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USSR Report

AGRICULTURE

(FOUO 7/80)

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POST HARVEST CROP PROCESSING

UDC 664.315.6(47+57)"1979"

OPERATIONAL RESULTS OF MARGARINE INDUSTRY FOR 1979

Moscow MASLO-ZHIROVAYA PROMYSHLENNOST' in Russian No 6, Jun 80 pp 30-34

[Article by G.N. Kasparov, candidate of Technical Sciences and chief of All-Union Association of Margarine Industry and A.P. Nikonenko, chief of Planning Department of All-Union Association of Margarine Industry:
"Operational Results of Margarine Industry for 1979"]

[Text] During 1979 the collectives of enterprises of the margarine industry concentrated their attention on raising production efficiency and operational quality based upon the introduction of new equipment and technology, an increase in labor productivity and a reduction in losses in raw materials, other materials and working time.

By solving these tasks in a practical manner and utilizing all internal reserves, the enterprises achieved definite successes in increasing output production. The plan for 4 years of the five-year plan for the production of margarine products was over-fulfilled by the USSR Ministry of the Food Industry by 110,000 tons, including 67,900 tons by Soyuzmargarinprom [All-Union Association of the Margarine Industry].

With the exception of the RSFSR, where over the 4 year period there was a shortfall in the production of margarine products of 2,500 tons, all of the union republics coped with their planned tasks.

The production of margarine products during the 4 years of the five-year plan is furnished in Table 1 by union republics.

The enterprises of Soyuzmargarinprom over-fulfilled their task for 4 years of the five-year plan in the production of packaged margarine products by 69,000 tons (by 5.8 percent) and in the production of hydrogenated fat -- by 34,800 tons (by 1.8 percent).

Some enterprises of the association over-fulfilled to a considerable degree their plans for 4 years in terms of the principal indicators. This included the Moscow, Donetsk, Uzhgorod, Minsk and Karaganda margarine plants,

the Leningrad Oil and Fat Combine and the L'vov and Tbilisi fat combines. The Ivanovo, Krasnoyarsk, Volgograd and Kirov margarine plants and the Moscow Fat Combine are not handling their tasks for the five-year plan in a satisfactory manner.

TABLE 1

Republics	Plan, Thousands of Tons	Fulfillment	
		Thousands of Tons	% of Plan
USSR	4580.0	4690.0	102.4
Including:			
Soyuzmargarinprom	3506.9	3574.8	101.9
republic industry	1073.1	1115.2	103.9
RSFSR	701.2	698.7	99.6
Ukrainian SSR	223.0	247.3	110.9
Armenian SSR	16.1	21.4	132.9
Tadzhik SSR	39.0	43.7	112.1
Uzbek SSR	69.0	77.8	112.8
Estonian SSR	24.8	26.3	106.0

During the 4 year period, the majority of enterprises and Soyuzmargarinprom on the whole did not fulfill their sales plan. This came about owing to a change and replacements in the assortment of margarine products. Low concentration types of margarine were developed and introduced into production operations -- Raduga, Gorodskoy and Solnechnyy -- the production of which must be increased to 400,000 tons in 1980. This will make it possible to release a considerable quantity of fat raw materials and to increase the production of goods, both for satisfying the requirements of the population and for expanding deliveries for industrial processing. The new types of products have lower wholesale prices compared to those types the production of which has been reduced.

Underfulfillment of the plan for product sales during the 4 year period, taking into account the reduction in average prices, should have amounted to 220.7 million rubles for Soyuzmargarinprom. However, the additional output of margarine products and hydrogenated fat reduced this underfulfillment amount to 92.6 million rubles.

The collectives of Soyuzmargarinprom enterprises, by implementing the party's socio-economic program, achieved the following results in 1979 (see Table 2).

The product sales volume for Soyuzmargarinprom increased 3.5 percent over the figure for 1978 and even higher growth was achieved by individual enterprises. For example, the Karaganda Margarine Plant increased its sales by 22.0 percent, Perm -- by 13.0, Kiev -- by 12.3, Znamensk -- by 8.0, Donetsk -- by 6.3 and the Kuybyshev Fat Combine -- by 6.3 percent.

TABLE 2

Indicators	Plan	Actual	Fulfillment, in %	
			Of Plan	Of 1978
Products sold, millions of rubles	1611.5	1628.4	101.0	103.5
Gross output, millions of rubles	1614.5	1631.5	101.1	103.7
Margarine products, thousands of tons	978.5	977.4	99.9	104.8
including packaged	320.0	316.2	98.8	98.3
Mayonnaise, thousands of tons	92.9	92.8	99.9	102.7
Hydrogenated fat, thousands of tons	507.0	516.2	101.8	103.9
Vegetable oil, thousands of tons	30.2	30.7	101.7	107.3
Packaged vegetable oil, thousands of tons	36.1	29.1	80.6	105.1
Synthetic cleansing agents, thousands of tons	23.9	16.4	68.6	71.0
Soap in a 40 percent calculation, thousands of tons	82.9	83.5	100.7	98.8
Stearin, thousands of tons	12.0	11.8	98.3	93.7
Technical glycerin, tons	3000.0	2909	97.0	103.4
Natural drying oil, tons	6400.0	6427	100.4	84.5
Fatty acids, tons				
hydrogenated fat	4400.0	4455	101.3	120.0
soap stock	5500	7250	131.8	90.9
Output per industrial-production worker, in rubles	123900	125018	100.9	102.4
Expenditures per ruble of commodity output, in kopecks	90.38	90.19	99.79	99.87
Balance profit, millions of rubles	167.7	165.1	98.4	105.0

Compared to the summary data for 1978, a considerable increase in the production of margarine products was achieved at the Leningrad Oil and Fat Combine -- 37.3 percent, Karaganda Margarine Plant -- 15.5, Perm -- 16.8, Znamensk -- 8.5, Kiev -- 11.3 and Kirov -- 8.8 percent.

Compared to last year, the production of mayonnaise increased by 2.7 percent for the association as a whole and even higher figures were recorded at a number of enterprises. Thus, at the Volgograd Margarine Plant there was an increase of 22.2 percent, Sverdlovsk Fat Combine -- 17.6, Gomel' -- 15.4, Karaganda Margarine Plant -- 12, Moscow Fat Combine -- 11.3, L'vov -- 11 and at the Kiev Margarine Plant -- 9.1 percent.

An increase took place in the production of hydrogenated fat: Sverdlovsk Fat Combine -- 4.5 percent, Troitskiy -- 5.3, Kuybyshev -- 5.6 and Gomel' -- 10.7 percent.

The association fulfilled its labor productivity plan by 100.9 percent. Compared to the 1978 level, labor productivity was increased by 2.4 percent.

TABLE 3

Product	Plan, Thousands of Tons	Fulfillment	
		Thousands of Tons	% of Plan
Margarine	969.2	975.0	100.5
Mayonnaise	92.9	93.4	100.5
Soap in a 40 percent calculation	82.9	83.7	100.9
Synthetic cleansing agents	22.8	16.7	73.2

Last year the entire increase in output was obtained by means of increased labor productivity and with no increase in the number of workers.

In terms of the production cost for commodity output, the 1979 plan, recalculated for the actual production and assortment of products, was fulfilled. A savings of 3.1 million rubles was realized. Compared to the plan, the expenditures per ruble of commodity output were lowered by 0.19 kopecks and compared to last year -- by 0.12 kopecks.

The data cited underscores the fact that the collectives of enterprises, notwithstanding the difficulties encountered, increased their production rates and are searching for and placing in operation additional reserves and potential.

In 1979 the deliveries of products produced by enterprises of Soyuzmargarinprom were carried out in a more stable manner than in previous years, as shown by the data in Table 3 for the principal types of products.

In 1979, an increase of 48,000 tons in the production of margarine products by the USSR Ministry of the Food Industry made it possible to maintain higher surpluses in the retail trade network and also in the wholesale trade and in industry.

Comparative data on margarine product surpluses for the USSR Ministry of the Food Industry is furnished in Table 4 (in thousands of tons).

The placing in operation of margarine and mayonnaise departments at the Moscow Fat Combine made it possible to improve the supply of margarine products and mayonnaise to the trade network for Moscow and Moscow Oblast and also to supply enterprises of the food industry with liquid confectionery and culinary fats, which are delivered mainly in loose form. In 1979, 71,000 tons of margarine products, or 9,000 more tons than in 1978, were delivered in this manner.

The enterprises of the margarine industry carried out the measures required for ensuring the production of liquid fats in the quantities needed by industry.

TABLE 4

Surpluses on	In Retail Trade		In Wholesale Trade and in Industry		Totals	
	1978	1979	1978	1979	1978	1979
01-01	54.5	69.0	19.3	21.7	73.8	90.7
01-04	74.5	86.3	36.4	36.3	110.9	122.6
01-07	76.9	88.2	72.3	91.0	149.2	179.2
01-10	63.2	74.5	32.9	54.3	96.1	128.8
01-12	56.7	75.1	24.8	37.8	81.5	112.9

In the interest of increasing the production of goods, the following principal measures aimed at raising the technical level were carried out during 1979:

-- production lines for the production of margarine products having a productivity of up to 5 tons per hour were mastered for the very first time at the Moscow Margarine Plant and the Leningrad Oil and Fat Combine;

-- sections having self-discharging separators were introduced into operations at two enterprises. Using these separators, the fat and oil refining volume amounted to 560,000 tons in 1979;

-- all of the association's enterprises were converted over to a more effective and physiologically valuable emulsifier -- mono-glycerides;

-- based upon ester interchange fats, 45,000 tons of margarine products were produced against a plan calling for only 30,000 tons;

-- a technological system was introduced for purifying waste waters, with calcium salts of fatty acids being obtained and subsequently delivered to private farms for feeding to the livestock;

-- the delivery of 10,500 tons of products to a store in packaged form was organized at the Moscow Fat Combine;

-- based upon the implementation of measures for mechanizing production processes and transport-warehouse operations, the level of mechanization was raised to 47.5 percent.

A number of measures were carried out at enterprises of Soyuzmargarinprom in connection with the conservation and proper use of natural resources.

As a result and notwithstanding the increase in output production volumes, the consumption of water from the municipal water line decreased by more than 1 million cubic meters and the discharge of drainage water into surface water areas fell from 2.9 to 1 million cubic meters.

All drainage water discharged into surface water areas is subjected to mechanical (in fat separators and at pressure flotation stations) and physical-chemical purification.

In 1979, Soyuzmargarinprom, jointly with the Maslozhirprom NPO [scientific production association] and enterprises, carried out work aimed at improving the quality of the products being produced. A complete system for controlling the quality of output was developed and introduced at 12 enterprises.

An increase took place in the production volume for goods of the highest quality (in wholesale prices): compared to the plan -- 44.0 percent, compared to last year -- 55.8 percent, that is, 137.4 million rubles worth of goods were produced against a plan calling for 95.0 million rubles worth. In 1979 the proportion of high quality margarine products reached 71.8 percent, against a plan calling for 69.6 percent.

The efficiency experts and inventors made a great contribution towards raising production efficiency. Last year, 1228 rationalization proposals were advanced at enterprises of the association, 977 of which were placed in operation. The savings realized from 286 proposals and four inventions amounted to 1.19 million rubles, compared to only 971,000 rubles as called for in the plan.

The scientific organization of labor underwent further development in 1979. The actual expenditures for introducing measures for the scientific organization of labor amounted to 236,200 rubles and the economic effect realized from such introduction -- 283,500 rubles, including 231,380 rubles for the wage fund.

Owing to the scientific n of scientific organization of labor, 50 more individuals were released from work during 1979 than was the case in 1978. Fine results were achieved in this work by the Moscow Margarine Plant, which released 13 individuals, the Leningrad Oil and Fat Combine -- 24, Yevdakovskiy -- 24 and by the Donetsk Margarine Plant -- 13 individuals.

During 1979, 86.3 percent of the piece workers worked on the basis of technically sound output norms, compared to only 82.7 percent in 1978. For Soyuzmargarinprom on the whole, the labor of 99.5 percent of the workers has been standardized in terms of individual time norms and normatives, interbranch and branch time norms, output norms and normatives for personnel strength.

Last year a great amount of attention was given to the dissemination and introduction into operations of leading experience.

-- The experience of the Tbilisi Fat Combine in purifying soap-containing waters using a solution of calcium chloride was disseminated.

-- The experience of the Leningrad Oil and Fat Combine in the production of ester interchange fats was introduced at nine enterprises.

-- Eight enterprises adopted the experience of fat hydrogenation using catalysts of the petro-chemical industry.

-- At two enterprises (Moscow Margarine Plant and the Kuybyshev Fat Combine), the Shchekino method for organizing labor was introduced.

-- A school of leading experience was conducted for the purpose of improving production accountability and raising its quality.

-- A seminar was held for the chief bookkeepers of enterprises in connection with studying new forms and methods for composing the annual report.

-- The experience of the Odessa Oil and Fat Combine in the organization of schools for young efficiency experts at enterprises was introduced into operations.

In all, 73 brigades of manual workers, engineering-technical personnel and office workers of the association visited related enterprises of the margarine and oil and fat industry and planning and scientific-research institutes for the purpose of studying and subsequently introducing leading operational experience into operations.

The socialist competition to prepare in a worthy manner for the 110th anniversary of V.I. Lenin's birth became very popular at enterprises of Soyuzmargarinprom. As a result, the Donetsk Margarine Plant was awarded the Challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the AUCCTU and the Komsomol Central Committee and a diploma and its title was added to the Board of Honor at the USSR VDNKh [Exhibition of Achievements of the National Economy of the USSR].

Thirteen challenge red banners of the USSR Ministry of the Food Industry and the Central Committee of the Professional Trade Union for Food Industry Workers were awarded to the Moscow, Donetsk, Minsk and Karaganda margarine plants and to the Saratov and Tbilisi fat plants; nine second and 12 third place awards were also issued.

Of the association's 26 enterprises, 20 were singled out in the socialist competition as having earned high positions.

The badge "Winner in the 1979 Socialist Competition" was awarded to 410 individuals and 58 individuals were the recipients of the badge "Shock Worker of the Tenth Five-Year Plan."

The title "Enterprise of Communist Labor" was earned by the Saratov, L'vov and Tbilisi fat combines and by the Donetsk Margarine Plant.

The movement to achieve a communist attitude towards labor has taken a strong hold at enterprises of the association. In 1979, the high title of "Shock Worker of Communist Labor" was conferred upon 5,538 individuals. Of 220 tutors of youth, one fourth were awarded the honorary certificate of the USSR Ministry of the Food Industry and the Central Committee of the Professional Trade Union of Food Industry Workers.

The collectives of departments, shifts and brigades are actively supporting examples of leading initiative as they develop throughout the country. In 1979 the association's workers followed one principal slogan "In the campaign to achieve high operational efficiency and quality, there should be no lagging workers."

Among the engineering-technical workers and office employees, a socialist competition has been launched based upon personal creative plans aimed at providing engineering support for production.

It is a matter of honor for each collective to improve the management mechanism, utilize the production reserves more completely, introduce the brigade forms for organizing labor and to develop the socialist competition. This will be of great assistance in successfully fulfilling the tasks of the final year of the Tenth Five-Year Plan and creating a fine base for the start of the Eleventh Five-Year Plan.

7026
CSO: 1824

POST HARVEST CROP PROCESSING

UDC (664.76+665.117.4].002.2:665.335.2.002.3

ORGANIZATION OF PRODUCTION OF OIL SEED MEAL, SOY MEAL

Moscow MASLO-ZHIROVAYA PROMYSHLENNOST' in Russian No 6, Jun 80 pp 43-44

[Article by V.G. Pavlov, Roszhirmasloprom of the RSFSR Ministry of the Food Industry: "Organization of Production of Oil Seed Meal and Soy Meal"]

[Text] In 1976, for the purpose of raising the nutritional and biological value of food products and based upon the use of nutritional soybean meal, Roszhirmasloprom was assigned the task of organizing the production of oil seed meal and soybean meal.

During the 1976-1979 period, the association's specialists, workers attached to VNIIZh [All-Union Scientific Research Institute of Fats] and the collectives of enterprises carried out a great amount of organizational work in connection with the creation and introduction into operations at the enterprises of a technology for producing soybean meal, cake and flour.

The State Standard "Nutritional Soybean Oil Seed Meal" was developed and approved by USSR Gosstandart [State Committee for Standards of the USSR Council of Ministers] and an instruction was developed and approved for the production of nutritional soybean oil seed meal and flour.

Jointly with the food administration of local subordination and VNIIZh, three seminars were conducted at the Georgiu-Dezh Oil Extraction Plant on organizing the production of nutritional soybean oil seed meal and flour. The industry's workers acquainted themselves with the new technology for obtaining nutritional soybean oil seed meal and at the Bobrov Mill -- with the process for producing soybean flour.

Such a technology was introduced into operations at the Georgiu-Dezh, Labinsk and Nevinnomyssk oil extraction plants, at the Arkadak, Seversk, Anninskiy, Balashov, Starooskol'skiy and Volgograd oil plants and at the Khabarovsk Oil and Fat Combine.

The following work was carried out at these enterprises: a new technological system was developed and introduced, including a method for

separating the ripe and unripe soybean seed with the aid of sieves (set of sieves with openings measuring 10 and 5.5 mm) on separators, thorough cleansing of the seed of organic and mineral impurities, hulling of the seed on rolling machines 400 mm in diameter and 800 mm long and separation of the fractions obtained during the hulling of the soybeans on separators. In addition, toasters were installed for the moisture and heat treatment and deodorization of the nutritional soybean oil seed meal and so forth.

Roszhirmasloprom, jointly with food industry administration of local subordination, carried out a considerable amount of work in removing metallic impurities from the oil seed meal and soybean flour and organizing the grinding of soybean oil seed meal at grinding plants of the Krasnodarskiy, Stavropol'skiy and Altayskiy kray executive committees and the Voronezhskaya and Rostovskaya oblast executive committees.

During the 1976-1979 period, 32,000 tons of nutritional soybean oil seed meal and cake were produced at the mentioned oil extraction plants and at the Starooskol'skiy Oil Plant -- 19,000 tons of nutritional soybean flour. As a result, Roszhirmasloprom alone realized an annual economic effect of 855,000 rubles.

The confectionery and baking industry is presently making extensive use of nutritional soybean flour and is thus raising the nutritional and biological value of the confectionery products and enriching them with protein substances.

7026
CSO: 1824

LIVESTOCK FEED PROCUREMENT

UDC 665.391.4:636

FEED PROTEIN PRODUCTION IN FATS, OIL INDUSTRY

Moscow MASLO-ZHIROVAYA PROMYSHLENNOST' in Russian No 2, Feb 80 pp 1-6

/Article by G. K. Pen'kov, chief technologist for oil extraction of the Administration of the Fats and Oils Industry and Cleansing Agents of the USSR Ministry of the Food Industry: "The Tasks of the Oils and Fats Industry in Solving the Problem of Feed Protein"/

/Text/ The inadequate production of feed proteins in the country was indicated in the report of General Secretary of the CPSU Central Committee Comrade L. I. Brezhnev at the July (1978) CPSU Central Committee Plenum and in the plenum decree.

In order to solve this problem in the next few years it is planned to expand the plantings and increase the harvet of leguminous and oil-producing crops, alfalfa, clover, rape and the most valuable protein crop, soybeans.[1]

Moreover, it is proposed to increase sharply the production and state purchases of sunflowers, to increase their yield, to eliminate the losses of seed during harvesting, to develop actively the base for their storage and processing and not to allow losses of products.

Along with other sectors of the national economy the food industry should also make its contribution to the solution of the problem of feed protein. The oils and fats industry supplies the greatest amount of feed protein in the system of the food industry (in the form of oil-seed meals and oil cakes).

At present mixed fodders are the main protein and vitamin concentrated fodder for the leading meat producers, including poultry and hog factories, fish hatcheries, as well as for all types of ruminants. The main protein component of mixed fodders is oil-seed meals and oil cakes, which are obtained at oil mills during the processing of the seeds of sunflowers, soybeans, cotton, flax and other oil-producing crops.

1. L. I. Brezhnev, "O dal'neyshem razvitii sel'skogo khozyaystva SSSR" /On the Further Development of USSR Agriculture/, Moscow, 1978.

Approximately 5-10 percent oil-seed meal is included in mixed fodders depending on their purpose. They successfully supplement barley, corn, oats, wheat and other fodder crops.

If we compare various fodder crops and oil-seed meal by the content of albumin (protein), and especially the protein which can be assimilated by the animal's body (Table 1), it is evident that oil-seed meal is the richest in proteins.

Table 1

Source of protein	Fodder units	Protein content, percent	Including available, percent
Fodder barley	1.21	11.6	8.1
Oats	1.00	10.7	8.5
Corn (grain)	1.34	9.3	7.8
Wheat	1.20	13.7	11.7
Soybeans	1.31	33.2	29.2
Oil-seed meal			
sunflower	1.02	42.0	36.3
soybean	1.19	43.0	38.7
cotton	0.96	43.0	32.5

From Table 1 it is evident that in fodder units oil-seed meals in practice are not inferior to forage crops, while in the content of protein, especially available protein, they exceed them considerably: barley by 4.4-fold, oats by 4.2-fold, corn by 4.6-fold and wheat by 3.2-fold.

If we take into account here that the price of oil-seed meals is several times less than the disbursing prices for oats, barley and other forage crops, the advantage of oil cakes and oil-seed meals in the production of mixed fodders will become even more obvious.

Protein additives to mixed fodders, fodder yeast, fish and bone meal and others cannot compare with oil-seed meals and oil cakes. The disbursing prices for them considerably exceed the prices for oil-seed meals and oil cakes.

The mixed fodder industry is developing rapidly. In 1979 the output of mixed fodders increased approximately twofold as compared with 1970.

The oils and fats industry annual processes about 10 million tons of oil-producing raw materials and along with the output of about 3 million tons of vegetable oil produces up to 4.5-5 million tons of oil-seed meals and oil-cakes (Table 2, thousands of tons).

The oil-seed meals and oil cakes, in addition to 45-50 percent crude protein, contain fat (0.5-1.5 percent in oil-seed meal, up to 7 percent in

oil cake), phosphorus-containing compounds, vitamins, cellulose and other substances.

Table 2

Oil-producing raw material	1976		1977		1978		1979 (plan)		1980 (draft plan)	
	processed seed	produced oil-seed meal and oil cake	processed seed	produced oil-seed meal and oil cake	processed seed	produced oil-seed meal and oil cake	processed seed	produced oil-seed meal and oil cake	processed seed	produced oil-seed meal and oil cake
Total.	9306	4556	9970	4845	9605	4407	9582	4250	9686	4550
Sunflowers . .	3220	1212	3652	1410	3868	1465	3762	1359	3708	1398
Cotton	3984	1796	3957	1730	4173	1770	4245	1818	4180	1806
Soybeans . . .	1814	1382	2068	1563	1304	999	1330	1000	1609	1185
Flax	83	48	73	25	52	30	46	16	30	17
Other crops. .	204	117	293	118	208	154	199	57	139	44

Much attention is being devoted in the oils and fats industry to the meeting of the need of the mixed fodder industry for oil-seed meals and oil cakes and to the improvement of their quality.

First, the technology is being constantly improved. In 1979 the construction was completed and the assimilation of the capacity for the processing of cotton seeds by the direct extraction method, that is, without prepressing, is being carried out in Gulistan. In 1980 the same kind of plant will be put into operation in Kasan.

With this method the high temperature denaturation of proteins in the roasters of the presses is decreased, which makes it possible to maintain to a greater extent the content of soluble (available) proteins in the oil-seed meal as compared with the prepressing-extraction arrangement.

Second, the chemical technological monitoring of the observance and stability of the technology of processing the seeds, producing and preparing the oil-seed meal for storage in elevators and warehouses and shipping it to consumers is being stepped up and improved. What is meant here is the systematic monitoring of the moisture content, temperature and content of solvent in the oil-seed meal being produced and the control of the temperature of the oil-seed meal being stored and shipped.

The technological conditions in oil extraction are maintained so that with exposures to heat and other influences the food value and availability of

protein would not worsen, but here the inactivation of the antinutrients contained in the oil-producing raw materials would occur and the solvent would be removed.

However, according to a report of the USSR Ministry of Procurement, not all oils and fats enterprises are meeting these requirements.

Thus, in June 1979 the Zaporozh'ye and Kirovograd oils and fats combines delivered to mixed fodder enterprises of the Belorussian SSR sunflower seed meal with a temperature of 65-80°C and food properties which had been lowered in connection with this.

The kernel of the cotton seed contains from 0.46 to 1.44 percent (in absolute dry weight) of the antinutrient gossypol.

In large doses this substance evokes inflammatory processes in tissues, irritates the mucous membranes of the gastrointestinal tract and affects the heart and liver. Its effect causes sluggishness and weight loss among animals. Young animals suffer greatly from gossypol. Of adult animals hogs, then horses are most sensitive to gossypol.

With a content in the fodder of 0.02 to 0.05 percent gossypol has a comparatively weak effect on animals, but with a content of 0.15-0.20 percent it can cause poisoning. Chicks are especially sensitive to gossypol. The maximum permissible content of gossypol in feed for chicks is 0.016-0.020 percent.

Gossypol poisoning occurs mainly with the unbalanced feeding of animals with oil cake and oil-seed meal and is intensified if there are not enough vitamins and calcium salts in the diet.

The All-Union State Standards permit a content of free gossypol in cotton oil cakes and oil-seed meal of 0.02 percent of the absolute dry substance, which is absolutely safe when feeding animals oil cakes and oil-seed meals in mixed fodders, and in some cases with some precaution even in case of the feeding of oil cakes and oil-seed meals in pure form in a mixture with other fodders.

Gossypol dissolves well in alcohols, esters and heated oil; it dissolves poorly in benzine; it does not dissolve in water. In the process of the roasting and pressing of the mash, which is obtained during the crushing of the kernel of the seeds, it is mainly transferred to the oil. A negligible amount of it remains in oil-seed meal and oil cake. With the observance of the recommended process of roasting and pressing the content of gossypol in the expeller and prepressing oils does not exceed 0.1-0.2 percent, while the content of free gossypol in the oil cakes and oil-seed meals does not exceed 0.005-0.02 percent.

During the refining of the oil the gossypol easily interacts with alkalis, forming gossypolates, which are insoluble in oils, enter the soap stock and

are removed with it from the oil. Therefore cottonseed oil, which is intended for food purposes, without fail goes through the entire cycle of refining.

Numerous transformations of gossypol, including the formation of the nontoxic, physiologically inactive, bonded form, occur under the influence of heat in the presence of water and oxygen of the air in the mash, pulp and oil-seed meal in the roasters, presses, worm vaporizers and toasters.

The careful pulverizing of the material before moisture and heat treatment, its optimum moisture content before roasting and during roasting and the thorough self-steaming of the material in thick layers in the vats of the roasters are necessary for the maximum bonding of the gossypol and the obtaining of oil-seed meal and oil, which are satisfactory in quality. The observance of these requirements guarantees a content of gossypol in oil-seed meal within the range of 0.005-0.02 percent, while with the violation of the indicated conditions it increases.

Specialists of the All-Union Scientific Research Institute of Fats and the Central Asian Scientific Research, Planning and Design Institute of the Food Industry made control checks of the content of gossypol in oil-seed meal at a number of oil-extracting plants of Central Asia. At the enterprises, where the approved operating conditions were observed, the content of gossypol in the oil-seed meal ranged from 0.001 to 0.017 percent.

At the same time in one of the samples of oil-seed meal at the Kokand Oils and Fats Combine the content of gossypol was 0.04 percent, which was the result of the violation of the conditions of the moisture and heat treatment of the pulp and oil-seed meal.

The Tashkent Oils and Fats Combine shipped to enterprises of the Moldavian SSR Ministry of Procurement in two dirty railroad cars moldy, lumpy cottonseed meal, in which glass was found. The stepping up at the combine of the monitoring of the preparation for storage, the oil-seed meal being stored and shipped and the condition of the cars, in which the oil-seed meal is shipped, made it possible subsequently to ship only standard oil-seed meal.

At the Kattakurgan Oils and Fats Combine during the increase of the capacity for the processing of cotton seeds from 690 to 950 tons/day measures on the pneumatic transportation of the oil-seed meal were not ensured. The cooling of the increased amount of oil-seed meal during transportation to the storehouse on a conveyer belt was inadequate, and the oil-seed meal was shipped with a higher than normal temperature. In this connection it was necessary to organize the additional cooling of the oil-seed meal with air on the operating conveyer.

Soybeans, which are very rich in protein, are the most promising crop for the improvement of the fodder base in the USSR, just as throughout the world. They are used as a fodder for all types of agricultural animals and poultry both without the preliminary removal of the oil from them and after its removal at oil mills, in pure form and in mixed fodders.

However, soybeans and untoasted oil-seed meal contain a number of antinutrients, which worsen the assimilability of fodders and retard the growth of animals. The use for hogs and poultry of feed, which contains untoasted soybean meal, decreases the weight gains of animals as compared with feeding with toasted soybean meal.

Soybeans contain the enzyme urease, which worsens the assimilation of food by the body of animals. When heated the urease loses its activity.

A trypsin inhibitor, hemagglutinin (soin) and saponin, which are also contained in soybeans, are biologically active substances and cause the retardation of the digestibility of feed. Therefore, soybeans and soybean meal, which are intended for animal feed, should without fail undergo heat treatment--toasting. The degree of inactivation of all the antinutrients in soybeans is characterized here by the activity of the urease (a change of the pH after 30 minutes), which should be not more than 0.3.

The inactivation of the antinutrients is carried out by heat treatment in the roasters of the prepresses, in the worm vaporizers and the roasters, which are installed after the worm vaporizers, in the toasters and other heat units, in which heating, mixing and steaming are possible. A combination of such units is also used.

At the Armavir Oils and Fats Combine and the Georgiyevsk Oil-Extracting Plant the toasters and worm vaporizers have been installed in parallel, at the Kropotkin Oil-Extracting Plant they have been installed in series. The comparison of the results of the operation of these enterprises will make it possible to determine the most efficient arrangement.

In 1979 40 toasters had been installed and were in operation at the plants, while by the end of the year another 12 had been put into operation. Their total capacity in 1980 will be 2,000 tons of toasted oil-seed meal a year, which can ensure the toasting of all the soybean meal being produced.

The fulfillment of the technological instructions, which were elaborated by the All-Union Scientific Research Institute of Fats for oil-extracting plants, which have toasters, and for plants equipped with worm vaporizers, will ensure the obtaining of soybean meal with the necessary degree of inactivation of the antinutrients.

During the first quarter of 1979 the Bendery and Ataki oil-extracting plants did not ensure the stable output of toasted soybean meal, which meets the requirements of the All-Union State Standard on the activity of urease and the residual content of benzine. This occurred because the set of operations on the assimilation of the Armavir method of toasting soybean meal was not carried out in full at the Bendery and Ataki plants.

The soybeans were pulverized in five-roller mills only after two or three passes, the pulp was coarse and hard to process in the roasters. Moreover, in the six-vat roasters only two to four vats were filled with mash, the

heating was carried out at low steam temperatures. The self-steaming of the material virtually did not occur. It was treated in the roasters for less than the necessary time. The retrograde product and fuz (trans. unknown) were fed not into all the roasters and unevenly. As a result there was a large amount of smalls in the oil cake received for extraction. The extraction shops received technological steam with low parameters. And hence the poor steam conditions in the worm vaporizers and the high residual content of benzine in the oil-seed meal.

Specialists of the Armavir Oils and Fats Combine, the Moldavian SSR Ministry of the Food Industry, the All-Union Scientific Research Institute of Fats and the USSR Ministry of the Food Industry gave the plants practical assistance. As a result in one 10-day period these enterprises were able to produce toasted soybean meal.

In early 1979 the Khabarovsk Oils and Fats Combine shipped untoasted oil-seed meal to the mixed fodder enterprises of the Kirgiz SSR. The reason was the low parameters of the technological steam in the extraction shop.

In January 1979 the Valuyki Oil-Extracting Plant also shipped oil-seed meal with a higher than normal activity of urease. The installation of an additional roaster from a KhSP-18 press for the moisture and heat treatment of the oil-seed meal after the worm vaporizers made it possible to ensure the output of toasted soybean meal.

At the Krasnodar Oils and Fats Combine during the changeover from the processing of sunflowers to soybeans there were cases of the output of oil-seed meal with a higher than normal activity of urease. After the installation of a roaster for the additional treatment of the oil-seed meal at the last stage of the technological process the output of untoasted oil-seed meal was halted.

As a result of the large amount of work, which was performed in the oils and fats industry, the use of special and adapted equipment and the introduction of temporary systems in the third and fourth quarters of 1979 all the soybean meal was shipped in toasted form.

The oil-seed meals, which are produced from other types of raw materials, can be divided into two groups. The first group, like sunflower-seed meal, does not contain antinutrients and does not require additional treatment. They are flax-seed, rapeseed, hempseed, corn and other meals. The second group (like cottonseed and soybean meals) contains toxic substances and therefore requires additional processing for their inactivation or removal. Castor meal and cake, which contain the toxic substance ricin, as well as the meal and cake, which are produced from fruit pits, in which prussic acid forms under certain conditions, also belong to this group.

For both fruit pit and castor cakes and meals methods of transforming them into fodder products have been developed and are being used.

In recent decades cotton hulls have begun to be used completely as a coarse fodder. This is approximately 1.5 million tons of feed. Moreover, 310,000 tons of cotton hulls are used for the production of fodder yeasts, alcohols, furfurol and other no less valuable products for hydrolytic plants.

Methods of using sunflower shells for fodder purposes have been developed, but, unfortunately, are not being used. Only 28 percent of the shells, or about 150,000 tons, are being sent as a raw material to hydrolytic plants.

In order not to allow the worsening of the fodder value of oil cakes and oil-seed meals during their storage and transportation, the construction of storehouses and elevators is not being halted, although its rate is inadequate. In four years of the 10th Five-Year Plan storehouses with a capacity of 244,000 tons have been built. According to the plan in 1980 storehouses for 96,000 tons should be put into operation.

For the better preservation of oil-seed meal in the process of storage, loading and unloading operations and during its shipment after production it is being conditioned with respect to moisture content and temperature.

The moisture content of sunflower-seed meal as a finished product should be within the range of 7-9.5 percent, soybean meal--8.5-10 percent, cottonseed meal--7.5-10 percent, while the temperature should not be higher than $35^{\circ}C$. The residual amount of solvent (benzine) should be no more than 0.1 percent. A lower moisture content of the oil-seed meal than indicated is not allowed, since static electricity accumulates in it during mixing, as well as during movement through gravity spouts and over conveyers, while abundant dust liberation here can create explosive conditions.

Heavy dust formation complicates loading and unloading operations and worsens the working conditions in these operations. The enterprises of the mixed fodder industry are urgently demanding that cottonseed meal be delivered to them in granulated form, reckoning that the impact from the improvement of working conditions and the greater fillability of cars will cover the expenditures on the granulating of the oil-seed meal at the oil mills and its crushing in the process of producing mixed fodders.

An excess of moisture in the oil-seed meal above the upper limit during storage leads to its spontaneous heating up, spontaneous combustion, clumping and the formation of molds. The simplest means of conditioning the oil-seed meal being produced with respect to the moisture content and temperature is the method of its moistening after the worm and vat vaporizers and other units for the toasting of the oil-seed meal with cold water with subsequent transportation to the storehouses by pneumatic conveyer. Here not only the reduction of the moisture content and the reduction of dust formation, but also the cooling of the oil-seed meal in the process of vaporizing the absorbed moisture and by the air during the transporting occur.

Moreover, conditioning makes it possible to preserve the nutrients, the consistency and granulometric composition and to prevent caking.

At a temperature of the oil-seed meal in excess of 35°C all the indicated processes develop more intensively.

Oil cakes and oil-seed meals should be stored in dry, clean, well-ventilated elevators and storehouses, which are not infested with granary pests. Oil cakes and oil-seed meals should be transported in clean, dry cars, ships, trucks or carts, which are not infested with granary pests.

The spontaneous heating up, carbonization, agglutination, contamination and mixing of oil-seed meals of various crops, the appearance of musty smell, molding and infestation with mites and various granary pests can occur if these rules are violated. All this leads to the denaturation and breakdown of the proteins and other nutrients, the oxidation of the oil and lipids, the appearance in the oil cakes and oil-seed meals of the products of their breakdown, that is, to the worsening of the food properties.

It is impermissible to mix the oil-seed meals and oil cakes, which have been obtained from different seeds. According to a report of the Dagestanskaya ASSR Council of Ministers, the Yerevan Oils and Fats Combine shipped in violation of the All-Union State Standard to the Dagestan Administration of Grain Products a mixture of soybean and cottonseed meals. The mixture of these oil-seed meals could not be used properly.

In order to meet the demands of the mixed fodder industry of the USSR Ministry of Procurement shops for granulating the oil-seed meal have been set up at some oil mills, especially those processing cotton seeds. In 1976 they produced 99,600 tons of granulated cottonseed meal, in 1977--101,800 tons, in 1978--120,000 tons and in 1979--150,000 tons. For 1980 it is planned to produce 252,000 tons of it. At the oil-extracting plants being built in Gulistan, Kasan and Chardzhou it is envisaged to set up shops for granulating cottonseed meal.

The production of granulated sunflower-seed meal has also been organized at two enterprises of the RSFSR Ministry of the Food Industry and two enterprises of the Ukrainian SSR Ministry of the Food Industry. However, the cost of 1 ton of granulated sunflower-seed meal, which is enriched with lipids, is greater than conventional meal. Moreover, additional expenditures on the crushing of the oil-seed meal are necessary. Therefore the mixed fodder enterprises of these republics are not insisting on their supply with granulated oil-seed meal.

In order to improve the nutritional value the oil-seed meal is being enriched at a number of oil mills with lipids. Hydration fuz--a phosphorus-containing substance, which is separated from the raw oil during its hydration with water--is used as an enriching additive. This enriching additive also contains raw fat (about 40 percent), protein, tocopherols and other associated substances.

Cottonseed meal, which has been enriched with soap stocks, contains up to 4 percent lipids, 3-3.5 percent oil and 40-45 percent protein.

The oil content of sunflower-seed meal, which has been enriched with lipids, amounts to 2.5-4 percent; it contains up to 42-45 percent protein.

In eight months of 1979 214,200 tons of enriched oil-seed meals were produced, including 2,000 tons in the RSFSR, 80,800 tons in the Ukrainian SSR, 131,400 in the Uzbek SSR and 4,600 tons in the Moldavian SSR. In the plan for 1980 it is planned to produce 582,000 tons of it.

It should be noted that the fodder value of oil cakes and oil-seed meals depends to a considerable extent on the quality of the oil-producing raw materials being processed, and not only on the technology of their processing, the conditions of storage and transportation.

When processing imperfect, moldy and low-quality seeds, oil, oil-seed meal and oil cake only of lower food and fodder value are obtained. For example, at the Poltava Oils and Fats Combine during 1977-1978 with the processing of sunflower seeds with a greater degree of imperfection the content of protein in the oil-seed meal decreased to 36.5-40.14 percent. Therefore, it is necessary to begin the work on obtaining high quality oil-seed meals with the drive for the high quality of the oil-producing raw materials, which are being grown, procured and processed.

It has been calculated that in order to make up the shortage of protein in the diet of animals, some farms need to increase by almost 1.5-fold the consumption of fodders. But where this is impossible, the productivity of livestock decreases by 30-35 percent.

The workers of the oils and fats industry are faced with the task of ensuring in a short time a great effectiveness of the use of the obtained agricultural raw materials, of achieving the output with few expenditures and the minimum losses of high-quality oil, oil-seed meal and oil cake with the use of all the production wastes for fodder and other purposes. Not a single kilogram of oil-seed meal and oil cake should be lost or spoiled.

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AGRO-ECONOMICS AND ORGANIZATION

OPTIMIZATION OF AGRICULTURAL PRODUCTION, INCLUDING OPTIMUM FARM SIZE

Moscow VOPROSY EKONOMIKI in Russian No 5, May 80 pp 63-73

[Article by I. Kryachkov, Doctor of Economic Sciences, Head, Kursk Agricultural Institute imeni I.I. Ivanov, and G. Shukshin: "Optimization of Agricultural Production*"]

[Text] It was noted at the July (1978) Plenum of the CPSU Central Committee that the general level of agricultural development "does not meet the rapidly growing needs of society and requires energetic efforts for the further strengthening of the material and technical base of agriculture, improvement in production organization and an increase in its efficiency." One of the main causes for the inadequate efficiency of agricultural production is the nonoptimal nature of its basic parameters: economic concentration, specialization of production and the level of its intensity (fixed capital size and structure, annual material-monetary and labor costs, the amount of fertilizers applied, etc), the production, maintenance and managerial personnel, their living conditions (work, daily life, culture), etc.

In practice, the lack of studies on the basic agricultural production parameters results in inefficient organization expressed primarily as the disorderliness of production dimensions and structure. Within the bounds of a single oblast, Kurskaya Oblast for example, there are farms with areas of agricultural lands ranging from 1,500 hectares to 10,000 and more. Modern equipment and capital investments are inefficiently used at the nonoptimal farms, and the possibilities for incorporating the achievements of agricultural science, advanced technology, etc are restricted. The irrational location of farms and of their production centers, populated areas and other facilities in the oblast, the inadequate number of enterprises to process the agricultural output, the small cargo capacity of transport equipment and the lack of hard-surface roads increase transport expenses.

One of the important trends in resolving the problem of increasing the economic efficiency of agricultural production is the scientifically based optimization of its parameters and the creation of specialized

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* A formulation of the problem.

agricultural enterprises on this basis. As is noted in the decree of the CPSU Central Committee "On the Further Development of Specialization and Concentration of Agricultural Production Based on Inter-farm Cooperation and Agro-Industrial Integration," the specialization and concentration of agricultural production are the main trends in further agricultural development. The process of agriculture's production and economic links becoming constantly more complex, the development of interfarm cooperation, the allotment of significant state and kolkhoz resources to these ends and the need for them to be used effectively make it necessary to develop scientific bases for the optimization of agricultural production. In the Summary Report to the 25th Congress of the CPSU, L.I. Brezhnev stressed: "It is first necessary to provide for serious refinement in planning... Here is a broad field for application of the efforts of economic science and for incorporation of modern scientific methods, including those of mathematical economics...."[1]

The level and efficiency of agricultural production depend on a multitude of natural-economic factors. Their varied concatenation determines a multitude of variants in the economic status of production. One may select from among the multitude of variants the most advantageous one, given which the product yield is maximal and costs are minimal. It is a complex matter to solve this task using classic methods developed in mathematical analysis since many linear and nonlinear dependencies [zavisimosti] of the final result on the multitude of production factors are missing. A linear mathematical model does not reveal all of the physics of a phenomenon or process, the continuity of a change in parameters is missing, and there is a static nature--in the solution process, unknowns take on a single value. When solving a problem by linear programming, one cannot determine the optimum for agricultural production because of the impossibility of introducing the totality of information into the model (e.g. design or technological information), of calculating the minimum for costs for production of a given volume of a product or the maximum for a product in a specified assortment and quantity, the nonoptimal nature of resources and the linearization of nonlinear links and dependencies.

It is possible to solve the problem of scientific justification of optimal parameters for agricultural production given a comprehensive, systematic approach based on mathematics and using the economic laws of socialism, achievements of related sciences, advanced practice and existing research methods. Analyzing questions of the intensification of agriculture in capitalist countries, V. I. Lenin stressed: "First of all, and more than anywhere else, an image of the overall process is required, a calculation of all tendencies and a determination of their resultant or their sum, their result."[2] Lenin's position retains its significance under the conditions of the intensification of socialist agriculture. Such an approach should be realized on the basis of an examination of the production process in operation, taking into consideration the linear and nonlinear dependencies, i.e. based on production functions [funktsii].

The result of the effect of a multitude of factors on agricultural production may be expressed by its final product--the yield (average statistical for a number of years). A harvest, being a material mass, is considered as the resultant of a number of production factors in which they are accumulated. In practice, we have only an intuitive conception of the many factors influencing agricultural production. But they are operative in production independently from our understanding and are manifested in the resultant of all conditions--the harvest. Therefore, in order to know about these factors, it is necessary to utilize the information about them which the yield, seeking to reduce the size of the farm (the greater the size, the greater the transport costs for fathering the harvest), carries. It is possible to materialize many natural and economic production factors, which are difficult to measure, in the form of uniformly distributed area and concentrated goods[3] and to express the dynamics of their changes using a coefficient of relative intensity.[4]

Thus, we consider yield as the basis for optimization of agricultural production. To obtain it on an optimal level (given a maximum of production and a minimum of costs), it is necessary to have the optimal production concentration, on which a number of factors are acting: cultivated land area, fixed capital, labor resources, fertilizers, capital investments, labor, living and cultural conditions for the population, etc. These parameters are the main ones and the most common to agricultural production. V. I. Lenin stressed: "...He who tackles individual problems without having solved the common ones beforehand will at every step inevitably be unconsciously 'stumbling' over these common questions."[5]

In a mathematical model of agricultural production expressed as a system of linear functions of product yield and nonlinear functions of production costs, the maximum of product yield per unit of production costs is taken as the main criterion of the optimum for this production under the condition that the set goal is realized--production of a specific volume, assortment and quality of the product and observation of the following necessary limitations: optimum concentration of labor and capital; fulfillment of all agrotechnical and technical requirements for efficient management of the farm; exclusion of losses of resources; the maximum economy of work time and labor achievable with the greatest possible reduction in the distance between production and consumption points; establishment of living conditions for the population which most closely approximate those necessary; employment of all able-bodied persons year-round.

The functions of production costs depend both linearly and nonlinearly on various agricultural production parameters: the area of cultivated land; the level of production intensity; cargo capacity of transport vehicles; the speed with which they move; cargo loading and unloading times; costs for their transportation; the coefficient of the deviation of the production center with regard to the geometric center of the area of the farm's agricultural lands; the coefficient of technical progress conditioned by

changes in the number of workers, their salary and skills, given a varied machine-worker ratio; the coefficient of the curvilinearity of roads[6] and the location of the farms on the territory of the oblast.

It is necessary to consider the basic linear and nonlinear dependencies of agricultural production and cost elements on various arguments to fulfill the problem which has been posed using dynamic programming. Among these are the total length of the route for a transport vehicle when transporting cargos over the farm's agricultural land area; the number of transport vehicles, technicians and agricultural production workers needed; increase in crop yield as a function of rates at which organic and mineral fertilizers are applied; the amount of capital investments necessary for construction of production, housing and cultural and domestic buildings and structures; amortization, repair and maintenance costs for production and nonproduction buildings and structures; production costs for an agricultural product, etc.

We have worked out the types of farms (optimum specialized farms [OSKh] with a minimum number of connecting sectors, the optimum level for their concentration and the maximum product yield per unit of production costs, taking into consideration the establishment of the necessary social conditions) based on the derived dependency of the efficient size of the area of a farm's cultivated ground on the various parameters. The subject of our research is the economic system of the agricultural production of an oblast, an administrative-territorial unit which most completely satisfies the requirements for complexity and regularity and which represents a complete, independent system. The study of isolated production (of a farm or group of farms) without links with other similar sites does not make it possible to calculate its optimum since it may be supplied at the expense of a reduction in efficiency at other facilities. Therefore, a complex, system-level examination of agricultural production on a scale for the whole oblast is necessary so no errors are permitted during analysis of economic status of the farms.

With the aim of reaching the optimum for agricultural production based on the theoretical bases for optimization which were worked out, we justified the optimum parameters for the system of agricultural enterprises in Kurskaya Oblast, the mathematical model of which consists of 33 linear functions of product yield and 1,432 nonlinear and linear functions of production costs. A provisionally optimal statistical model of the system of promising farms in the oblast with a strictly determined value for crop yield and for productivity of livestock and poultry providing for reaching the provisionally optimal reference price of the oblast when producing the necessary volume and assortment of agricultural products at the level of the visible perspective (20-22 years in our example) was compiled to determine the coefficients of the function of product yield and production costs.

The basic statistical model represents a united, developed, interrelated and interdependent, scientifically based logical structure of the oblast's goal to produce the maximum in gross production of a necessary assortment and quantity, reflecting the agrozootechnical, engineering and economic conditions throughout the sectors and specialized farms and the efficiency ratios of the sectors on them when determining the dimensions of farms of each production type, and it includes 81 types of parameters. The functions of product yield and production costs, amount of required mineral fertilizers and capital investments as a function of concentration of production, etc. (44 types of functions in all) are compiled on the basis of the parameters for the provisionally optimal model.

The costs for creation of grain processing and storage centers, for which a concrete yard, a shed for storing uncleaned grain, a grain-cleaning and drying complex, storage facilities for treatment and storage of state grain reserves etc. have also been incorporated into the provisionally optimal statistical model of long-term farms in Kurskaya Oblast. At the November (1979) Plenum of the CPSU Central Committee, L. I. Brezhnev said: "The system for storage of the product purchased by the state is also in need of substantial improvement. It is more advantageous to store a part of it right on the kolkhozes and sovkhozes for a time. It is thereby possible not only to improve product quality and reduce losses, but to reduce the burden on centralized storage facilities and utilize transport and the work force more uniformly. It is consequently necessary to expand construction of kolkhoz and sovkhoz warehouses and storage facilities."

We solved the problem of determining the main criterion for the agricultural production optimum of the oblast--the maximum product yield per unit of production costs--analytically using a computer in view of the difficulties of its realization. We composed a dynamic programming algorithm for a nonlinear model of the oblast's long-term farm system according to 11 specialized types, with output of 16 basic parameters for farms in each production type and for the oblast as a whole. The problem is solved in two stages. In the first, the optimum production cost of each type of product and the optimal levels of production intensity and crop yield corresponding to this cost are determined. In the second, introducing calculation of the optimum crop yield and coefficients of relative intensity into the algorithm and having changed the ratio of the sectors on the farms given the condition that the oblast goal in producing the necessary volume, assortment and quality of the product has been attained, the main optimum criterion and the system of other criteria are determined. On the basis of data from calculation of the system of long-term farms in Kurskaya Oblast, curves were plotted of the dependencies of the total profit volume, profitability, fixed productive and nonproductive capital, capital investments for construction, the number of workers and the amount of transport vehicles and mineral fertilizers necessary and the costs for management and production services and for services for the farms' population etc. on the size of the farms' agricultural lands and the level of production intensity.

However, it is impossible to determine the agricultural production optimum from curves of the dependencies of profit volume on the size of the area of land being cultivated by a farm and the level of production intensity since the maximum product yield per unit of production costs is unknown. Curves of the dependence of profit volume are given below for 3 levels of production intensity: I--the contemporary level, with production costs of R 663.3 million and gross product yield of R 848.1 million; II--the optimal level of intensity, with costs of R 975.02 million and gross product yield of R 1,640.6 million; III--a level of production intensity beyond the optimal (costs of R 2,169.1 million and gross product yield of R 3,281.2 million).

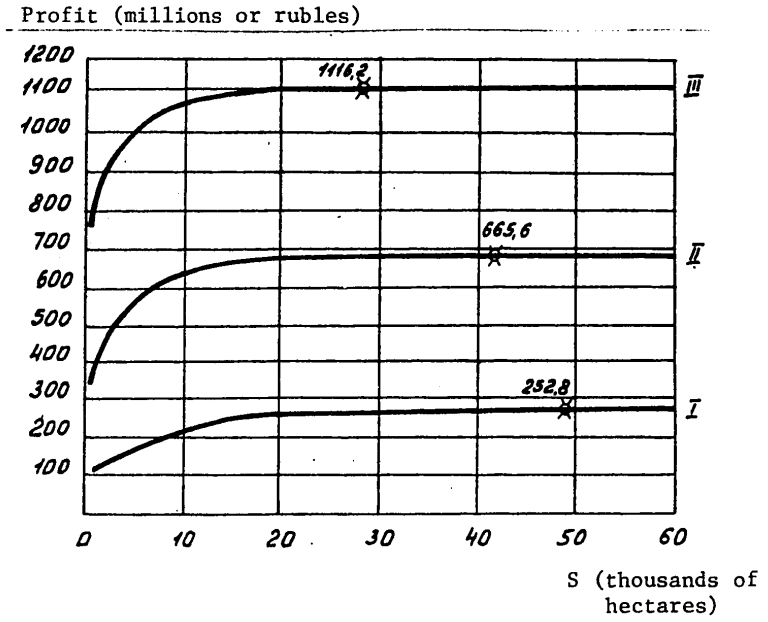

Figure 1.

The main criterion for the agricultural production optimum in the oblast is determined on the basis of curves of the dependencies of profitability of production (Figure 2), the maximum of one of which corresponds to the maximum of product yield per unit of production costs and the maximum for profit volume.

The system of other criteria for the optimum (volume of capital investments, amount of fertilizers, labor resources, etc) is determined based on the corresponding curves of dependencies, with regard to the level of production concentration of the main criterion.

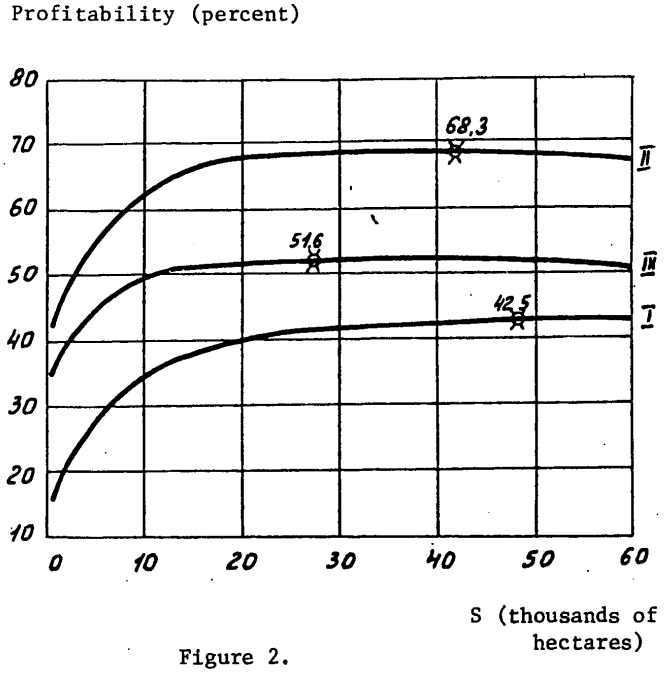

Figure 2.

The volume of capital investments for construction of buildings and structures, both productive and nonproductive, in an oblast's farm system, costs for management and production services and services for the farms' population (type 2[7]) and the number of required workers in agriculture are declining as the size of the farms' agricultural lands increases, a sharp drop occurring to the lower limit of the optimum, after which the decline of the indicated parameters occurs slowly, approaching a direct dependence. When the level of production intensity is increased, the volume of capital investments for construction, costs for management, production services and services to the farms' population (type 2) and the number of required workers for the same area of farm lands grow.

The number of necessary transport vehicles, transport expenditures, costs for management, production services and services to the farms' production (type 1) increase with the growth of the size of agricultural lands, based on the concentration of production and the level of its intensity. Particularly rapid growth of the given factors is observed up to the lower limit of the optimum, beyond which the growth rate of these parameters is close to a direct dependency. This is explained by the fact that when a value for the area of the farms' agricultural lands which is greater than the lower limit of the optimum is reached, the radius for transporting goods grows more slowly than the increase in the area of the farms' agricultural lands.

Let us present certain data from the calculations and plotted curves of the dependencies. The maximum profitability of the oblast's agricultural production, corresponding to the optimum, the maximum of product yield per unit of production costs, given the existing prices for the product and given that the goal of producing the necessary volume, quality and assortment of the product is reached and the limitations of an optimal farm are realized, can be 68.3 percent in the long term. Calculations show that at the present-day level of concentration of agricultural production in Kurskaya Oblast, it is impossible to raise profitability beyond 28.9 percent without increasing the size of agricultural lands and raising the level of production intensity to the optimum dimensions.

The total amount of capital investments for construction of buildings and structures, both productive and nonproductive, to produce the oblast's product in the volume of optimum agricultural production given the present-day size of kolkhozes and sovkhozes would be R 5.96 billion. To produce this same volume of produce given the optimal size of the area of the farms' cultivated lands, R 4.2 billion, or R 1.76 billion less, will be required in capital investments. Calculations show that R 143.3 million, or 3.1 percent of the total amount of capital investments, are required for construction of modern centers for the processing and storage of a part of the state grain reserves and to satisfy the particular needs of the farms, given the agricultural production optimum for Kurskaya Oblast.

Presently costs for management, production services and services to the population (type 1) for a single farm are equal to about R 28,000, R 13.9 million for the entire oblast. At the optimum agricultural production level, these costs should be R 360,000 for a single farm, R 19.6 million in all. The total costs for management, production services and services to the population of the oblast's farm system (type 2) are presently equal to R 127.0 million, R 61,300 for one farm on the average, per year without costs for schools, commercial enterprises etc, and without many of the forms of service. Similar costs for one farm which is equal to the average present-day kolkhoz and sovkhoz in the area of agricultural lands should be R 255,000, given the condition that optimum conditions of management, production services and services to the population are created at the farms. On farms which have been optimalized on the basis of the size of agricultural lands, the costs for management, production services and services to the population (type 2) should reach R 1,064,200 for a single farm, and the total expenditures for the oblast's system of promising farms should be R 58.0 million, or R 69.0 million less than at the present size. And this will occur with an increase in the number of management and service workers from 207 on each farm, equal to the average present-day kolkhoz and sovkhoz, to 865. In essence, the optimal conditions for their active life are created given this increase in the number of workers in management, production service and services to the population of the farm.

Taking into consideration transportation of central, uniformly distributed goods using K-701 truck tractors and fan-shaped, uniformly distributed area and concentrated goods by truck transport, their numbers for the long-term, given the oblast's optimum agricultural production and year-round utilization should be as follows: tractors--2,826 units, 15-ton trucks--1,844 units.

It follows, based on data from mathematical economics calculations and plotted curves of the dependencies of profit, profitability, production costs, etc. that the onset of the agricultural production optimum for Kurskaya Oblast occurs when the level of production concentration, the area of the farms' cultivated land, as a function of the type of farm, is from 27,000 to 42,000 ha, sugar beet yield is 450 quintals, grain, 32.5 quintals,[8] milk production is 39.4 quintals per hectare of food crops, feed consumption per cow is 41 quintals in feed units, etc. In this case, the gross product yield is R 1,640.65 million, the total profit volume is R 664.4 million and the profitability of production is 68.3 percent.

The volumes of product production (Tables 1, 2) and livestock population (Table 3) in Kurskaya Oblast under optimum agricultural production conditions are presented below.

Table 1. Volume of Products from Plant-Growing Obtained in Kurskaya Oblast Given Optimum Agricultural Production

Crops	Product Amounts (thousands of tons)	Area (thousands of hectares)	Relative importance of crops to total tilth (percent)
Grain	3885.47	1200.00	60.00
Sugar beets	6505.82	189.00	9.50
Potatoes	200.00	12.25	0.61
Vegetables	247.64	11.16	0.60
Fruits	100.00	12.00	--
Hemp	10.03	10.03	0.50
Feed Crops	4153.50*	923.00**	--

* In feed units.
** In area of agricultural lands.

Table 2. Volume of Animal Husbandry Production in Kurskaya Oblast, Given Optimum Agricultural Production, the Product from Poultry-Raising (Chickens) Being Supported on State Feeds Not Included

Product	Amount (thousands of tons)
Meat, live weight including:	317.31
beef	181.90
pork	123.51
duck meat	11.90
Milk	1,634.92

Table 3. Livestock and Poultry Populations Given Optimum Agricultural Production in Kurskaya Oblast, Poultry-Raising Being Supported on State Feeds Not Included

Type of Livestock and Poultry	Number of Livestock and Poultry (in thousands of head)
Cattle	778.86
including: cows	408.73
Swine	1,236.08
including: sows	71.62
Ducks	5,725.6

The optimum has a wide range of variations with regard to the area of agricultural lands. Product yield per unit of production costs varies inconsequently within this range. Thus, for example, given the above-indicated levels of yield and product yield for animal husbandry per hectare of feed crops on farms of the grain-beet-milk administration, the extreme value of product yield per unit of production costs corresponds to an area of 41,700 hectares of cultivated land. When gross production profitability is reduced by 1 percent from the extremum and given the same level of production intensity, the lower limit for optimum area of agricultural lands equals 22,100 hectares and the upper limit is 76,800 hectares. This makes it possible to practice efficient differentiation of farm size while creating optimum specialized farms taking specific local conditions into consideration.

To reach optimal agricultural production in Kurskaya Oblast, it is necessary to bring the set of its parameters into optimum condition, first of all the size of the farms, the volume of fixed productive capital and the level of production intensification. The volume of the oblast's fixed

capital for agricultural production at its optimum should be R 4.62 billion, including R 2.68 billion in productive and R 1.94 billion in nonproductive capital. Taking into consideration the availability of existing fixed capital in the oblast in the amount of R 1.4 billion (at the end of 1979) and their incomplete utilization (about 75 percent), the optimum may be reached in approximately 20-22 years, given the creation of optimum specialized farms in the oblast and annual contributions of about R 210 million in capital into fixed capital funds.

Aside from the increase in the size of the farms and fixed capital, the growth in agricultural production concentration to the optimum requires the improvement of other factors for production intensification, the application of large amounts of mineral fertilizers, efficient use of watering with local run-off and the use of advanced technology and production organization. It is necessary to apply 3.6 million tons of mineral fertilizers to farm crops annually and irrigate approximately 250,000 hectares of young crops using local run-off to reach the optimum level of agricultural production intensity, taking the present-day level in the development of agricultural equipment and today's working conditions and production standards into consideration.

Making the decision for the optimum level of agricultural production concentration for each oblast has a relative nature, signifying that, although the optimum level of production concentration is accurately determined by computer using dynamic programming, it is possible that in practice concentration levels not of the calculated optimum, but of one located right next to it will be adopted on the basis of a comparison of the profitability of the various oblasts of an economic region or of the country as a whole. To this end, it is necessary to compile a single, provisionally optimum statistical model for the whole country, one which consists of the individual models republic by republic.

In an oblast with minimal profitability from production of individual types of products, it is expedient to select a level of production concentration somewhat below the level corresponding to the optimum. In those oblasts where profitability of these products is maximal, it is possible to be guided by a concentration level somewhat greater than the optimum, just as long as the profitability of production is oblasts with minimal profitability. The production cost of an agricultural product fluctuates significantly in the various economic regions of the country (cf. Table 4). The production of appropriate products should be situated primarily in zones with minimal production costs, from the point of view of national economic interests.

In addition to establishing the optimum levels of concentration and intensity of production and costs for it, the possibility of solving a set of questions on the optimization of agricultural production, including the establishment of scientifically founded purchase prices for agricultural products, determining the amount of capital required, the optimum locations for farms and individual facilities within the territory of the

Table 4. Production Cost for 1 Quintal of Agricultural Product on Kolkhozes in the Union Republics (Average for 1975-1977, Rubles)

Republics	Grain	Sugar Beet	Potatoes	Milk	Weight gain in cattle	Pork
Ukrainian SSR	4.93	2.43	9.03	20.86	151.73	138.36
Belorussian SSR	8.60	4.10	6.46	21.46	160.33	176.10
Kazakh SSR	7.86	3.36	15.90	25.60	175.10	163.60
Moldavian SSR	5.13	2.33	16.50	22.70	190.56	139.20
Latvian SSR	11.00	3.83	9.80	21.53	144.46	135.93
RSFSR	6.83	3.43	9.26	24.26	168.13	162.46

oblast, settlement of the rural population etc are established on the basis of the computed optimum.

Optimization of agricultural production parameters permits costs to be sharply reduced, product yield to be increased and labor productivity to be raised. For example, in 1976, 240,000 workers were employed in agriculture in Kurskaya Oblast, a gross product worth R 795 million was produced, production costs were about R 785 million, profitability of production was 1.2 percent, product yield per worker was R 3,270, production cost of 1 ton of sugar beets was R 40.3, of milk, R 218.3, of grain R 42.6. When optimization of agricultural production is reached, the number of workers employed in agriculture in the oblast should be 198,400 persons, an annual product worth R 1,640.65 million will be produced (without poultry-raising on state feeds), production costs will be 975.02 million, profitability of production will reach 68.3 percent, gross product volume per worker will be R 8,720 per year, the production cost of 1 ton of sugar beets will be R 20.16 of milk, R 183.5 and of grain R 50.16. Labor productivity should grow by 252.9 percent.

In the decree of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Effect of the Economic Mechanism on Improving Production Efficiency and Work Quality" it is stressed that "selection of the most effective ways to reach high national economic results" is the most important trend for improving all planning work.

The method we are proposing and formalization of many factors of an economic arrangement which formerly did not yield to measurement on the basis of the method, the establishment of many nonlinear dependencies in agricultural production and the application of dynamic programming make it possible to study and derive optimum solutions not only for an individual sector or an individual farm, but for the entire system of agricultural enterprises for an oblast, a republic, an economic region

or even the country. This method permits us to examine agricultural production comprehensively, from the engineering, economic and social angle. Consequently it can become the basic method for planning the development of national economic agricultural industry complex by 5-year plan and for even longer periods.

We have made a computation to substantiate the basic parameters of long-term agricultural enterprises in one administrative oblast--Kurskaya. Calculations can be performed for any region of the country in similar fashion. Optimization of agricultural production parameters in the agro-industrial complex system of an oblast includes several stages: working out the scientific bases for optimization, establishing a multitude of linear and nonlinear dependencies of the result of production on various factors, development of the provisionally optimum statistical model for the oblast's farm system, compiling an algorithm for the dynamic, nonlinear program to compute this system, its computation on a computer and plotting of curves of the dependencies of the parameters, analysis of the curves and determining the extremum of the main criterion for the optimum of agricultural production as well as its lower and upper limits, formation of the agro-industrial complex for the oblast and incorporation of the data which are obtained into practice.

The development and incorporation of a methodology for determining the optimum of an oblast's agricultural industry complex can circumvent the economically ill-founded distribution of massive capital investments associated with construction of new, expensive and long-term production, domestic and cultural facilities to small-scale farms and will permit us to begin to establish conditions for highly efficient production of agricultural products on an industrial basis on long-term farms and modern domestic and cultural living conditions for the rural populace.

FOOTNOTES

1. "Materialy XXV s"ezda KPSS" [Materials of the 25th Session of the CPSU]. Politizdat, 1976, p 59.

2. V. I. Lenin. "Polnoye sobraniye sochineniy" [Complete Collected Works] vol 27, pp 195-196.

3. Agricultural goods may be divided into 3 types on the basis of the means for moving them: central, fan-shaped (uniformly distributed area) and concentrated.

4. A coefficient of relative intensity reflecting the level of investment of capital and labor and the crop yield thereby conditioned, the density of cattle population and its productivity--a comprehensive variable permitting examination of agricultural production in a dynamic state.

5. V. I. Lenin. "Polnoye sobraniye sochineniy" [Complete Collected Works] vol 15, p 368.

6. The coefficient of curvilinearity of roads is the ratio of the actual length of a route over the land of a farm to the length of a route based on an accepted estimating plan.

7. Costs for management, production services and services to the population of a farm are divided into two types. Type 1 includes those costs for support of a manager, chief specialists and heads of services, workers of whom there should be no more than one per farm. Type 2 includes costs for support of sector specialists and workers in domestic and cultural services, of whom there may be more than one per farm.

8. Computation of optimum crop yield was performed based on present-day varieties.

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END