tendencies reflected by the USSR Food Program until 1990.

For the current stage of the Soviet agriculture development, these can be formulated as follows:

- to meet requirements of the Soviet people in food and agricultural products in accordance with scientifically determined standards;
- to achieve high growth rates in farm production on the basis of intensification;
- to improve the economic management mechanism and the structure of the country's agro-industrial complex in accordance with current stage of the national economic development;
- to reach the maximum self-sufficiency of the Soviet Union in main products.

In order to satisfy the general requirements, the SOVAM has to possess characteristics which will permit it to take into account the specific character of Soviet agriculture development described in the previous sections of this paper.

3.8. Main assumptions for the SOVAM construction

The guidelines for the development of the national economy are provided on the basis of the state plans system. It is predetermined by the public ownership of the means of production, land, mineral resources and factories in the Soviet Union. The system of planned economic management helps to secure coordination in the functioning of the socialistic economy, to ensure balance of its development. The system of plans consists of comprehensive long-term programs for scientific and technological progress, ten-year guidelines for economic and social development, five-year plans and annual plans.

Let us give a very short description of this system. For more detailed reading see Tikhonov, 1983. The initial indices of the Soviet economy development are advanced by the CPSU Congresses and then they are considered by the Plenums of the CPSU Central Committee and the USSR Council of Ministers. Thus, the main national economic targeted characteristics of development such as development rates of industry, agriculture, transport and communications, proportions between consumption and accumulation funds in the national income, growth rates of salaries, growth rates of labour productivity etc. are determined initially by the USSR State Planning Committee. Then on the basis of these targets the plans of republics, branches of industry, agriculture and enterprises are drafted. These drafts and amendments to them from enterprises teams and local bodies are used for making a detailed draft. This draft is discussed by the USSR Council of Ministers, corresponding commissions of the USSR Supreme Soviet and other organizations. Then the draft of the State Plan for the Economic and Social Development of the USSR is submitted to the CPSU Central Committee for consideration and endorsement. After it is approved at the session of the Soviet Supreme Soviet the final draft acquires the force of law. And now the enterprises begin to prepare their annual plans. Thus, centralized guidance in drafting state, sectoral, territorial and other plans is combined with the initiative of workers' collectives.

1. The Soviet food and agriculture system is a constituent part of the USSR's whole socialist economy. Domestic market as such has an insignificant role in agricultural production development. Hence main assumptions for the Soviet agricultural policy model construction have to reflect the features of the socialist planned economy. Thus, the SOVAM structure and information flows have to be different from those of models for countries with market economies. All the abovementioned facts mean first of all that a number of normative elements such as target levels of production and consumption, planned growth rates etc. have to be considered.

A set of these normative elements for the Soviet agricultural development can be found in state plans and especially in the USSR Food Program.

Assumption 1.

Being descriptive in nature as many of the FAP models are, the SOVAM has to contain the normative elements in order to reflect planned character of the socialist agricultural development.

2. The social production is based on the division of labour. Hence the determination of its proportions in accordance with capabilities and requirements of the society is its overall feature. The advantage of the planned socialist economy is the ability for formation of national-economic proportions of the organization of production. Coordination between the country's social requirements and its material and financial resources is achieved due to the

elaboration of a system of balances: balances of social product and national income, of fixed assets, of manpower resources, of the population's cash income and expenditures etc. According to proportions of the USSR economy development, determined in these balances, the target levels, growth rates and structure of output of production are specified. These are reflected by long-term plans. It is also true for the Soviet agricultural system.

Assumption 2.

Target levels, growth rates and structure of output of agricultural production are specified within the framework of the SOVAM exogenously.

3. Once the state plans for the Soviet economy development as a whole and for the agricultural sector development in particular, have been approved and the brought into force, then target levels, growth rates and other indexes fixed in these plans have to be implemented as close as possible to these targets. Deviations of real agricultural output from target levels in the Soviet Union are mainly conditioned by weather fluctuations.

Realizing the existence of such deviations in some years various measures are envisaged in the country in order to minimize them, for instance, by intensification of domestic production, improvement of stocks management, etc.

Assumption 3.

Alternatives for minimization of deviations of real domestic agricultural output from target levels have to be considered explicitly within the framework of the SOVAM and have to be determined endogenously.

4. Besides the productive sphere rational proportions of Soviet economic development are also determined for the sphere of distribution. In general these are based on proportions whereby the national income is divided into consumption and accumulation funds. According to Tikhonov N.A. (1983, p.95) "the size of the consumption funds sets the economic limit to the growth of the real incomes of the population, thereby determining the scale and growth rates of living standards, while the size of the accumulation funds determines the potential possibilities of further expanding production." As far as the levels of internal consumption in agricultural and food commodities are concerned we have considered those in Section 3.1 (see Table 5 for per capita consumption, for example.)

Assumption 4.

Annual target levels of internal consumption in agricultural and food commodities and its growth rates are specified exogenously.

5. Implementation of these targets is one of the main tasks for the whole economy. The state policy is oriented towards permanent and stable improvement in the living standards of the population. A set of measures concerning internal agricultural production, commodities distribution, foreign trade, etc. intended for the fulfillment of these targets are envisaged by the State. Attainment of determined level of self-sufficiency in main agricultural commodities is considered as one of the preferable ways for the period under consideration and various alternatives for implementation of determined target levels of consumption in these commodities are studied.

Assumption 5.

Versions for the consumption targets in agricultural commodities have to be modelled explicitly within the framework of the SOVAM and comparison of these versions and selection of the preferable one has to be envisaged endogenously.

6. The system of balances which are elaborated by planning offices is also intended for determination of distribution of rational proportions of the country's material and financial resources between different sectors of the economy and their utilization. Provision for the agricultural sector corresponding input resources such as capital investments, fertilizers, machinery, etc., is calculated according to these balances and long-term places by various regulations.

Representation of labour requirements is, for example, one of the important aspects within the system of agricultural production planning. The main factors which are considered here are: employment, labor productivity, education, qualifications, structure by age and sex, etc. The state pays great attention to long-term planning of labour requirements and its utilization as well as to problems of raising the living standards of workers in agriculture and to working and social conditions in the countryside. All these questions were reflected in the USSR Food Program. Labour movements within agriculture and between agricultural and other sectors of the economy are determined by corresponding regulations of government. Then the dynamics of labour input for agriculture in the SOVAM could be modelled according to historical trends, adjusted to the supposed governmental future policy.

Assumption 6.

General volumes of input resources (capital investments, labour, fertilizers, etc.) for the agricultural sector for the period under consideration are specified exogenously.

7. One of the essential parts of the USSR economic system is the institution of the state foreign trade monopoly. State monopoly of foreign trade means that all foreign economic relations are executed by the State. Existence of this monopoly permits planning export and import on the basis of the country's economic potentialities and requirements as well as ensuring the priority of national interests over those for individual enterprises and social groups. Thanks to this the USSR's foreign trade promote the fulfillment of national tasks and the solution of internal social and economic problems.

The state foreign trade monopoly in the Soviet Union has flexible and branching organizational system, including the Ministry for Foreign Trade of the USSR which implements general control of foreign trade and supervises the activity of export-import associations, the State Committee of the USSR for Foreign Economic Relations which promotes economic ties with the socialist and Developing countries and a number of other institutions, for example foreign trade associations each of which specialized in a particular group of commodities. These associations are the main organizations to enter into commercial deals with foreign firms. They have a specified independence in their operations and commercial activity and function under centralized management of foreign economic relations on the basis of annual and long term plans and plan assignments.

The import plans for these associations are compiled according to requirements of various economic sectors, ministries and enterprises and the export plans are drawn up on the basis of the production plans, assignments of

different industries and enterprises.

The state foreign trade monopoly also covers all export/import activities in agricultural and food commodities. The volumes and structure of foreign trade in these commodities have to meet internal needs, trade agreements, quotas and other policy instruments.

Assumption 7.

Volumes of foreign trade in agricultural and food commodities both for import and export have to meet both lower and upper constraints given exogenously. Structure of foreign trade in these commodities is specified by central authorities.

8. An important complement of state foreign trade monopoly in the Soviet Union is state foreign exchange monopoly. According to it the state takes possession of all foreign exchange earnings from export and other foreign economic operations and from the extraction of precious metals in the USSR. All operation with foreign currencies are carried out under the control of the State Bank of the USSR as well as the Bank of the USSR Foreign Trade. State foreign exchange monopoly enables accumulation of the necessary foreign exchange funds and to use them for the development of the national economy. For this aim annual export-import and foreign exchange plans as well as long term plans are drawn up as a part of the overall economic plans of the USSR. According to this plan, the state determines how and over what periods foreign exchange resources should be used. The rules of using foreign exchange resources have to be satisfied for import-export operations in the sphere of agricultural commodities trade.

Assumption 8.

Financial constraints for import and export in agricultural and food commoditiers are determined by exogenously given foreign trade deficit.

9. Another important feature for the socialist economy is that direct relationships between domestic and international markets are absent. Domestic consumer and producer prices on agricultural and food commodities express internal policy options and for overwhelming majority of these commodities these prices do not relate to world market prices. The fact is that world prices are subject to fluctuations and to follow them implicitly would be inconsistent with a planned economy.

The principles of internal price formation radically differ from the practice of the free market. All internal prices are established in a planned way by state bodies. In the process of determining these prices, such factors as commodity production cost, the rate of profit and also social significance of the commodity are taken into account. Domestic prices in the USSR are an instrument for implementation of the social and economic policy of the state.

Assumption 9.

Domestic producer and consumer prices on main agricultural and food commodities do not relate to their world market prices. Retail prices of most goods are stable for the period under consideration.

4. Summary

This paper gives a short description of the current state of the Soviet agriculture and tendencies of its development. The author has attempted to outline the specific requirements for the Soviet Agricultural Model (SOVAM) first of

all from the point of view of their correspondence to the main directions of the country's agro-food complex development. The main assumptions for the SOVAM construction were given here also in order to outline the conceptual framework for the SOVAM. It is supposed that the next paper will contain the first version of the formal description of the Soviet model as a whole or some of its submodels.

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