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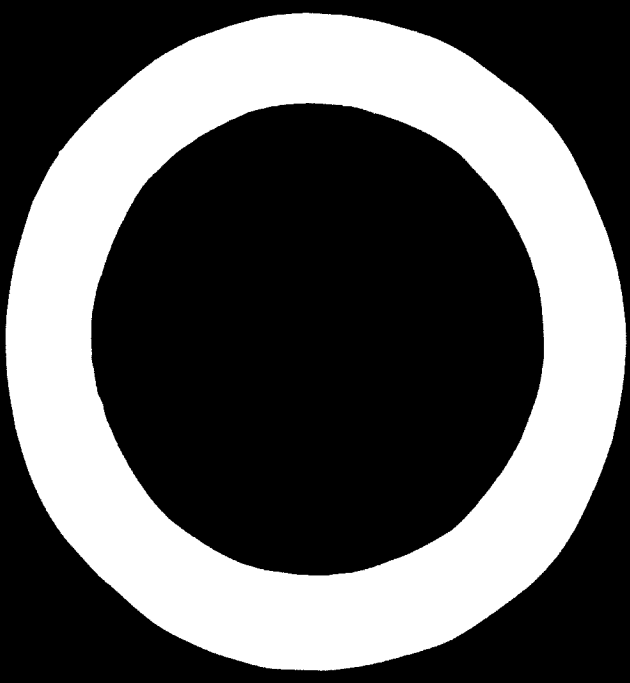
INTEGRATED FOOD PROCESSING IN YUGOSLAVIA

UNITED NATIONS



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
VIENNA

INTEGRATED FOOD PROCESSING IN YUGOSLAVIA

Report of seminar
and digest of technical papers

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Contents

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Explanatory notes

Dollars ($) refer to US dollars unless otherwise indicated.

Tons refer to metric tons (1,000 kg) unless otherwise indicated.

One hectare (ha) equals 10,000 m^2 or 2.471 acres.

One new dinar equals 100 old dinars.

The following abbreviations are used in this publication:

h.p.	horsepower
lb	pound
CMEA (formerly COMECON)	Council for Mutual Economic Assistance (USSR)
EEC	European Economic Community
EFTA	European Free Trade Association
FAO	Food and Agriculture Organization of the United Nations
OECD	Organisation for Economic Co-operation and Development
UNDP	United Nations Development Programme
WHO	World Health Organisation

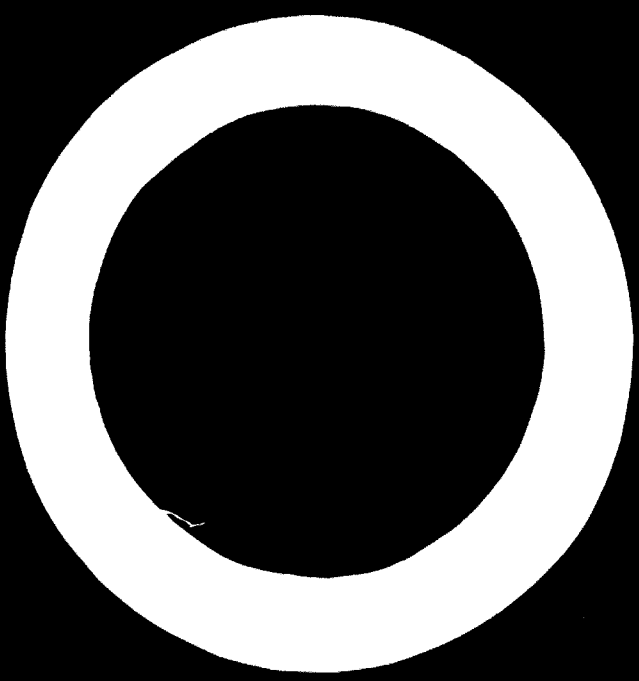
Foreword

The Seminar on Integrated Food Processing, organized by UNIDO, was held in Novi Sad, Yugoslavia, from 14 to 23 November 1968. Lectures were delivered by agro-industrial experts who had been working in integrated food processing with encouraging results. The lecturers came from agro-industrial combines varying in size from 20,000 to 140,000 hectares. Some of the combines are integrated with 10 to 15 factories and have their own distribution network. Others have a staff of 10,000 to 25,000 and, in some cases, they co-operate with 10,000 to 20,000 private farmers.

Some 35 lectures were delivered to an audience of 23 participants from 20 developing countries. The participants, who are listed in annex 2, attended the seminar in their personal capacities and not as official representatives of their organizations. Visits were arranged to supplement the lectures, often to plants managed by the lecturers.

Literature on integrated food processing by authors with knowledge and experience of organizing and operating agro-industrial enterprises is scarce. Publication of the material issued in the course of the seminar is expected, therefore, to make a contribution towards a better understanding of the problems that may arise and of the results that can be achieved when agro-industrial enterprises are set up in developing countries.

Apart from the introductory chapter, the material in this publication is based on the lectures given at the seminar. The views expressed are those of the group or of the individual contributors and do not necessarily reflect the views of UNIDO.



Introduction

Integrated agro-industry is a modern effort to industrialize one of the oldest and most highly significant spheres of human activities. Agro-industrial development should prove to be of interest to developing countries particularly when new regions (reclaimed areas, virgin land etc.) are about to be exploited.

To be able to compete with other branches of the economy, agriculture will have to find a way of adapting its conventional structure to the tempo of contemporary technology and the current rate of productivity in industry. One of the difficulties peculiar to the food-processing industry throughout the world is that production is dependent on the small farmer. In developed countries inefficient rural production can call upon the national income for help in the form of subsidies. In developing countries, however, where the other branches of the economy lack revenue, subsidization on such a scale is impossible.

Chapter 1 endeavours to demonstrate the economic significance of low-priced raw materials in a competitive food-processing industry. It shows that small-scale farmers and their surpluses cannot offer a basis for competitive prices.

In developing countries, the bottleneck in food production is marketing rather than the lack of raw naterials or processing facilities. Developing countries must give top priority to products for which no marketing difficulties are anticipated. Following initial emphasis on exports, the domestic market should be expanded, the prerequisites for such a process being suitable quality, convenient prices and prudent investment in marketing and publicity.

Increasing food production along conventional lines is a lengthy process, particularly in a developing country. Agrarian reform schemes must be initiated; the skills of the small-holders must be upgraded or co-operatives set up; land reclamation and resettlement projects must be planned with highlanders coming to the lowlands. The standard of living must be raised, mechanization programmes boosted and transport improved. The standard of small-scale production and processing will also have to be improved, and the financial means will have to be found to do this if food is to be produced on a substantial scale. The time needed to carry out all these programmes will range between 20 and 50 years; great sums of capital will be necessary; skilled labour requirements will be overwhelming; and the risks involved will be far in excess of those faced when a country enters upon agro-industrial development. However, this type of development has a great advantage over conventional methods of production, since it successfully solves the conflicts of interest among producer, processer and consumer.

Agro-industrial development entails the vertical integration of the whole food-production process (or the production of other agriculture-based consumer goods) from the field to the final consumer. Vertical integration means that all stages of the process and their planning are organized and owned by one market-oriented authority that has an industrial approach and applies a policy suited to market demands. The basic theory behind integration of this kind is to produce and process acceptable food products at the lowest possible cost and to obtain profits from their sale that can then be reinvested in other projects to the benefit of the country at large. The only acceptable criterion for evaluating such projects is profitability.

A developing country cannot afford not to devote some of the money at its disposal to the more conventional objectives. It should always be left to the respective Governments to decide upon the relative importance to be ascribed to agro-industrial development.

Chapter 1

TECHNO-ECONOMIC ASPECTS OF AGRO-INDUSTRIAL DEVELOPMENT

The increased application of industrial technology to the agricultural sector is recognized as a major attribute of socio-economic growth in all countries, both developed and developing. This has resulted in a trend away from the small, family-unit farm towards more complex systems of economic organization, such as fully integrated agro-industries. For example, the United States Department of Agriculture has forecast that by 1980 the average-sized farm in California will be 2,100 acres in contrast with an average size of 835 acres in 1968.

The fundamental economic reasoning behind the trend from small- to large-scale agricultural production is illustrated by table 1, which gives two examples of total production costs of freshly harvested tomatoes on delivery to the factory. The first example is based on a system of small-unit production in Trinidad and Tobago and Chad; the second example concerns large-scale production in California.

The costs of production were about $0.08/lb for Trinidad and Tobago and Chad; the tomatoes had been planted, cultivated, harvested and marketed by individual farmers, using approximately one fourth of an acre for this crop. The average cost of production on a fully mechanized, large-scale farm, owned and operated by a tomato-processing plant in California, however, was only $0.02/lb on delivery to the plant. The average distance from field to plant on this 8,000-acre farm was 4.5 miles. Therefore, the cost of producing industrial tomato paste on a small scale (50 tons/day), where raw material accounts for 50 per cent of total costs, is $800/ton on the basis of the dry substance content.

On the other hand, when tomatoes are processed on a large scale (2,000 tons/day) using modern industrial facilities, the cost of tomato paste production, where raw material represents 75 per cent of the total costs, does not exceed $100/ton, once again on the basis of dry substance content.

Table 1

Comparison of small-scale production and large-scale industrial production of tomatoes

	Small-scale production	Large-scale industrial production
Acres of tomatoes under cultivation	0.25	8,000
Yield per acre (kg)	800 (approximately)	4,000 (approximately)
Varieties	Poor variety with an average of 4.8 per cent of dry substance	Special varieties, streamlined for the production of whole peeled tomatoes canned, tomato purée, tomato paste concentrate, tomato juice and for tomato ketchup; average for paste: 6.2 per cent of dry substance
Income of the farmer and the industrial worker	$0.20/hour/man (The farmer's average income is $1,600 for a family of 4.)	$3.20/hour/man (The worker is employed all year round, first on the farm, then in the factory.)
Total cost of 1 lb of tomatoes delivered to the factory	$0.085	$0.021
Factory cost per ton of dry substance a/	$393	$74.8

a/ The world market price of 1 ton dry substance, estimated at 28 per cent tomato paste, in 1-gallon cans, is $400 to $450 per ton.

Costs of production of tomato paste may be summarized as follows:

	Dollars/ton
Tomato paste from rural industry	800
World price for dry tomate paste	425
Tomato paste from integrated agro-industry	100

The above examples give two extremes; there are many intermediate cases that could be cited. For example, in Italy (the biggest tomato paste producer after the United States), the overall cost of production does not exceed $300 to $320 per ton of dry substance. Moreover, Italy is able to export large quantities of tomato paste without granting special subsidies to producers. The more extreme examples were offered as a basis for the discussion of trends and principles relating to agro-industrial development. While no one disputes the desirability of the trend towards agricultural industrialization, opinions vary as to the techniques and institutional arrangements most appropriate for accelerating it.

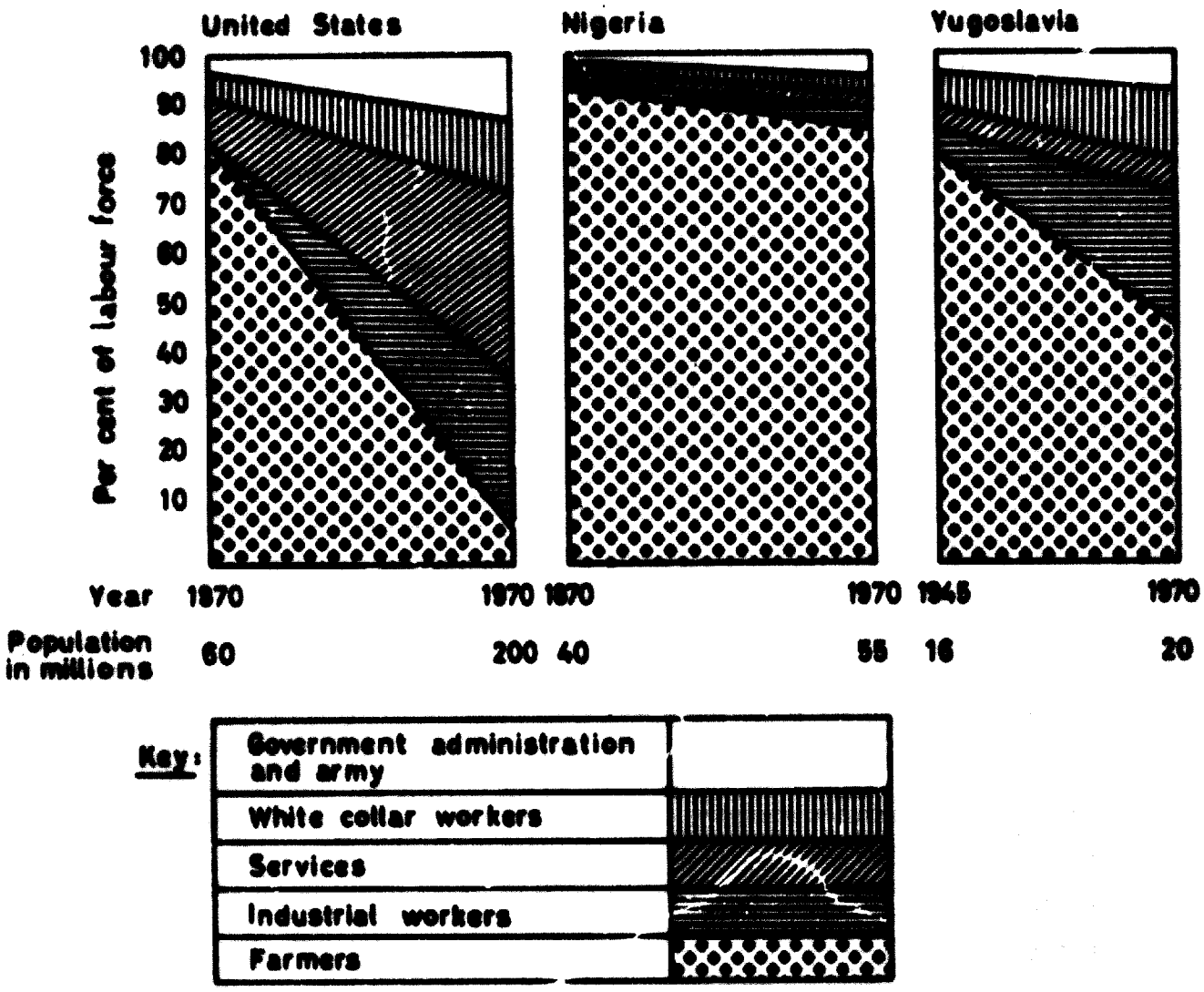
To put the problem in a broader perspective, it is necessary to consider the profound impact that industrialization has had on the social structure of rural communities in some countries. Figure 1 illustrates the changes in social structure that are associated with industrialization. The three examples represent countries at various levels of industrial development and suggest a correlation between industrialization and changes in social structure.

Defining industry

Before methods of industrializing rural areas successfully or changing the social structure of the rural community are considered, a definition of industry should be agreed upon. One could accept the definition promulgated by H. Singer, United States: "It is difficult to define a giraffe. But the moment you see one, you know what it is." Some authors (Chenery, Mandelbaum) use the term 'industry' very broadly to include manufacturing, mining,

Figure 1

The change of social structure in selected countries



construction, power and handicrafts. Other authors (Hoffman and Myrdal) restrict their definition of 'industry' to manufacturing. In the United States, numerous large-scale agricultural operations are regarded as industries, such as the chicken industry and the soybean industry, which cover an entire field of vertically integrated processes from the production of special chicken animal feedstuffs to the marketing of frozen and canned chicken in chain or department stores. The United Nations decided to include only "manufacturing" when dealing with processes and problems of industrialization in developing countries.[1/] Even if the term "industry" is limited to manufacturing, the problem of defining and demarcating industrial production in relation to other economic activities still remains. According to the United Nations definition, manufacturing is the mechanical or chemical transformation of inorganic or organic substances into new products.[2/] This definition, however, has specifically excluded biological processes in order to make a distinction between industry and other economic activities, particularly agricultural production. This raises certain conceptual problems when biological processes are used in the manufacture of foods, pharmaceuticals, chemicals, beverages, and when the modern agro-industrial processes have integrated the sequence of mechanical, chemical and biological operations to such an extent that no clear-cut distinction can be made.

The main criteria for defining industrial production are as follows:

(a) A significant transformation of various imports into new commodities;

(b) Production of commodities very distinct from raw materials with a higher, added marketing value;

(c) Production as a continuous process or a set of consecutive operations integrated in a processing line requiring both extensive production planning and production engineering;

1/ United Nations (1955) Processes and Problems of Industrialization in Developing Countries, New York, Sales No. 55.II.B.1., p.2.

2/ United Nations (1968) International Standard Industrial Classification of All Economic Activities, New York, Sales No. E.68.XVII.8., p.28.

(d) Industrial production as characterized by a substantive division of labour among production activities and between management and production itself;

(e) A relatively high capital/labour ratio and a high concentration of production capacities concentrated in one location;

(f) A relatively high productivity/labour ratio combined with an extensive utilization of power, power-driven machinery, automatic transport, and mechanization.

In other words, all activities that can be characterized by any of the above criteria can be regarded as industrial activities.

Capital-intensive industry

The frequently used criterion of capital-intensive industry can sometimes be misleading because the capital/unit-of-product ratio is far more relevant to the structure of industrial production than is the capital/labour ratio. For example, Thailand has 10,000 small rural rice mills dependent on skilled craftsmen. In order to maintain its present milling capacity, Thailand invests yearly four to five times more than would be necessary for the same capacity based on a modern commercial-sized wet-rice milling process. These plants would produce 10 to 14 per cent more whole rice kernels, and the whole rice oil and protein content of the paddy, covering 50 per cent of the national consumption of these two important commodities (which is presently going to waste entirely), could be recovered for human consumption.

The traditional concept of industry (based on the impressions of 50 to 60 years ago, i.e. dark red brick buildings with boiler houses and high chimneys) has to be replaced by a more flexible concept that includes the industrialization of rural areas. It should be emphasized that the type of large-scale agricultural production described above is industrialization par excellence.

Type of industry to be favoured

The question as to what kind of industry should be favoured goes to the heart of the problem. Generally speaking, a rural

area can be industrialized by:

(a) Activities that differ widely from present economic activities and that use new raw materials, apply industrial techniques for production and provide a diversified range of products;

(b) Introducing improved techniques and services in agricultural production and animal husbandry; raising the productivity of individual farmers through increased mechanization; establishing co-operatives for the selection of breeds and for joint small-scale processing operations of different field crops and animal products; improving marketing methods; supplying irrigation water to individual farmers; reclaiming land; providing the multiple services of agriculturists, veterinarians, sanitarians, schoolmasters, lawyers, administrators etc. to the area, thus raising and improving the standard of living of the average citizen;

(c) Applying the above industrial methods of production in the form of partial or complete integration and specialization in agro-industrial production, thus abruptly changing the social and economic structure of the community.

The feasibility of any one of the above approaches will depend on the particular conditions existing in the various countries under consideration. There is no general rule or approach that can be applied in all situations. The first approach is practical only in those areas that possess an ideal set of preconditions for development, such as: a particularly good supply of newly developed raw materials (ores, minerals, petroleum etc.); a special accumulation of expertise, skills, patents and capital; and an increasing demand for the products a particular country can produce with the resources at its disposal. The existence of such a set of preconditions would permit the industrialization of the agricultural sector along with related changes in the social structure with a minimum of social, economic and political problems. Since these conditions, however, seldom exist in developing countries, the first approach will not be discussed. What remains is the difficult task of appraising the relative merits of the gradual and the extensive approaches. In other words, one must attempt to determine whether it is more desirable to industrialize the agricultural sector gradually by providing a limited range of services

and organization within the existing social structure (based on individual, small farm holdings) or rapidly by introducing fully integrated agricultural complexes, which will radically alter the pre-industrial social structure, transforming a stagnant, rural economy into a dynamic component of the national economy.

As only the Government of a particular country can select a particular path towards agro-industrialization, the role of the expert is to provide such a Government with an objeotive appraisal of the various alternatives. The question to be asked, therefore, is: Is it feasible to recommend to developing countries an approaoh that is already regarded as obsolete in developed countries?

Admittedly progress can be made by gradually improving agrioultural production. Some circumstanoes prohibit any other approach. However, as there are several variations between the two extremes of gradual and immediate industrialization of the agricultural sector, the selection of a particular approach should be made only after a thorough study of the various alternatives within the context of a specific country's sooial, economic and political environment.

The advantages of agro-industrial projects are:

(a) Agro-industrial projects are bankable. It is easier to find souroes of finanoing both domestic and foreign. Gradual industrialization of rural areas oan be financed only from public funds and has to be subsidized for many years;

(b) Agro-industrial production evokes a chain reaction. It oatalyses its own growth by profits, which can be reinvested partly in enlarged agro-industrial production projects and partly in the reconstruction of the rural area, i.e. the improvement of social and political conditions, investment in services and cultural development and the further diversification of industrial activity;

(c) Integrated agro-industrial production can be established:

(i) In a very short period of time,
(ii) With far less investment per unit of product,
(iii) With far less skilled labour,
(iv) With few risks,
(v) In a sufficiently viable manner to meet foreign competition, thus creating exports,

(vi) To satisfy a growing demand for agricultural products on the home market,

(vii) With a substantively reduced level of investment in infrastructure for rural development;

(d) Integrated agro-industrial production would appear to be the only feasible approach to the development of reclaimed territories or vast virgin lands under very arduous conditions of tropical and subtropical climates and soil structure. The great number of failures and the few cases of success in this respect have shown that only the establishment of viable, agro-industrial combines can provide a basis for upgrading the living standards of white collar and other workers, i.e. provide not only conditions for their survival, but also establish an economically vigorous community with a modernized social structure and with the necessary material and cultural services.

Technocratic aspects of integrated agro-industry

One of the first prerequisites in formulating a viable programme for an integrated agro-industry is to include the three main fields of activity - production, processing and marketing - hitherto separated in one unified process. There are a great number of economic and technological reasons for such a unified, integrated process, as can be seen from the paragraphs below.

Today's sugar factory is unprofitable, if:

(a) Daily processing of sugar-cane or sugar-beet does not reach at least 4,000 to 5,000 tons/day;

(b) The production costs of the raw material exceed a certain limit;

(c) The average distance from the factory exceeds 10 km;

(d) The average yield of crystallized sugar does not reach a certain minimum;

(e) The daily supply is so organized that the period between harvesting and processing cannot be reduced to at least 24 hours;

(f) The factory is not supplied throughout the season at an average of 85 to 90 per cent of capacity.

On the basis of these criteria, it would be extremely difficult to organize the supply and flow of sugar-cane in co-operation with 20,000 farmers who plant 0.5 to 0.2 acres of sugar-cane. It

would be easier to achieve this by integrated agro-industrial production.

Today's meat-processing factory is unprofitable, if:

(a) The supply, price and quality of raw material are not adequate;

(b) The yield of prime cuts does not meet a minimum requirement;

(c) The daily capacity does not exceed a minimum level of 500 pigs a day, 150 to 200 cattle a day, 5,000 to 10,000 chickens a day;

(d) The entire quantity of by-products (hides and skins, fat tissues, bones, glands, blood, intestines and heads) and waste is not fully exploited to produce: meat extract, gelatine, shortenings, meat and bone meal, drugs and other products;

(e) The processing facilities are not technically and sanitarily suited to the production of goods that comply with the quality, quantity and assortment required by an expanding domestic or a sophisticated and changing world market;

(f) The management of the enterprise fails to provide an appropriate marketing organization, backed by technical storage, transport and marketing facilities;

(g) The marketing department does not dispose of a minimum quantity of certified, standardized meat products corresponding to the trading and sanitary prescriptions of both the domestic and foreign markets.

Many meat-processing factories set up in developing countries that have failed to satisfy these criteria have either operated at a loss, closed down, or have never been put into operation. This indicates that only profitable, integrated meat-processing operations can be safely recommended, especially in developing countries.

A home market or an export market can sometimes be developed through small-scale operations, by isolated investments and by filling a persistent gap. But the rate of industrialization by this method is too slow and the risks are too high to attract capital, which is particularly scarce in developing countries.

Criterion for planning a long-range agro-industrial development programme

The traditional approach to agricultural development, which considers in the first instance existing soil characteristics, climate, type of crop hitherto grown, agricultural surpluses, and present assortment of products, should be abandoned as soon as possible. For example, it is not sufficient for a profit-minded industrialist to plan the future meat production of Iran by virtue of sheep husbandry alone simply because sheep is a traditional part of the Iranian animal husbandry or a traditional dish for the Iranian consumer. There are sufficient economic and technological reasons why sheep production throughout the world has failed to become a major meat source. Australian sheep husbandry has shifted to wool production.

The market-minded planner of today's integrated food industries must thoroughly explore both the existing and the future demand on the domestic and the world markets and must assess the priority of the most profitable commodities. He must then turn to the raw material resources and explore the possibility of large-scale industrial production of these resources according to the market situation. He has to estimate the investment and production costs of raw materials delivered to the processing facility. At this stage of the programming, the planner selects the optimum-sized processing facility that will permit the complete utilization of products and by-products of the previously assessed agricultural production, correcting or eliminating all unbalanced factors and quantifications from the first agricultural programme. After he has calculated the final investment in the processing and distribution facilities and estimated the final costs of production, he is able to study the market for a second time, taking into account more clearly defined quantities, timing, qualities and prices. The second market study will confirm the viability of the programme or will indicate minor or major corrections that may be required throughout the integrated planning process.

On the basis of such a long-range programme, which should not pretend to replace an existing rural economy, but rather to form the progressive part of it, locations, zones and areas can be explored to determine where the programme can be implemented gradually.

Structure of integrated agro-industrial food production

An analysis of the structure of present agro-industrial integrated combines makes it possible to identify some groups of activities that are fundamental to a unified industrial process.

These groups are as follows:

(a) Production of basic crops and collection or catch of raw materials;

(b) Pre-processing, transport and storing of basic crops, catches and pre-processed products;

(c) A basic food-processing industry adjacent to the production of raw materials;

(d) Production of animal feedstuffs for up-to-date animal husbandry;

(e) Production of animal proteins using industrial ranching methods;

(f) Food production for direct consumption;

(g) Distribution and marketing activities.

The first group of activities includes the complete range of large-scale agricultural operations involved in the production of crops specifically grown for processing. There are various forms of industrial production, in particular where the catching of fish or game, the picking of wild fruits, berries, vegetables and the like are concerned.

The second group of activities includes harvesting, cropping operations, cold storage, sorting, grading, drying, washing, dehydrating, chopping or other forms of pre-processing raw materials with the aim of presenting them in a cleaner or more concentrated form for further industrial processing.

The third group of operations includes the basic, primary food-processing industries such as: the production of sugar,

fruit and vegetable preserves, vegetable oil, oil cakes; the production of flour for the purpose of processing basic, individual food commodities and to separate by-products needed elsewhere. This group of primary food industries is closely associated with the production of raw materials.

The fourth group of activities in the consecutive flow of operations is the industrial production of animal feedstuffs, on which an up-to-date, successful animal husbandry of the industrial ranching type is based. The producer of animal feedstuffs is the most important entrepreneur of today in the establishment of profitable meat, egg, milk and wool production.

The fifth group of operations consists of industrialized animal husbandry based on the fattening or feeding of a large number of animals in "animal protein factories", which are often located very near the markets or adjacent to processing facilities (slaughter-houses, meat-processing plants, dairies etc.), creating a logical combination of the animal feedstuff factory, industrial cattle farm, processing facilities and marketing facilities.

The sixth group of activities is the fast-growing, secondary food processing industries supplied directly with raw materials from the first, second, third and fifth groups. The materials are combined into a rich assortment of ready-made foods that can be distributed directly to, or consumed by, the individual purchaser. This is accomplished by developing labour-saving engineering techniques for manufacturing products of high nutritional value.

The seventh group of operations consists of all the technical and commercial facilities (cold storage, cold transport facilities, catering services, restaurant and department store chains etc.) necessary for the regular supply of food products to the domestic and export markets.

Integration of all these groups of operations is not always necessary; sometimes a group can be eliminated or can be replaced by co-operative operations. Sometimes it is not feasible to implement all the operations at once but only gradually. It is

clear that the assortment of operations at each level has to be selected according to the procedure explained in the programming part discussed earlier. Some lines of food products can be developed successfully also as small-scale, individual operations. However, it is equally clear that whenever integrated food processing is feasible it should be preferred to all other production methods, especially in developing countries.

The industrialization of rural areas has to be programmed and implemented under the leadership of industry, rather than of agriculture, since industry alone is capable of applying objective criteria to all operations. In this way the benefits associated with the application of industrial technology to the agricultural sectors of developing countries can be maximized.

Chapter 2

THE AGRO-INDUSTRIAL COMBINE IN YUGOSLAVIA

Collectivization

Faced with the task of introducing agrarian reform after the Second World War, the Yugoslav Government began to explore the possibilities of joint farming procedures, with the aim of solving the technical and social problems connected with agriculture. The initial step was to collectivize the farms by creating 'peasant labour co-operatives'. Although the number of co-operative farms rose rapidly, productivity figures showed no improvement over the pre-war situation. Most co-operatives were undermechanized and almost always in financial straits, one of the problems being the chronic lack of trained staff.

In the early 1950s, the Government introduced a more liberal form of economy. Compulsory sowing schedules and centralized planning were replaced by free market operations, and it was generally recognized that agricultural problems were best solved by economic rather than purely administrative measures. In the late 1950s, a more effective approach to co-operative farming began to be adopted: farmers, instead of being antagonized by compulsory measures, were now encouraged to co-operate with these institutions under the motto "collective work is more valuable than individual work". At the same time, urban migration became an important factor in rural development, since the Government was now able to purchase land and so increase its social holdings without having to resort to coercive measures. Thus, alienation of the farmers' sympathies was avoided, which was important in a country where 40 per cent of the gross national product is dependent on agriculture.

Characteristics of the agro-industrial combine

In the second half of the 1960s following the economic reforms in Yugoslavia and an average annual growth rate of 4 per cent over the last ten years, agricultural production was seen to be most rapid on social holdings, in particular in agro-industrial combines (table 2).

Table 2

Average rate of growth in agricultural production, 1962-1967
(per cent)

	Total (social and private)	Social
Agricultural production	3.9	10.1
Farming	5.1	10.1
Crops	6.3	12.5
Plants for processing	8.1	13.1
Vegetables	1.4	5.4
Livestock	4.6	7.7

Equally dynamic was the decrease in the actual number of social enterprises and the increase in area within one organization, again primarily within the agro-industrial combine sector.

The change in number and average size of social holdings (exoluding co-operatives) was as follows:

	Number	Average size in hectares
1958	713	585
1966	282	2,983

In addition to these holdings, there are some 1,712 agricultural co-operatives purchasing produce from private farmers, hiring out machinery and supplying them with fertilizers, seed, feed and livestock.

Agro-industrial combines, unlike co-operatives, do not play a purely agricultural role in rural society. They are, as the name indicates, the outcome of the desire to integrate agricultural production with food processing. By joining production and processing, they aim at a better and more rational production process. By refusing to adopt measures of expropriation, by co-operating with private producers and by encouraging the workers with incentive schemes, the agro-industrial combines have overcome any resistance to the system. The principle of cheaper and better production has established itself as a significant factor in Yugoslav agriculture.

The combines themselves represent 9 per cent of the total number of socially owned farms, yet some 56 per cent of the total agricultural surface of the social holdings. Intensification and integration are the touchstones of agro-industrial combine policy, which is based on the principles of rationalization and close association between producer and processor. Table 3 shows the importance of production in agro-industrial combines to the food industry.

Table 3

Production in agro-industrial combines
(Per cent of total processing)

Meat	41.3
Sugar	73.0
Starch	64.0
Animal feed	58.2

Integrated production of this kind has many advantages: the decreasing number of agricultural workers can be effectively compensated for by increased mechanization; the extremely long distances that often have to be covered are reduced by placing the factory in the field; while the presence of trained staff ensures the implementation of the best agricultural methods. (Social holdings, for instance, use 793 kg of fertilizer/ha;

they have 34,782 tractors, 12,526 combine harvesters, 18,000 machines of other kinds and 3,987 trucks.)

The processing sectors of the agro-industrial combines, though including meat-processing and fruit-processing plants, sugar mills, breweries, margarine plants and the like, have been reduced to manufacturing a narrow range of products based on the principles of productivity and profitability. The impressive volume of production they have achieved shows that the greater the concentration of resources and capacities, the better the conditions for further specialization and the more effective the transfer to industrial methods of production.

The role of the private farmer

Notwithstanding the excellent production figures, the agro-industrial combines are dependent upon the private farmers, particularly in the wheat-growing districts (Vojvodina and Slavonia). The percentage of private farmers co-operating is shown in table 4.

Table 4

Percentage of private farms co-operating with agro-industrial combines

	1960	1963	1966
Crop	23.7	34.4	36.4
Fruit	0.7	0.7	1.3
Cattle	8.0	11.6	13.4
Total	32.4	46.7	51.1

Good public relations and the recognition of mutual interests are imperative. The combine guarantees fixed prices for produce purchased and provides equipment on a loan basis. Incentive schemes are introduced to maintain the private farmer's interest in co-operating. Table 5 summarizes the private farmer's share in total production.

Table 5

The private farmer's share in total production, 1966

	Per cent
Wheat	76
Maize	85
Sugar-beet	53
Vegetables	95
Fruit and wine	93
Meat	83
Milk and milk products	37

In addition to encouraging the private farmer with the aid of certain material incentives - cars, TV sets, fertilizers etc. - agro-industrial combines have initiated a series of agricultural information programmes to help propagate new ideas, the main aim being to help the private farmer to realize that he really is essential to the production process.

Close co-operation between the private farmer and the agro-industrial combine has other distinct advantages. The agricultural organization can inquire from the food industry and wholesale organizations as to the kind of product and quantities needed and pass this information on to the private produoers, who can then follow the optimum operation procedures. Thus, complete integration in the industrial production of food is achieved. The trend towards co-operation, despite a minor setback in 1966, is expected to continue once the advantages of co-operation have become apparent to all.

Rationalization of production

Despite the significance of co-operation with private producers, the intensification of agricultural production on the social holdings themselves is a factor that should not be ignored. The merging of small agricultural enterprises permits a more viable form of production, and the implementation of agro-technical methods on a larger scale results in better production figures.

The agro-industrial combines, organized on the basis of self-management, have been able to apply modern techniques rationally and introduce specialization. Specialization has, in turn, brought about a decrease in administrative personnel.

The production of agricultural goods on a large scale, however, gives rise to a greater need for security and continuity with regard to sales. This requirement is best met by the establishment of economic and organizational relations with the largest consumer of such goods - the food industry - without going through the motions of buying and selling. This is where the agro-industrial combine offers particular advantages.

Not only does the agro-industrial combine offer a more rational implementation of producer-processor relations, it also permits a more rational utilization of labour. A glance at Yugoslav statistics will show that the workers on private farms are scarcely employed in the most advantageous manner. The agro-industrial combines with their division of labour can attempt to organize their workers along more efficient lines.

Integration in agro-industrial combines may be vertical as well as horizontal. Horizontal integration has already been dealt with at length in connexion with the association of private and social holdings and the absorption of smaller estates by large-scale agricultural enterprises. Vertical integration is not so much concerned with the stabilization of agricultural production as with the integration of the agricultural and food-processing industries. The more that vertical integration increases, the more extensive the association of the agricultural and food-processing industries will be.

Thirty-five of the largest agro-industrial combines in Yugoslavia have reached an agreement on economic and technological co-operation as well as on co-ordination in marketing activities. They regularly exchange experience on techniques and co-operate to increase sales figures on the domestic market. They also pool funds in order to build up a modern marketing apparatus and thus improve distribution. Relatively backward marketing methods and

correspondingly low sales are incompatible with large-scale production and increased consumption.

The amalgamation of land and other agricultural capacities with processing plants and other production units calls for adequate organization and clear business objectives. An economic unit comprising a combine and processing plant has many advantages. It is easier to direct specialization, organize methods for increasing productivity and apply them most efficiently. The system of self-management within the combine facilitates, since it reflects the interests of the agro-industrial combine as a whole.

Equally important is a proper appreciation of the effect of external factors, such as domestic and foreign market conditions, credit facilities, foreign currency procedures etc. Thus, agro-industrial combines must be well informed as to economic trends at home and abroad. They co-operate with other combines in the same field in studying these trends. They also co-operate in development, in solving problems in connexion with specialization and the co-ordination of production; in the planning of long-term programmes, thus providing a framework for the large-scale integration of the food and agricultural industries in the future.

Relevance of the Yugoslav experience to developing countries

Developing countries can learn a great deal from the experience gained by the Yugoslav industrial combines. Apart from realizing the importance of encouraging the goodwill of the industrial farmer, countries introducing joint farming procedures must also consider the suitability of the plan of cultivation they intend to introduce. Yugoslavia has teams of experts specially trained in the preparation of development projects, a case in point being the organization of an integrated meat-processing plant in Madagascar. Specialists will be sent to Madagascar to aid and advise in the initial stages of development, after an exhaustive feasibility

study for the whole project has been prepared by officials of the Malagasy Government and Yugoslav specialists.

Other projects are the setting up of a large-scale pig farm (100,000 pigs) in Eberswarde, German Democratic Republic, and a broiler plant in Königswasterhausen in the same country.

The principles applied in the organization of such enterprises are exactly the same as those applied in Yugoslavia itself. Intensive implementation of the latest techniques is the keyword, since a characteristic shortcoming in developing countries is the unawareness of difficulties in the field and lack of information concerning the latest research findings.

In Yugoslavia itself, however, the social holdings are fully aware of the latest techniques and their successful implementation. Although they cover only 14 per cent of the total agricultural area, social holdings account for 63.5 per cent of all agricultural products on the market.

First, the old methods of cultivation using manpower and old-fashioned machines, often horse-drawn, have to be thrown overboard. The uneconomical nature of small-unit farming is obvious, and it is an anachronism in an industrialized country: capitalization is too low, production too slow and labour too arduous and prolonged for an economic system concerned with the problems of distribution and marketing. The pace of production must be geared to that of the industrial factory, and this can be achieved only through rapid modernization of techniques. Mass production of food has become a modern necessity.

Progressive mechanization also has the advantage of helping to narrow the gap between the number of hours worked in agriculture and the number of hours worked in industry. Mechanization is not restricted to crop husbandry alone; it is applied in all branches of animal production. The broiler industry is perhaps the closest approach to a factory system producing food from animals for human consumption; the process, beginning with newly hatched chicks and ending with pre-packed frozen chickens, is completely mechanized.

Nevertheless, although the results of mechanization and the economic convenience of agro-industrial combines have been clearly established, the method of their application entails certain difficulties.

Chapter 3

ORGANIZATION OF THE AGRO-INDUSTRIAL COMBINE

The continuous integration process

The setting up of an agro-industrial combine depends on local conditions and on the economic interest enterprises may have in establishing an integrated community. It is not possible, therefore, to lay down any hard and fast rules with regard to their structure and organization.

Agro-industrial combines are conceived on the lines of a continuous integration process, the aim of such integration being the creation of a bigger and better supply of raw material on the one hand and the better utilization of the processing industry and its marketing facilities on the other. A concomitant feature is the concentration of financial means and staff. The integration should be open-ended so as to permit further extension and modernization in the course of subsequent production.

Basically, an agro-industrial combine is composed of highly heterogeneous elements, and thus there is a tendency towards imbalance, which may manifest itself in a deficit in one sector and overproduction in another. This means that before a decision is taken to make up for the shortage of pigs, the economic aspects of the new sowing schemes to provide food for them, the current market prices etc., must be carefully considered.

Figure 2 shows the basic production of an agro-industrial combine where four different plants were originally combined to rationalize production and processing: a confectionery factory, a powdered milk factory, an agricultural plant and an agricultural-cum-processing plant. Later, the slaughter-house attached to one

of the above plants joined forces with a nearby meat-processing plant to promote the rapid development of the local meat-processing industry. Then, a second agricultural-cum-processing plant joined the main group. This shows once more the continual state of flux in which such agro-industrial combines find themselves. The figure also shows the interdependence of the various production processes, but does not indicate the extent to which certain raw materials are sold locally or abroad.

The scope of an agro-industrial combine

The agro-industrial combine illustrated in figure 2 includes the following activities:

(a) Industrial activity

Sugar and confectionery factory
Powdered milk factory
Oil and alcohol plant
Hemp plant
Flour mill
Processing plant for agricultural produce
Refrigerating plant;

(b) Agricultural activity, also in co-operation with private farmers

Crop farm
Cattle farm
Co-operative
Agricultural service plant (research);

(c) Other plants

Building plant
Auxiliary plant;

(d) Services

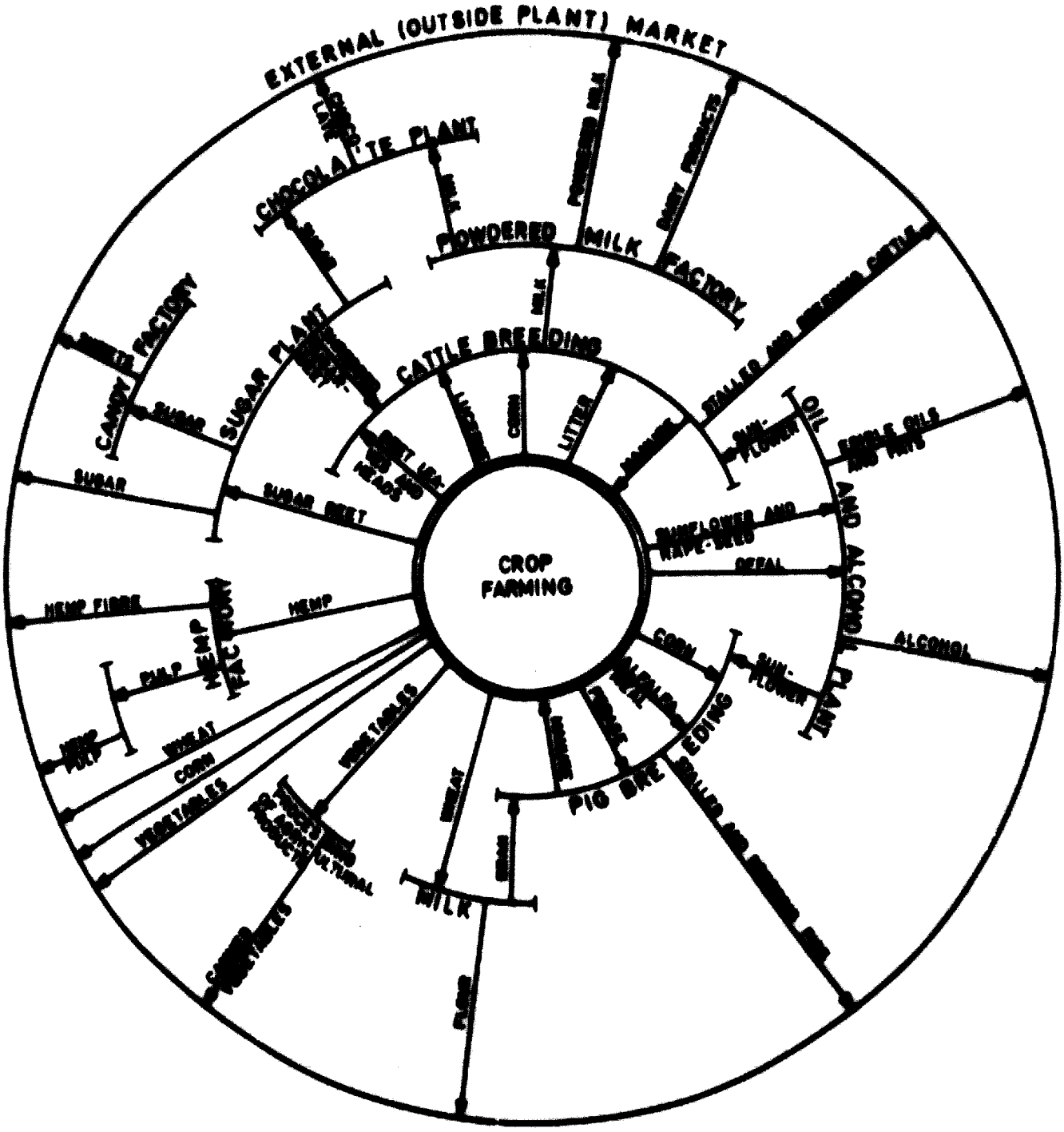
Joint management (director, staff and audit offices)
Economics section (electronic data processing)
Banking division (credit and other accounting activities)
Export department;

(e) Social services

Housing management (workers' dwellings etc.)
Old-age pensioners' home
Re-education of redundant workers.

Figure 2

Activities of the agro-industrial combine



Despite the heterogeneity of the industrial combine as a whole, each of the above divisions is self-managing and technologically and economically homogeneous. Each division can determine its own income and revenue. Likewise, it can dispose of financial reserves formed at the divisional level, although its autonomy is always limited by the rights and interests of other divisions, as well as by the obligations of the agro-industrial combine as a whole.

Each division is subdivided into working units. Altogether there are 60 working units in the combine under discussion, and, like the divisions, they are limited by the interests and rights of the other working units within the division. They foster the feeling of solidarity and unity among the workers, for each employee feels that his efforts contribute to the success of the unit as a whole. The sugar and confectionery factory, for example, is split up as follows:

Sugar section
Production of chocolate
Production of sweets
Power and maintenance
Joint services
Transport.

The average area covered by a working unit in crop farming varies between 1,600 and 3,000 hectares.

Each agro-industrial combine sets itself certain goals, which have to be achieved within a certain time. Often such targets can be reached only with the help of outside associates, i.e. the private farmer, and thus planning is very important.

"Vertical" aims affecting several sectors include increasing the supply of sugar-cane to the combine's own factory by up to 70 per cent, increasing the production of livestock to satisfy demand in the meat-processing plant or simply introducing a modernization programme to bring the products up to international standards. "Horizontal" aims limited to one particular sector

include the intensification of annual milk production or technological improvements in the meat-processing sector to increase production and thus lower costs.

Economic goals may entail the creation of new jobs, increasing wages to an annual average of $1,500 or initiating housing or training schemes for the employees. Whatever the aims may be, they are worked out on the principle of the 'input-output' analysis and mathematical models devised by the American Leontief. Once calculated, the targets have to be approved by common consent. Once accepted, they have to be kept to.

Management

The management of a typical agro-industrial combine includes the following officials:

Director General
Acting Director General
Staff Manager
Manager of Investment Service
Trade Adviser
Manager of Research Division
Manager of Internal Audit
Industrial Assistant
Agricultural Assistant
Managers for the various industrial divisions
Managers for the various agricultural divisions.

Although enjoying a certain degree of autonomy, the Director General is personally responsible to the working community. He is assisted throughout by the Acting Director General and his professional assistants. The working community is represented by the Workers' Council. Members of the council are elected by all the workers on the combine, electoral procedure being determined by internal statutes. The Workers' Council is in charge of management, receives suggestions from the various divisions and takes decisions on the basis of these suggestions and recommendations. The

executive staff is responsible for the actual implementation thereof.

The executive staff is obliged to:

(a) Keep the Workers' Council informed of its activities;

(b) Reply to any questions, proposals or opinions expressed if required by a member of the Workers' Council;

(c) Examine proposals put forward by the workers at their meetings and make comments on them;

(d) Give reasons for the refusal of any proposal thus put forward.

Direct management is implemented through the workers' meetings, their referenda, their right to nominate or dismiss any members of the executive staff. All members of the executive staff are appointed for a period of four years and are entitled to re-election. The posts are open to tender, advertisements being placed in the newspapers stating the qualifications required. The management of the combine forms a committee to deal with the applications and select the most suitable candidate. It should be stressed that the main requirements are education and experience.

Once contracts have been made with the executive staff and agreements have been reached with the private farmers willing to co-operate, the main question is financing. The combine as a whole receives credit from the Agricultural Bank in Belgrade. This loan is then distributed through the combines' own internal banking system according to the requirements of the working units. Computers are used to aid functional organization; the disproportionate increase of administrative staff in relation to manual workers is thus prevented. However, since the acquisition of computer hardware is a costly undertaking, several agro-industrial combines have co-operated in the purchase of a regional computer.

Common funds

One of the advantages of the agro-industrial combine is that funds previously split among several separate enterprises are now pooled. With such resources on hand, each combine devises a

long-term investment programme to ensure the maintenance and modernization of the working units over a longer period. The main funds are derived from the combines themselves, the actual amount being determined by the business performed. Overheads and other expenditures are met first, excess revenue being distributed as bonuses and payments to other funds. The individual working units are obliged to allocate some 30 per cent of their net earnings to the reserve and other funds, the rest being kept to fulfil the needs of the workers. For instance, in a working unit where revenue was 1,000 new dinars and overheads came to 800 new dinars, the difference of 200 new dinars would be distributed as follows: 140 new dinars (70 per cent) would be handed out as personal income, 60 new dinars (30 per cent) would be allocated to reserves and other funds.

Some working units operate at a loss, a so-called planned loss. Such units are kept going simply because other units wish to avail themselves of their services. Should the losses incurred be higher than anticipated, contingency measures are adopted: management demotion or wage cuts.

The two main funds are the business fund and the joint welfare fund. The actual amount of money available depends on the business performed, and the combine is free to dispose of the business fund as it thinks fit. It can be used for purchasing equipment, constructing new buildings or repaying loans. Part of it may be used as working capital: paying for stock and other material and meeting current production requirements. The joint welfare fund is used to initiate plans for the construction of recreation centres, medical facilities, nursery schools, social amenities etc. It can be used for building workers' accommodation and for trainee schemes.

The reserve fund is used to cover the losses appearing in the annual report. It can also be used to make up for losses suffered in the personal incomes sector, though here the sum drawn must be reimbursed from future returns.

The depreciation fund is an important financial source. The rate of depreciation is calculated on the basis of the value of the

fixed capital and the percentage fixed by the workers' council. The depreciation is worked out for each month. The combine is able to use this fund to meet investment requirements such as replacement of equipment, purchase of other capital goods, repayment of loans and working capital for current operations.

Another fund is the foreign exchange fund (some 7 per cent or more of the total value of goods exported by the combine), which the combines can use when importing the equipment or goods they need. Foreign private capital may be invested in any agro-industrial combine, but it must not exceed 49 per cent.

Alternative sources of income

Generally speaking, however, despite the above, funds are often inadequate, and the combines have to turn to other financial sources to obtain:

(a) Short-term credit to ensure normal production;

(b) Long-term credit to expand and modernize existing production lines, provide for new ones and erect dwellings for the workers.

Like any other business organization, agro-industrial combines can avail themselves of various credit schemes provided by banks and other special funds. The schemes available can be summarized as follows:

(a) Short-term credit schemes of various kinds: turnover, stock and production credits;

(b) Long-term loans, permitting the purchase of machinery and other equipment, building and reconstruction schemes;

(c) Foreign loans, with or without bank guarantees, usually for importing equipment;

(d) Relief credit schemes;

(e) Credit to permit the export of machinery and construction projects abroad;

(f) Credit schemes among the combines themselves (commercial credit schemes).

Yugoslav banking schemes

Some of the most interesting provisions of the legislation enacted in 1965 to regulate banks and credit operations in Yugoslavia are those concerned with the establishment of banks by business enterprises and other organizations. At least 25 such organizations are required for the founding of a bank. The founders are obliged to invest 150 million new dinars if they wish to start an investment bank, 50 million new dinars for an investment-cum-commercial bank and 15 million new dinars for a commercial bank alone. Furthermore, the founder members must invest another 20 million new dinars for sight deposits, while commercial banks are not permitted to grant credits directly for fixed capital investments. Banks with at least $2 million in their credit funds and a minimal annual turnover with other countries of $80,000 may undertake credit and payment operations with other countries. Banks are permitted to operate all over the country instead of being restricted, as previously, to one area.

There is, in fact, one special bank solely designed for financing the agricultural, food and tobacco industries: the Yugoslav Agricultural Bank. Its backers are 235 enterprises connected with the three industries as well as export-import organizations of various kinds. (Its funds are given in table 6.) Shares in the bank can be obtained at a price of 1 million new dinars, payable in five annual instalments, the number of votes in the bank assembly being proportionate to the number of shares held. A significant part of the credit fund is derived from the profit made by the bank's other operations, other sources being the deposits made by the various clients and foreign loans.

Another special source is the funds offered by the Government within the framework of its social plan to those banks offering the best credit conditions. Other funds are allocated by the Federal Board for Foodstuffs Reserves, a government body that guarantees minimum prices to the agricultural producers for their products. Adequate funds are derived from the difference between the price paid for the products on acquisition and the price at

which they were sold, the board itself awarding funds to the banks with the best plans for their utilization. Still more funds can be obtained from the National Bank within the terms that have already been prescribed.

Table 6

The funds of the Yugoslav Agricultural Bank as of 30 September 1968

		Million new dinars
Credit fund (total)		626.2
Foreign exchange portion	149.2	
Sight deposits		934.2
Time deposits		538.5
Foreign credits		164.5
Specific purpose funds (Federation etc.)		5,774.7
National Bank credit		1,263.9
Credit with other banks in the country		771.3
	Total	10,073.3

The provision of credit for agro-industrial combines depends therefore on the bank's potential, whereas the total volume of short-term credits is subject to control by the National Bank. The most important forms of short-term credit granted by the banks are turnover, stock and production credits. Export credits are granted for 90 days from the date of export, whereas import credits can be approved for a period of up to 90 days from the date of transfer or 30 days from the date of import.

Production credits are very important to farmers. Banks supply credit facilities for the sowing of crops. These credit schemes cover the cost of machinery, seed, semi-manufactures and raw materials. The credits are repaid once the crop has been sold, and banks should make every endeavour to grant credits on time so as to avoid delay in sowing and cropping operations. Other credits are supplied for periods of over three months for the rearing of livestock.

Credits are granted only to efficient enterprises. Interest rates have been limited to the maximum of 8 per cent (formerly 10 per cent), the Yugoslav Agricultural Bank providing loans at 7 or 7.5 per cent. Commercial banks are obliged to invest at least 50 per cent of their short-term pool into credits that are redeemable after three months; when credit is extended to agricultural enterprises, this period can be extended to ten months.

Commercial banks are also obliged to keep 25 per cent of their sight deposits with the National Bank as a compulsory reserve. Credits may not be granted from this sum, nor does the National Bank pay interest on it.

Capital investment

Every year the Federal Assembly lays down guidelines for capital investments, allocating a certain sum for investment in agriculture. As several banks offer credit facilities to the agricultural industry, the funds for investment are put to tender, and the bank offering the most favourable terms obtains the funds. The bank pays 4 per cent interest to the Government and re-lends to investors at a rate of 4.4 per cent. The term of repayment is up to 7 years for machinery, 20 years for land purchase, 15 years for buildings etc. The bank also pools the government funds with its own, those of other banks and investors. Legislation on investment ventures further stipulates that such ventures can be undertaken only if financial coverage for the whole project has been obtained, regardless of whether the funds are supplied by the bank or by the combine itself.

Before receiving a loan, enterprises are obliged to deposit a sum equivalent to 10 per cent of the total investment, as a guarantee. Agro-industrial combines can apply for a loan either directly to the Yugoslav Agricultural Bank or through their own banks. After a close examination of the project, the bank experts submit a proposal to the credit board. Once permission is granted, the lending procedure swings into operation, and throughout the construction period the bank officials are available to provide

advice. As long as the combines are run with evident success, the banks require no guarantors. The banks, together with their clients, are willing to assume the business risks involved. In case of a loss, the combines cover the loss by drawing on their reserves or the business operation funds.

The banks demand very seldom that other combines stand as guarantors. They are usually satisfied if the material goods are insured and an insurance policy is taken out for the money lent. Over the years, bank experts have gathered a great deal of experience and ability to judge the viability of proposed investment schemes. They lay particular stress on the need for skilled personnel and they can make loans conditional on the elimination of inefficiency within the enterprise.

Almost 30 per cent of the funds made available by the Yugoslav Agricultural Bank has been invested in new machinery, which is an understandable investment, since most agro-industrial combines have highly mechanized wheat, maize and sugar-beet production schemes. Another large per cent of the loans is destined to be spent on land purchase and reclamation projects. Nevertheless, a considerable drop over the years has been felt in the farm sector:

	Hectares purchased
1964	83,159
1965	36,488
1966	17,399
1967	19,677

Particularly favourable conditions have been laid down for the financing of hydro-reclamation schemes. Many applications have been submitted for the setting up of new plantations: vineyards and orchards (mostly apple orchards).

Special funds have also been made available by the Federal Board for Foodstuffs Reserves through the Yugoslav Agricultural Bank for financing the construction of silo, warehouse and refrigeration plants. The period of repayment varies from 20 to

30 years, the rate of interest being 1 to 2 per cent; however, the combines must put up at least 50 per cent of the sum involved, taken either from their own funds or elsewhere. Also, as the Agricultural Bank is obliged to repay the board irrespective of how regular the combine's repayments are, there is a very rigid screening procedure. Particular attention is paid to the marketability of the goods involved. It has been observed that debts are paid more promptly when only part of the project has been financed by outside sources.

Another factor that deserves particular attention is that over the years the banks have made the mistake of overemphasizing their financing of production and have tended to neglect storage and communications. With increased production, difficulties have arisen, and new loans have had to be approved to permit the extension of storage facilities etc.

It happens occasionally that an agro-industrial combine gets into financial difficulties and the decision is taken to close down. The winding-up procedure is amply provided for in Yugoslav legislation. Once the liabilities have been ascertained the assets are apportioned, and the bank has to bear any liabilities that are not covered, particularly if there are no other guarantors.

Alternative credit schemes

Other credit facilities, although less favourable than those offered by banks, are granted by tractor and combine-harvester manufacturers. In addition, the Federation has set up a fund to aid the lesser developed areas of the country. The loans granted under this scheme are financed by the interest paid by other enterprises and are on a very favourable basis (20 to 30 years at 1 to 2.5 per cent). Special regulations entitle the investors in these areas to an additional 3 per cent interest from federal sources. This means that the Yugoslav Agricultural Bank or any other bank outside these regions is entitled to both the regular interest payable by the debtor and an additional 3 per cent interest from federal funds, if they are invested there. Yet another incentive

to invest in these areas has been provided by various authorities approving an additional 3 per cent interest from their funds.

Federal legislation also provides for the compulsory establishment of joint reserve funds at a provincial and communal level. The combines pay a maximum share of 5 per cent of their surplus income, the federal and communal authorities determining the amount to be paid into their respective funds. There is no obligation to repay loans or grants from these funds. They are used as relief loans to help combines in material and financial difficulties. Credit schemes are set up to help combines meet their various obligations or counterbalance their losses. In effect, it is a kind of solidarity fund, with the more successful organizations setting aside a certain percentage of their revenue to help their less fortunate colleagues. Relief is not granted a priori. The board appointed either by the commune or provincial authorities investigates the cause of any losses and prescribes certain requirements that must be fulfilled before the relief is granted.

Yet another fund deals with the financing of exports - either equipment or plant construction abroad. So far $75.4 million has been credited to the export of equipment and plant to 26 countries, 89 per cent of which went to developing countries.

In 1968, the percentage of export financing was up to 70 per cent, payment over 10 years being at an interest rate of 3 per cent. The following case illustrates how the fund works. The 'Agrovojvodina' enterprises apply for credit in connexion with the export of tractors to Guinea. The partner in Guinea is granted a credit of $700,000, 15 per cent of which is paid in advance. Repayment is within five years; the rate of interest is 4 per cent; and a guarantee from the National Bank is required. Thereupon the Yugoslav Agricultural Bank grants 'Agrovojvodina' a loan, 40 per cent of the value of the equipment which 'Agrovojvodina' sold on credit; the remaining 60 per cent is then requested from the export fund. The fund itself will demand security when it appears that repayment may present difficulties. The fund has also studied the possibility

of extending credit to enterprises undertaking projects jointly with other organizations; an example is the joint construction of an agro-industrial combine in Iran.

One of the aims of the economic reforms introduced in Yugoslavia was to prepare the way for the convertibility of the dinar. Currently, agro-industrial combines are allowed to retain in foreign exchange 7 per cent of the value of goods exported; anything in excess of this must be sold to the National Bank for other payments abroad. Other producers who are more export-oriented are permitted to retain a higher percentage, but all combines put foreign exchange to the same use: the purchase of raw materials and semi-manufactures or the import of equipment etc.

All agro-industrial combines are entitled to use a certain percentage of their fixed capital (or depreciation) to pay for the import of equipment or spare parts or to repay foreign loans. Combines may import equipment freely except in certain cases in which there are particular restrictions. Where the repayment of foreign loans is concerned, the combines have to obtain a guarantee from their banks; these in turn are limited in their issuance of such guarantees.

Financing within the agro-industrial combine

All agro-industrial combines are able to avail themselves of credit schemes and funds offered by institutes at various predetermined levels. Financing within agro-industrial combines, however, varies from enterprise to enterprise because of the differences in their internal organization.

The working unit, on which the organization of the combine is based, plans its own programme, determines its own income and distributes it accordingly. Depending on its size and the nature of its work, each working unit may include two or more accounting units. These accounting units prepare and check the punch cards before they are processed in the computer section. They also make decisions as to job evaluation and payroll distribution, the disposal of any funds and provision of social services. Another

outstanding feature is that the individual working units can sell their own products within the combine or without. This means that in effect, the working group cannot be compelled to sell its products at a cheaper price within the combine. If the price offered within the combine, however, is the same as the one offered without, the products must be sold within the combine. If the sale of goods or commodities without any set market value is involved, for instance, manure or other by-products, the price is determined by internal rules and standards. The transaction of products and services between the individual divisions and units is carried out at market prices.

Accounts and statements with regard to products and services between accounting units within the working units is done on the basis of product prices and prices of services set down in the economic plan for the current year. The exchange of goods and services over and above the planned amounts is carried out between working units within the combine on the basis of a special agreement. Invoicing is carried out at the working unit level regardless of whether the sales are made at the external, internal or intra-departmental level; invoicing is always done at current market prices.

Each working unit is responsible for the distribution of bonuses and for the planning of various incentive schemes. They are also instrumental in the assignment of jobs to the various workers and in the evaluation of the workers' operative skill. The working unit has a great deal of influence in the procurement of equipment; particular emphasis is laid on obtaining the maximum rate of depreciation. Although federal legislation has established minimum depreciation rates, there is no legal objection to depreciating fixed assets at a higher rate.

The working unit also specifies working conditions and the like, evaluating the workers' efficiency on the basis of the net review in the final accounts. The workers themselves receive an advance on their salary throughout the year depending on the results of their work.

Working units needing funds for new investments may apply to the Workers' Council for a loan. When funds are allocated, the managerial staff must clearly stipulate the purpose and period of the loan and the rate of interest. If there is a surplus of funds, it is put up for auction, with the banking division taking care of the technicalities. Surplus funds are lent interest-free to the working unit deemed capable of utilizing the funds in the most effective manner, i.e. for the benefit of all. Every working unit is entitled to tender for surplus funds by submitting a detailed investment plan. The funds are lent to the unit offering the best terms of repayment and promising the highest financial returns.

Once a loan is approved, an inter-unit agreement is drawn up stating its purpose, amount and duration. The interest rate must be agreed upon as well as other modalities of reimbursement and steps to be taken, if the deadline is not met. The basic principle is that one working unit credits another under circumstances very similar to those prevailing in normal banking usage. However, should a working unit, despite loans from the other units continue to operate at a loss, it is closed down.

Computerization

Computers are used by the banking division to keep the working units and divisions informed as to their financial transactions. Computers are also used by the economics section, the data processing centre paying its way by rendering services both to working units and third parties. In the agro-industrial combine shown in figure 2, computers are used for numerous tasks:

(a) Preparation of both individual and summary balance sheets for each working unit in the combine;

(b) Book-keeping for all current accounts of suppliers and buyers;

(c) Keeping a ledger on the fixed capital assets of all the units in the combine;

(d) Stock-keeping (materials) in the sugar factory division;

(e) Stock-keeping (goods) in the same division;

(f) Invoicing to buyers in above division;

(g) Statistical and quantitative check on chocolate production;

(h) Checking, calculation and analysis of feed for all categories of livestock;

(i) Central book-keeping on cows in livestock unit;

(j) Notation of expenses and operational efficiency of vehicles in the field cultivation unit;

(k) Programming of feed.

The computers are also used for various other tasks, and steps are being taken to inform people of the full scope of data processing.

Computer hardware is only one aspect of rationalization in agro-industrial combines. Agricultural machinery of a much more bulky nature is needed for the development of the extensive areas involved together with more sophisticated processing equipment. Agro-industrial combines are very much interested in the economic production of raw materials and their rational processing. To achieve this, they need not only an integrated economic organisation at the self-management level but also for harvesting, storage and processing. To achieve optimal results on large areas, bigger and better machines are required.

Chapter 4

MECHANIZATION

Prior to 1955, farm equipment was very primitive; horses and oxen were used as draught animals; the occasional steam engine (sic) pulled primitive ploughs; and there was a lack of mowing machines. Chemical fertilizers and insecticides were unknown. Machinery was in particularly short supply in the fruit sector. New fruit-growing areas were opened up, but despite every endeavour to adapt machinery to a multitude of tasks (row cultivation, pruning, fruit picking, sorting, packing etc.) it proved impossible to mechanize the entire production process or to keep the mechanization process in top gear. This problem must still be solved if further progress in cultivating fruits is to be made.

The advantages of rationalization and mechanization in the field cannot be disputed. For instance, sowing and harvesting wheat by hand in 1840 took 140 hours/ha; by 1933, this figure had been reduced to 22 hours, whereas today through the use of modern machinery, it amounts to 2 to 4.5 hours/ha.

However good the equipment is, it is ineffective if the operating conditions are unfavourable. Well-prepared soil is a prerequisite to any planting operation, so deep ploughing (more than 35 cm) has been developed together with the attendant equipment. Other examples of close co-operation between the agricultural engineer and the mechanical engineer are the series of machines produced to mechanize wheat and sugar-beet production.

On the basis of legislation in 1957, financing was provided to promote the mechanization of agriculture. A series of institutes was set up to deal with the problems pertaining to the

production of suitable machines, the establishment of an efficient sales network and the organization of adequate service facilities.

Taking advantage of funds supplied by the Agricultural Bank, the agro-industrial combines initiated a massive purchasing programme. The equipment manufacturers consequently set up large workshops in the main agricultural areas to deal with major overhauls. There is now also a stand-by team of trained mechanics attached to each service centre that can be called out to deal with urgent repairs in the field. While the machines are in for a major overhaul, the service centre supplies substitute equipment. The mechanics of the combines are specially trained on certain makes of equipment at distriot centres or at special schools run by the manufacturers themselves.

Yugoslavia has a large agrioultural equipment industry, which manages to meet 85 per cent of the local market requirements. Initially emphasis was laid on the mechanization of the principal crops (wheat and corn) from sowing till storing. This has led to a high degree of mechanization of the production of sugar-beet, sunflowers, hay and fodder. Attention is increasingly being paid to viticulture, fruit growing and market gardening. With respect to animal husbandry, automatic watering, feeding and milking machines are the major items produced, followed by cleansing, ventilation and heating equipment for sheds and stables, fodder mills, mixing machines and complete fodder factories.

The industrial development and design service and the agro-industrial combines co-operate to improve existing equipment and to develop new machinery. The industry itself keeps abreast of the latest innovations abroad and carries out test programmes to evaluate the equipment's effectiveness under Yugoslav conditions. Periodic seminars are organized to improve producer-oustomer relations.

The following equipment is produced locally:

Engines

Tractors

Aircraft for spraying purposes

Earth-moving equipment
Ploughs of all kinds
Hoes, harrows and rollers etc.
Manure equipment
Drilling and planting equipment
Weed-control equipment
Spraying and dusting equipment
Irrigation equipment
Haymaking equipment
Green-crop harvesting equipment
Harvesting equipment
Cleaning and sorting equipment
Trailers and stackers
Drying equipment
Livestock equipment
Fodder equipment
Food-processing equipment.

Thirty-five per cent of the total production of agricultural machinery is exported to some 35 countries. The concentration on larger and better production with the aid of mechanization leads towards more profitable production and more rational business operations.

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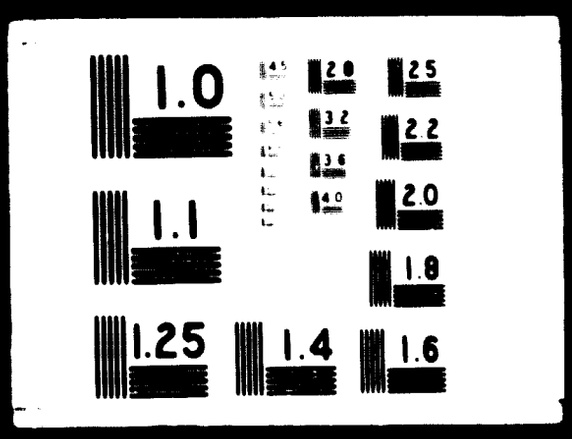


Chapter 5

PRODUCTION OF FIELD AND FORAGE CROPS (WITH PARTICULAR REFERENCE TO THE AGRO-INDUSTRIAL COMBINE SIRMIUM)

The previous chapters have been of a general nature, reviewing economic, sociological and other aspects of the establishment, organization, financing and operation of integrated agro-industrial combines. This and the following chapters, however, concentrate on the practical outcome of these planning operations, the results achieved and the targets set for the future. The reader's attention is drawn to various details of the combines, daily operations and their impressive record. Information is given about the approach and methods adopted, about the effort and money invested which, following the introduction of the agro-industrial form of farming, led to these achievements.

Particular attention should be paid to the production figures quoted for the various agro-industrial combines. The combines' average wheat yield is 5,500-5,800 kg wheat per hectare (13 per cent humidity) over an area of 5 to 6 thousand hectares, while the private farmers in the same districts obtain an average yield of only 1,500 to 2,000 kg per hectare.

Other remarkable results were achieved on the agro-industrial combine Belje. Not only did the combine increase its annual poultry production to several millions of broilers within a few years, but it also obtained a live weight gain of 1 kg for only 2.55 kg of combined animal feedstuffs. The magnitude of this undertaking is even more impressive when one realizes that the largest poultry farms in the United States and the Netherlands at the time were only one tenth of this size. Agro-industrial combines specializing in the production of pork, e.g. IHAN - Emona, have successfully

fattened 200 to 300 thousand pigs a year at a time when the most advanced countries of the world were avoiding large-scale farms because of the danger of infection and the management and marketing risks involved.

Some of the chapters give precise formulae and data drawn from the actual operations of various agro-industrial combines and are not to be found in standard textbooks. In most cases the authors were responsible for these operations, and their findings are of particular value.

The concrete examples given clearly illustrate how the application of modern industrial methods has increased agricultural productivity and efficiency. These methods are incomparably more efficient than the traditional agricultural methods used on private farms: agro-industrial combines, which occupy 15 per cent of Yugoslavia's total agricultural surface, supply about 45 per cent of the vegetable and cereal products and about 70 per cent of the animal products (including eggs) delivered to the domestic and export markets.

Field crops

The staple crops are maize, wheat and sugar-beet; secondary crops include sunflowers and lucerne. Soil and climate are satisfactory for growing these crops.

The soil is mainly black earth (chernozem); humus content ranges from 2.5 to 4 per cent, nitrogen from 0.15 to 0.20 per cent. Its fertility is due to a high reserve of mineral nutrients. Other soils are swampy black earth and waterlogged soils, podzols and alluvium, all of which are less productive and require particular treatment and generous application of fertilizers.

Figures 3 and 4 indicate mean rainfall and temperatures as opposed to ideal values. Despite the difference between actual and ideal rainfall, output is invariably good and in some years high, particularly for maize.

Figure 3

Actual versus ideal rainfall in Yugoslavia, 1928-1967

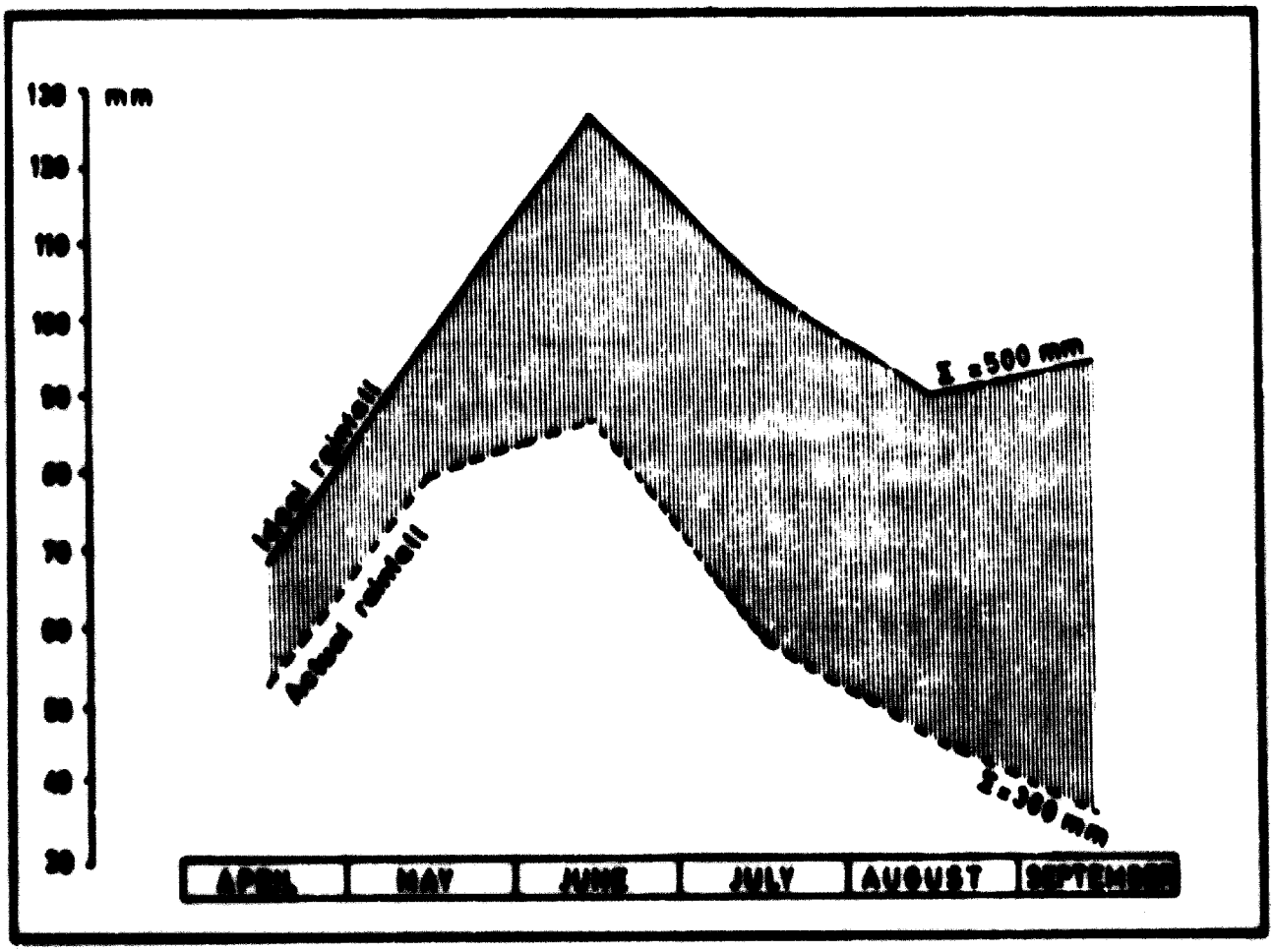
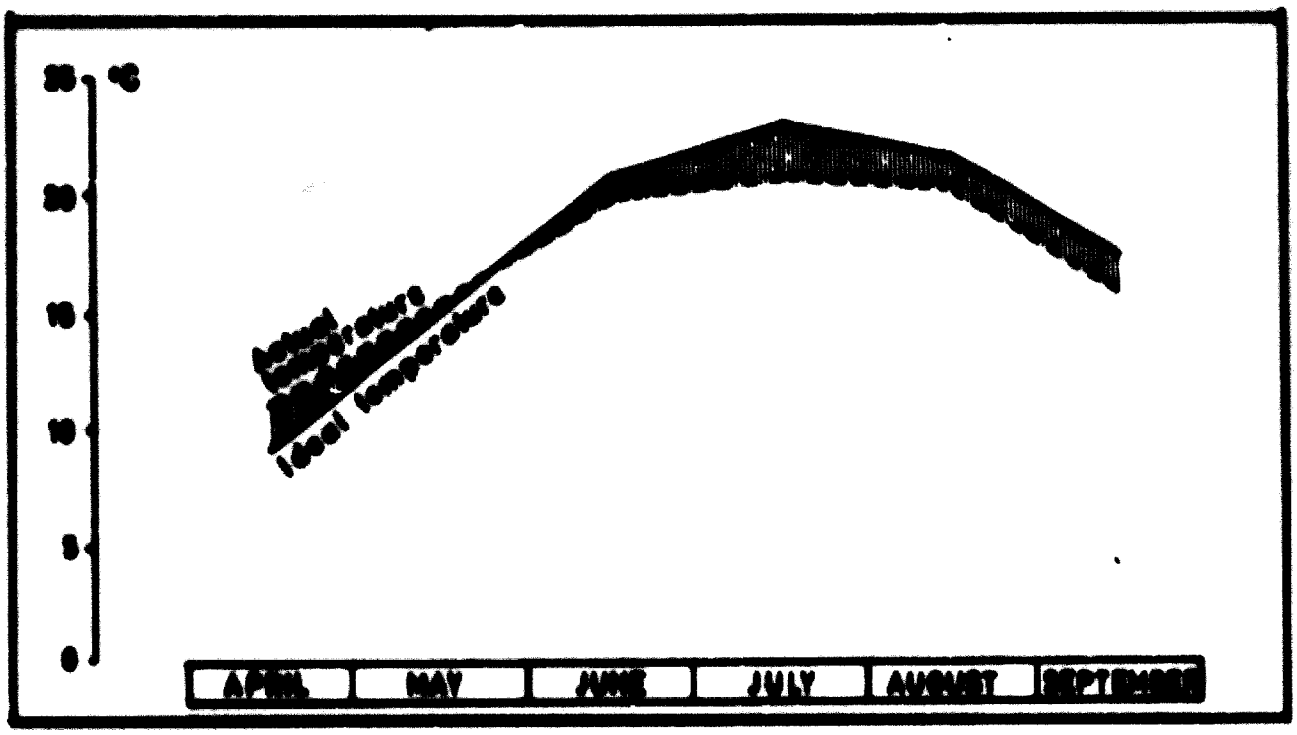


Figure 4

Actual versus ideal temperatures in Yugoslavia, 1928-1967



The combine's total area of 25,124 ha (1968) is divided into 13 production units, ranging in size from 600 to 4,500 ha. The area of a standard plot is from 80 to 600 ha. Wheat, maize and sugar-beet are grown on 80 to 90 per cent of the arable land (table 7).

Table 7

Yield of crops on the agro-industrial combine 'Sirmium'

Crop	1966		1967		1968	
	Ha	%	Ha	%	Ha	%
Maize	8,145	33.66	10,289	42.06	9,431	37.54
Wheat	8,360	34.47	8,350	34.16	9,295	37.00
Sugar-beet	3,526	14.57	3,100	12.68	3,997	15.81
Sunflowers	1,964	8.12	1,268	5.19	1,963	5.82
Lucerne	1,532	6.33	1,131	4.63	809	3.22
Others	688	2.85	312	1.28	129	0.51
Total	24,215	100.00	24,450	100.00	25,624 a/	100.00

Yield b/ (tons/ha)

	1966	1967	1968
Maize	6.82	6.53	6.80
Wheat	4.52	4.55	3.63
Sugar-beet	50.78	54.52	54.80

a/ Area increase is due to purchase of small private holdings.

b/ Fluctuations are due to variations in climatic conditions.

After research results and actual experience on the farm, have been appraised, a detailed plan is drawn up for each crop and unit. Attention is paid to soil peculiarities, climatic conditions, previous crops and available equipment. The plan covers the type and extent of work, deadlines, equipment and manpower requirements.

Maize

Crop rotation

The best results are obtained when maize is grown on areas previously planted with wheat (55 per cent). Maize following

sugar-beet is an acceptable alternative (20 per cent), and there is no appreciable drop when maize follows maize (25 per cent) provided that enough fertilizers are used.

Varieties used

Single-cross hybrids account for 90 per cent of the varieties used and domestic double-cross hybrids (early crop) for less than 10 per cent. The vegetation period is 120 to 140 days. The seed rate is 40,000 to 50,000 seeds/ha.

Fertilizer applications

Owing to lack of manure, chemical fertilizers are used primarily. The average application per hectare is as follows:

	Kilograms
N	140 - 160
P_2O_5	80 - 120
K_2O	80 - 100

Dressings comprising two thirds of the phosphate and potassium fertilizers are applied during deep ploughing. The remaining phosphate and potassium fertilizers together with one fifth of the nitrogen fertilizer are applied prior to and during sowing. The main dose of nitrogen is applied as a top dressing to established crops. Forty per cent is applied when seedlings have three to four leaves (first hoeing), the other 40 per cent when they have reached the nine-leaf stage (second hoeing).

Farming techniques

Stubble is cleared directly after the harvest by shallow ploughing (about 12 cm). In August or September the field is deep ploughed (35 cm). Rollers are used to break up the soil, and in March or April the seedbed is prepared. Maize is sown from 10 to 25 April; rows are 75 cm apart with 25- to 30-cm spacings between the plants, according to the desired yield. Herbicides are sprayed during or immediately after sowing. Agelon (atrasine - prometone ratio 2:1) of the aminotriasine group is used in concentrations of 2 to 2.5 kg/ha.

Hoeing is carried out as described above. Maize is harvested in October, when moisture content drops to 30 per cent or possibly to 22 or 24 per cent, depending on the hybrid, prevailing weather conditions etc. It is then dried to 14 per cent, whereupon it is either sold or stored. Maize leaves are not harvested as fodder, since there are other adequate sources of supply.

Machinery

Wheeled tractors of 100 h.p. are used for all ploughing and cultivation operations; smaller wheeled and larger tracked tractors are used occasionally. Cultivators are used for stubble breaking; they are 2.1 m wide, cover 1 to 1.2 ha/hour and are drawn by 100-h.p. tractors. A three-furrow unit plough is used for deep ploughing; it is 1 m wide, covers 0.4 to 0.6 ha/hour and is drawn by a 100-h.p. tractor. A disk harrow is used for pre-sowing purposes; it is 4.4 m wide, covers 2 ha/hour and is drawn by a 100-h.p. tractor.

A manure distributor is used to distribute chemical fertilizers; its width of spread is 8 to 12 m; it covers 2.4 to 5 ha/hour depending on quantities being applied. Present trends are towards spraying from the air.

Combine drill, seed and fertilizer (or herbicide) hoppers sow six rows, cover 1.3 to 1.8 ha/hour and are drawn by 65- to 70-h.p. tractors. Row-crop cultivators with spreader attachment for multi-row cultivation cover 1.5 to 2 ha/hour. Self-propelled combine harvestors for harvesting and shelling four rows simultaneously cover 1 ha/hour. Oil-fired driers dry 5 tons/hour, reducing moisture content from 28 to 14 per cent prior to ensilage or transport to market.

Productivity

Production figures are as follows:

	Per hectare	Per ton
Man-hours	69.7	10.2
Machine hours	20.5	3.0

Thirty per cent of the maize produced is used in concentrated cattle feed; 70 per cent is sold on the domestic or foreign market.

Wheat

Crop rotation

The best results are obtained when the preceding crops are lifted promptly, wheat usually following maize (65 per cent), then sugar-beet (20 per cent) and finally sunflowers (15 per cent).

Varieties used

The factors determining which varieties are used are yield requirements, quality and current demand. Half of the varieties used are "hard", half are "soft". The major hard and soft grains are the Russian "Besostaya 1" and Italian "Libelula", respectively, covering some 90 per cent of the combine's wheat field.

Fertilizer applications

The average application of fertilizers per hectare is shown below:

	Kilograms
N	90 - 120
P_2O_5	80 - 90
K_2O	60 - 70

All the phosphate and potassium fertilizers are spread prior to deep ploughing, whereas the nitrogen fertilizers are spread over two or three dressings. Nitrogen fertilizers are sprayed from the air in the spring and prior to active growth.

Farming techniques

Mineral fertilisers (P_2O_5 and K_2O) are spread immediately after the previous crop has been harvested. The field is then well worked; deep ploughing and seedbed preparations are performed in one stage, in September or October depending on the previous crop. Wheat is sown in October; rows are 11 cm apart; seeding rate is 550 to 650 grains/m^2 depending on the variety sown. Nitrogen fertilisers are spread in March and April, the crop being sprayed from the air with a hormonal herbicide (2.4 D with 750 grams of active substance/ha) at the beginning of April. Reaping takes place in the first half of July.

Machinery

The following machinery is used:

(a) Manure distributors for distribution of artificial fertilizers;

(b) Minimum tillage unit combinations, 0.4 to 0.5 ha/hour, drawn by 100-h.p. tractors;

(c) Seed drills, 5 m wide, drawn by 65- to 70-h.p. tractors;

(d) Universal combine harvesters, 1 ha/hour, spreading the straw in order to facilitate the ploughing in.

Productivity

Production figures are as follows:

	Per hectare	Per ton
Man-hours	2.9	6.4
Machine hours	8.5	1.7

Sugar-beet

Crop rotation

The best results are obtained when sugar-beet is sown after wheat.

Varieties used

The leading variety of sugar-beet is KW cerkopoly.

Fertiliser applications

The average application of fertilisers per hectare is shown below:

Manure	3-4 tons
N	165 kg
P_2O_5	125 kg
K_2O	225 kg

Phosphate and potassium fertilisers and manure are spread prior to deep ploughing and rolling. Dressings of nitrogen fertilisers are applied during multi-row cultivation operations. Herbicides and pesticides are sprayed from the air.

Farming techniques

The field is well worked; deep ploughing (35 to 40 cm) is done in July and August. Rollers are then used in September and October to prepare the seedbed. Final preparations are carried out in March, and sowing ordinarily begins immediately afterwards; rows are 50 cm apart with 6- to 7-cm spacings between the plants in the row. As soon as the beets reach the four-leaf stage, they are thinned by hand. Actual plant population is between 70,000 and 90,000/ha. Inter-row hoeing is carried out two or three times in April and May. The beets are lifted in September, October and the first half of November.

Machinery

The following machinery is used:

Ploughs

Rollers

Seed drills sowing twelve rows

Row-crop cultivators with spreader attachment for twelve-row cultivation

Sugar-beet harvesters.

Productivity

Production figures are as follows:

	Per hectare	Per ton
Man-hours	242.4	4.5
Machine hours	239.0	0.4

Only limited quantities of beet tops are used as cattle feed because of the cost of transportation from the field to the farm.

Sunflowers

Crop rotation

Sunflowers are grown on soil less suitable for maize or root crops or are grown between rows of maize.

Varieties used

Varieties with high oil content (40 per cent) are used, mainly Peredovik and Smena.

Fertilizer applications

The average application of fertilizers per hectare is shown below:

	Kilograms
N	40 - 50
P_2O_5	45 - 55
K_2O	40

Farming techniques

The procedure is similar to that for maize.

Machinery

The machinery used is similar to that used for maize.

Productivity

The yield is 2 to 3 tons/ha.

Fodder

For a long time, plant by-products and inadequate pastures supplied the main source of feed; and production on an industrial basis began in Yugoslavia only in 1955. Today, with the animal population of the combines running well into the thousands, the problem of livestock feed has become acute. The cultivation of lucerne and other leguminous forage crops has increased considerably: the relative increase in area in the period 1960-1965 as compared with the period 1956-1961 in Yugoslavia was: lucerne, 47 per cent; clover, 14 per cent and corn for ensilage, 91 per cent.

Chapter 6

PRODUCTION OF FRUIT

Almost all kinds of continental fruit, occasional subtropical varieties like olives and figs and, to a lesser extent, citrus fruits can be cultivated in Yugoslavia because of the diverse climatic and orographical conditions. The country's rapid economic development, the changes in population structure and the constant rise in personal incomes have affected the family budget and feeding habits; the demand for high-quality fruit and fruit products has increased. All this has led to the erection of modern fruit-processing plants, improved storage facilities and more efficient marketing methods, but primarily it has encouraged the long-term planning of fruit production.

Fruit on agro-industrial combines

Of the 450,169 ha of fruit-growing areas in Yugoslavia, 10.3 per cent is state-owned; here new, large orchards have been established that are being cultivated intensively. Table 8 shows the structure of fruit production on agro-industrial combines.

The current trend in Yugoslav combines is to concentrate on the production of apples and pears, which are in short supply. The production of other kinds of fruit, such as cherries, sour cherries, strawberries, raspberries and currants, is not emphasized because of picking problems and lack of mechanized methods of cultivation. The main varieties of apples grown in Yugoslavia are: Jonathan, 31.5 per cent; Golden Delicious, 31.0 per cent; Red Delicious, 28.5 per cent; and others, 9.0 per cent. The main varieties of pears grown in Yugoslavia are: Williams, 36 per cent;

Boskova Bočica, 20 per cent; Pasa krasane, 15 per cent; and oth kinds, either dessert fruit or strains developed for industrial processing purposes, 29 per cent.

Table 8

Structure of fruit production on agro-industrial combines and other socially owned holdings, 1967

	Hectares	Per cent
Apples	14,677	32.3
Pears	5,513	12.2
Plums	10,390	23.1
Cherries	590	1.5
Sour cherries	3,292	7.2
Apricots	2,971	6.6
Peaches	4,661	10.3
Other fruit	3,075	6.8
Total	45,169	100.0

Another feature of combine production is 'mono-cultivation' i.e. vast areas under one or at the most two kinds of fruit with three or four high-quality strains of each. This type of cultivation has been adopted to meet increased domestic demand and export requirements.

Main criteria for setting up new orchards

Before new orchards are set up, it should be determined whether the following criteria can be met:

(a) Good ecological and economic conditions guaranteeing high rate of production and good-quality fruit;

(b) A fruit-processing plant in the immediate vicinity to cut down transport costs;

(c) Concentration of fruit-growing in special agro-indus combines;

(d) Industry-oriented production of a limited number of varieties, possibly 'mono-cultivation' of the most popular strains;

(e) Correct application of fertilizers and choice of select fruits;

(f) High-density planting, 300 to 2,200 trees/ha as compared with the previous practice of planting 80 to 400 trees/ha;

(g) Palmetto-trained trees (at 2 to 3 levels) to aid mechanization, "fan and dwarf-pyramid" plum and peach trees;

(h) Highly developed techniques to protect the trees against disease, insects and allied pests and the ravages of the weather;

(i) High degree of mechanization for pruning, multi-row cultivation, harvesting etc; the current trend in combines is to combine the intensification of production with the maximum application of resources so as to obtain the maximum yield per unit area.

Current increases in yield show every indication of rising still further. Some combines have yields of 60,000 kg/ha of apples and pears and of 30,000 to 35,000 of peaches. Great quantities of these fruits, however, are produced for consumption as fresh fruit and not for processing. Table 9 shows fruit production in Yugoslavia.

Yugoslavia has a long-standing tradition of viticulture. Vineyards cover an area of 257,000 ha, with an average crop of 1.2 million tons of grapes and 550,000 tons of wine. Public ownership of vineyards is expanding steadily, whereas private growers, especially small farmers, are encouraged to avail themselves of the services and guaranteed market offered by the agro-industrial combines. The earlier preference for growing wine grapes rather than dessert grapes has been slowly reversed. Dessert grapes (52.8 per cent) and higher-grade grapes for table wines (47.2 per cent) are now preferred.

Attempts are being made to apply the latest technological developments. There is a decided trend towards 'mono-cultivation' (either dessert grapes or wine grapes) and newer wine-growing methods. In some combines there have been yields of 15,000 to 25,000 kg of dessert grapes/ha and 10,000 kg of wine grapes/ha. The targets for 1975 are a total of 2.5 to 3 million tons (wine and dessert grapes).

Table 9

Fruit production in Yugoslavia, 1968

Fruit	Total production (tons)	Social holdings (number)
Apples	304,000	66,420
Pears	98,800	11,530
Quinces	11,600	110
Plums	721,000	10,590
Cherries	49,600	390
Sour cherries	31,100	2,260
Apricots	16,100	61,130
Peaches	48,500	17,440
Walnuts	20,200	30
Almonds	6,320	30
Olives	11,400	60
Figs	20,200	10
Citrus fruits	630	300
Strawberries	18,400	850
Raspberries	17,400	500
Grapes	1,270,000	177,650

Chapter 7

PRODUCTION OF MEAT

The data that follow are based on the experience of the agro-industrial combine Beograd; the combine Belje (Baranja); and the Emona Farm, Ljubljana.

The increase in urban population in Yugoslavia has been accompanied by a corresponding increase in the consumption of food of animal origin. The consumption of pork in the period 1958-1968 rose from 152,000 to 247,000 tons, i.e. from 8.5 to 12.5 kg per person, whereas beef remained steady at 125,000 to 135,000 tons, or 7 kg per person. Current forecasts are that the share of proteins of animal origin will rise to 31 per cent by the end of 1970. The volume and structure of personal consumption exert a considerable influence on the development of agriculture and the food industry.

Pig breeding

Although large-scale poultry farming proved to be a tremendous success, there was some doubt even among experts, whether large-scale pig farming would be similarly successful. It was felt that the longer life cycle increased the risks. Larger capital investments were required and more responsibility was involved.

In the course of time, however, both industrial and technological principles have been applied to achieve a solution that goes beyond the mere multiplication of a small unit. The trend is away from reliance on the natural environment towards application of an up-to-date technology that has had no harmful effects on productivity. The ultimate aim is to arrange for litters to fall at any season so as to meet the market demand. The main criteria of good breeders are inborn capacity for growth, early maturity, efficiency of food conversion and fertility.

Agro-industrial combines are especially suitable for pig breeding. They can produce the necessary fodder and the pigs can utilize the by-products associated with dairying on the one hand and crop farming on the other. On dairy farms, skim milk, wheat offals, whey and the like are used for pig feed. On maize farms, the feed consists mainly of tail corn and milling offals. In the vicinity of sugar-processing plants, certain by-products, such as molasses, can be incorporated into the pigs' feed.

Breeds used

Stock has been introduced from other European countries in the last eighteen years with a view to breeding a pig best suited to Yugoslav conditions. Large whites have been introduced from the United Kingdom and similar quality stock from the Netherlands and Sweden.

Because pigs produce litters of about 10 to 12 piglets "three months, three weeks and three days" after servicing, pig breeding on mass-production lines has become possible. The normal production cycle is a gestation period of sixteen weeks. (The period can vary for a day or two.) Some ten or fourteen days prior to pigging, the female is moved to her farrowing quarters. After farrowing, the dam stays with her piglets throughout the 28- to 35-day suckling period.

Once weaned, the piglets are moved on into the breeding quarters, where they are kept until they are 70 to 140 days old, whereupon they are transferred to the fattening sties prior to slaughtering when 192 days old. The sows return to the mating centre, since they are more likely to conceive at the first heat after weaning than at subsequent heats. The advantages of each large-scale pig-breeding institute (i.e. more than 200 sows) having its own mating centre and artificial insemination laboratory are apparent. Smaller concerns can avail themselves of the services of artificial insemination centres, though care must be taken to avoid blood relationships between the two partners. The usual aim is to have the farrowings evenly distributed throughout the year and so achieve a regular flow of marketable pigs.

Pig farms should be equipped with adequate storage facilities, sanitary installations, incinerators and residential quarters for the staff concerned. Particular care should be taken to avoid any risk of an epidemic.

Basic design

Frequently, the individual sections are located at some distance from each other to enable a group to be isolated in the event of disease. (Distances between sections vary from 200 to 400 m.) A layout of this kind provides better air circulation, permits the growth of lucerne in the immediate vicinity of the sties and creates a pleasant environment for the staff working there. Another school of thought recommends the layout of the farm on linear production lines with the individual buildings (each one a different stage in the production process) close to each other to reduce internal transport distances. This layout is said to be more rational also from the point of view of civil engineering, since the public utilities are more concentrated, and uniform equipment can be installed throughout.

Staff requirements

Despite the high degree of mechanization, as for instance, where watering, feeding, waste disposal and ventilation are concerned, there is still a definite need for skilled staff. Regular attendants are needed who are capable of recognizing the onset of estrus, castrating, vaccinating, screening and checking the animals etc. The production process also requires the services of food technologists, veterinary experts, staff with a business management background and others. The insufficient number of qualified technologists, however, is one of the main limiting factors in the establishment of agro-based industries.

Feeding

The type of feed supplied depends on the basic ingredients available, which again depend on the proximity of feed plants or on the availability of by-products from other agro-industrial

sources. The feed may be of two types: wet or dry rations. It has been observed that the conversion rate is more favourable with wet rations; pigs fed on solid rations (pellets and the like) have to consume 0,3 kg of feed more for every kilogram of weight gained. Liquid feed does not irritate the respiratory tract, and prophylactic and therapeutic agents can be added without difficulty. Sugar and milk by-products can be efficiently used in liquid feed but not in granulated dry rations.

Feeding may be from troughs or from the floor; with the latter method the sty size is not determined by the trough size (usually 1 pig to 38 cm trough); in fact, space savings are somewhere in the region of 50 per cent. Feed can be transported to the buildings via pipelines, worms or conveyor chains. The capacity of the first is too small, the second method is not viable over long distances whereas conveyor chains have been found to fulfil both requirements.

A self-draining system is the most efficient means of disposing of manure.

Efficiency

On private farms the piglet mortality rate is 33 per cent. On industrial farms the percentage varies from 12 to 21 per cent, including compulsory slaughtering measures. (Weak piglets and all those below 1 kg at birth are automatically slaughtered.) On industrial farms, prophylactic measures can be readily adapted to combat the ever-present threat of gastro-intestinal diseases and respiratory complaints that often plague the fattening sties. Another difficulty that has to be faced are foot infections caused by concrete flooring.

Statistics

The Ihan AE Farm, a subdivision of the Emona Farm, Ljubljana, provides the following data:

Annual output: 10,000 breeding stock; 40,000 fattening stock

Staff: 85 employees working a 42-hour week

Productivity:	1 worker to 3,250 pigs for fattening or to 520 dams in-pig or to 74 sows with litters (700 piglets)
	2.4 farrowings per sow per annum
	10.16 live pigs per litter
	8.63 weaned pigs per litter
	20.7 weaned pigs per sow per annum
	18 pigs for fattening per sow per annum
Ratio of feed to weight gain:	4.13 kg of feed per 1 kg live-weight increase (cf. 3.4 kg of feed per 1 kg live-weight increase at Belje farm).

Cattle breeding

For practical purposes cattle are classified according to the object or objects for which they are kept, i.e. for beef, milk or both. The production of beef or milk from one animal should not fall below a certain minimum, and the ratio of feed input to the weight gain should also be above a certain value.

Beef breeding

In Yugoslavia, the emphasis is laid on fattening calves for veal or feeding them intensively for "baby beef". Friesian calves are used for baby beef and Red Danish for high-grade beef. The potential of a young calf for beef production depends largely on its breeding and care in the pre-natal and post-natal periods.

It is also imperative that each calf be fed with the colostrum of its dam for the first four days, whereupon a switch is made to all-fat milk with a gradual change-over to 'milk replacer' (milk equivalent or 'calf starter').

Calves are removed from their mothers as soon as they are born and placed in individual pens. They are moved to larger communal pens ten days later. The larger pens are fully equipped with hay and concentrate feeders and automatic drinking bowls.

Milk replacer is dissolved in warm water (45°C), the ratio being 1:9. The replacer comprises powdered milk (skimmed), lard, soya, lecithin, emulsifying agent, vitamins, antibiotics and trace elements. At the age of two or three weeks, calves can begin to eat a complete mixture of concentrates with a protein equivalent of about 12 per cent and high-quality lucerne hay.

Fattening for veal (white meat)

Calves destined for veal production are usually kept in a separate sector. The male calves are introduced into the fattening process when less than a month old. On their arrival in the fattening plant, they are confined to a small pen, and quietness is encouraged by keeping veal calves in a darkened environment. Cleaning is done with the aid of powerful jets of water. Slated lime is used for disinfecting, and sloping manure channels ensure adequate drainage. Particular heed must be given to ventilation and temperature, as they greatly influence the vigorous metabolic process in young fattening calves.

Veal calves are fed with milk replacers, the chemical analysis of which shows 94 per cent dry matter (26 per cent raw protein, 19 per cent fat, 6 per cent ash and 43 per cent non-nitrogen extracted matter). The calves are fed individually twice a day. Table 10 indicates the daily nutritional requirements. It is interesting to note the absolute increase in the amount of milk replacer and water but the relative decrease where the ratio of water to regenerated milk is concerned. The milk is prepared in a special mixer, the mixing in pre-heated water (45°C) taking 7 minutes, with a very low degree of precipitation subsequent to mixing.

A calf weighs 55 kg at the age of three weeks and 90 kg are gained in the three-month fattening period; thus the live-weight of a fattened calf is about 145 kg. The rate of growth is at its peak some fifteen days prior to the end of the fattening period, and it is both physiologically impossible and economically unprofitable to extend this period beyond the live-weight limit of 145 to

150 kg. At the end of the intensive fattening period, the calf provides a yield of 60 per cent high-quality veal.

Table 10

Total daily nutritional requirements for calves

Age (weeks)	Powdered milk (kg)	Water (litres)
3	0.9	6.3
4	1.0	7.0
5	1.2	8.0
6	1.4	8.6
7	1.5	9.5
8	1.7	10.3
9	1.9	11.1
10	2.1	11.9
11	2.3	11.7
12	2.5	12.0
13	2.7	12.0

The average gain in weight per day is as follows:

Month	Daily weight increase (kg)
1	0.76
2	1.00
3	1.16
Average	1.05

Rations should be well balanced not only with regard to protein and energy requirements but to mineral requirements as well. Calcium and phosphorus must be included in the diet, but care should be taken where iron and copper are concerned because they tend to affect the colouring of the flesh unfavourably.

Baby-beef

The bullocks are fattened in simple, open-air lots, the manure being removed manually. A standard cow-house accommodates 2,000 bullocks. The feeding programme is based on well-proved ingredients, such as maize, sunflower husks, dried sugar-beet pulp, urea, minerals, vitamins and mineral trace elements, produced industrially in the form of concentrated cattle feed (pellets). It has been observed that pellet rations offer the cheapest energy and protein sources as well as the most efficient means of fattening.

The fattening period (table 11) takes eight to nine months, East Friesian non-castrated male calves being selected at the age of three to four months. When they are 1 year old, the total live-weight is 410 to 440 kg depending on the quality of feed employed during the fattening period. The results obtained upon classification of the stock being fattened reflect the differences in the rates at which weight is gained and feed consumed. For every 100 kg live-weight gain 13.2 man-hours are necessary. One kilogram live-weight gain costs 5.8 new dinars and it sells at 6.2 new dinars.

The live-weight gain reaches its peak when the calf is six or seven months old, after which it decreases gradually. Consumption, however, increases at this juncture significantly, reaching its peak in the final month of the intensive fattening period. This can be taken as a warning to bring the fattening period to a close.

Experiments are being made with the cross-breeding of Red-Danish cows and Simmental, Charolais and Angus bulls. Results to date indicate that with Red Danish-Simmental crossbreeds the daily weight-gain is significantly higher: 0.146 kg more per day, an increase of 12.93 per cent with an appreciable decrease in the consumption of pelletized rations.

Table 11

Consumption and conversion of concentrate during nine-month fattening period of calves

Age of animal (months)	Average daily live-weight gain (kg)	Average weight at the end of the month (kg)	Consumption of concentrate per kg live-weight gain (kg)	Average consumption of concentrate (kg)
3–4	1.060	140	3.957	4.203
4–5	1.202	170	4.102	4.930
5–6	1.424	218	4.595	6.545
6–7	1.533	263	4.640	7.124
7–8	1.410	305	5.064	7.143
8–9	1.287	343	6.298	8.108
9–10	1.232	380	7.261	8.944
10–11	1.271	418	7.376	9.375
11–12	1.183	440	8.808	10.420

Table 12 shows the weight of calf parts at the time of slaughtering.

Table 12

Weight of calf parts at time of slaughtering

	Kilograms	Per cent
(Weight loss from lack of feed during transport)	(23.20)	(5.27)
Weight, pre-slaughter	417.00	100.00
Weight, warm halves	242.40	58.12
Weight, cold halves	237.20	56.88
Weight loss, when cooling	5.20	2.14
Suet around kidneys	6.95	1.67
Head and tongue	13.10	3.14
Legs	7.12	1.70
Skin	41.20	9.88
Lungs and heart	7.10	1.70
Liver and spleen	7.20	1.72
Kidneys	1.12	0.27
Rumen and intestines with contents	62.50	14.98
Blood	12.27	2.94
Tail	1.06	0.25

By-products are processed in other departments of the plant to produce gelatine, glue, dried blood, intestinal extracts etc. About 80 per cent of total beef production is exported, principally to Greece, Italy and the United Kingdom.

Mating

At the age of three months, heifers are taken off milk and taken to lots where they are kept in strictly categorised groups of 25 to 30 with freedom of movement. On reaching approximately 60 per cent of the total expected weight, heifers are mated. This usually occurs at the age of 15 to 18 months; they should be mated before they are two years old.

The success of mating, however, depends primarily on the right selection. The importance of a good bull must be appreciated (general appearance, fattening potential etc.) and adequate culling must be practiced where female stock is concerned (proved yielding properties). Artificial insemination promotes the rapid distribution of positive genes while the use of data-processing methods accelerates the exclusion of inferior stock.

Breeding for milk

The normal distribution of cows on a dairy farm is as follows:

(a) 6 to 7 per cent in calving sector (1.5 to 2 per cent dry immediately prior to calving, 4.5 to 5 per cent post-parturition);

(b) 80 per cent in milk;

(c) 13 to 14 per cent dry cows.

As a rule the cows are not allowed to move around freely when housed in the calving sector, except when movement has been prescribed for therapeutic reasons.

Cows in milk are housed in large sheds, which guarantee as high a plant-utilisation factor as possible and permit mechanised production. One hand is assigned to 30 head of cattle, and feed is supplied automatically. Milking is done by machine; cleaning and watering are also mechanised.

Scandinavian experiments have shown that one barley nutritive unit and 175 grams of digestible proteins are necessary for producing 2.5 kg of milk with 4 per cent fat content. Although cows do not always produce milk of this standard, it is possible with the aid of a FCM (fat-corrected milk) formula to establish a feeding programme. Table 13 gives daily nutritional requirements of cows.

Feed for highly productive cows is poorer in proteins and more ample in energy-giving contents. In general, pasture grazing has to be supplemented, especially where cows with high milk output are concerned, special emphasis being laid on the need for proteins.

Table 13

Daily nutritional requirements of cows classified by milk productivity

Kg of milk (4% fat)	Class of milk productivity	Weight of cow: 350–449 kg		450–549 kg		550–649 kg		Minerals	
		Barley nutritive units	Digestible proteins (g)	Barley nutritive units	Digestible proteins (g)	Barley nutritive units	Digestible proteins (g)	Ca (g)	P (g)
0.0 – 2.5	1	4.5	0.455	5.0	0.525	5.5	0.595	22	21
2.6 – 5.0	2	5.5	0.630	6.0	0.700	6.5	0.770	28	26
5.1 – 7.5	3	6.5	0.805	7.0	0.875	7.5	0.945	34	32
7.6 – 10.0	4	7.5	0.980	8.0	1.050	8.5	1.120	40	38
10.1 – 12.5	5	8.5	1.155	9.0	1.225	9.5	1.295	46	44
12.6 – 15.0	6	9.5	1.330	10.0	1.400	10.5	1.470	52	59
15.1 – 17.5	7	10.5	1.505	11.0	1.575	11.5	1.645	58	55
17.6 – 20.0	8	11.5	1.680	12.0	1.750	12.5	1.820	65	60
20.1 – 22.5	9	12.5	1.855	13.0	1.925	13.5	1.995	71	66
22.6 – 25.0	10	13.5	2.030	14.0	2.100	14.5	2.170	77	71
25.1 – 27.5	11	14.5	2.205	15.0	2.275	15.5	2.345	83	77
27.6 – 30.0	12	15.5	2.380	16.0	2.450	16.5	2.520	90	82

Vitamins are supplied in the form of roughage. If the fodder supplied is of good quality, no particular steps need be taken to supply vitamins. In winter, however, it may well prove expedient to add synthetic vitamins and in some cases, therapeutic steps may be necessary. Water should be freely available to all dairy stock.

With the correct application of modern technology and careful selection, milk yield per cow can be increased. Productivity figures for cows are as follows:

Year	No. of cows	Milk yield per cow (kg)
1966	11,780	3,545
1967	12,182	3,985
1968	13,146	4,120

On the average, 1.96 man-hours are necessary for every 100 kg of milk produced.

Beef-production plant in a developing country

Following the successful organization of animal husbandry in Yugoslavia, Yugoslav agricultural engineers were in a position to set up complete production plants abroad on a turn-key basis. They set up pig farms and broiler batteries in Eastern Germany. The experience gained thereby made it possible for Yugoslav experts to respond to the Malagasy Republic's request that they set up and operate a beef production and processing plant in Madagascar.

A joint feasibility study was carried out by Yugoslav and Malagasy experts. In addition to supervising the building and running of the plant in the shakedown period, Yugoslavia undertook to train native staff in Yugoslavia and to arrange the purchase of suitable bulls for cross-breeding with indigenous stock.

Two completely integrated plants, comprising three ranches, breeding area and a slaughter-house each, were planned, and the Malagasy sebu, the native bovine, was taken as the basis for all livestock purposes. Prior to eminently successful, controlled cross-breeding with Brahmans, Charolais, Friesians and Limousins,

the native zebu had bred uncontrollably, the only limiting factors being the climatic conditions and a high death rate caused by inbreeding. In addition to careful selection and breeding procedures, better-quality fodder was introduced in the dry season to supplement the lack of minerals and vitamins. Production of feed incorporating urea was initiated to permit intensive feeding schemes.

As few imported animals as possible were slaughtered. The processing industry was now able to work all the year round owing to the continuous beef production resulting from intensive fattening programmes etc. The native practice of burning pastures prior to the onset of the rainy season was abandoned, since it fostered soil deterioration. Fodder production on a large scale was introduced. Pasture intensification was initiated and extensive fencing took place.

Current figures indicate that animals on the ranches put on 70 kg during the rainy season; with rational feeding programme an equivalent weight increase can be expected during the dry period. Animals undergoing stall-feeding show a live-weight gain of 80 to 100 kg for 120 days, initial weight being 300 kg.

Stall-feeding units are also closely linked to fodder-production areas, super-concentrates being supplied in the form of urea-based products. Mechanization has been introduced at all possible stages, and veterinary control is stringent to guard against parasites.

The slaughter-house is designed according to the latest principles, with sanitary control that meets international standards. Annual output on the basis of a five-day work week will be 40,000 head of cattle; 160 head will be slaughtered daily, though capacity can be raised to meet peak requirements (200 head per day). Stall-fed animals will help to maintain a continuous flow, and eighteen specialists together with a veterinary surgeon, a technologist and two butchers will comprise the Yugoslav team in the initial period. Twenty butchers will travel to Yugoslavia to receive training in the latest techniques.

With respect to capital investment the Malagasy Government raised about $27 million from foreign sources with the assistance of Yugoslavia. The Malagasy Government will contribute $2.5 million as its share of the investment in addition to guaranteeing adequate security for all foreign capital.

Chapter 8

POULTRY AND EGG PRODUCTION

Poultry

The data that follow are based on the experience of the Kokingrad Poultry Farm, an integral part of the agro-industrial combine Belje (Baranja); and the agro-industrial combine at Zagreb.

The broiler industry is an excellent example of the intensification, centralization and mechanisation of animal husbandry. Within a decade, poultry has become one of the most genuinely competitive and highly nutritious forms of animal produce the Yugoslav consumer can buy. Originally egg production was the main concern of most poultry farmers, and frequently the poultry sold for consumption was surplus stock. Today, however, with the rapidly expanding market, poultry farming has become more specialised, with emphasis being laid on the production of either eggs or poultry for home consumption. An agro-industrial complex is especially suitable for production of poultry for consumption, since it provides an outlet for by-products (blood, bones, surplus chickens, feathers, manure etc.) and offers accommodation facilities and an adequate supply of feeding matter.

Despite the mushroom growth of the broiler industry, particular caution must be exercised not only in choosing the breeds of poultry but also in providing for their accommodation. The risk of disease is considerable, and every care must be taken to avoid the erection of 'hen-sick' housing. The buildings themselves should be set up on flat, well-drained land and should not be exposed to undue wind. Environmental conditions must be

suitable and an adequate water supply and other public utilities provided. The poultry farm should be at least 2 km from built-up areas, trunk roads or railways to reduce the risk of infection or disturbance from noise. There should, however, be direct access to main roads to permit the rapid distribution of the finished product.

Large farms have greater advantages than small ones. They are in a better position to implement the latest findings; they can obtain credit more readily and they have less difficulty in attracting specialists.

Stock

Raising poultry on a large scale means that the strains used have to meet certain minimum standards: rapid maturity, good conversion rate, resistance to disease, healthy colour of flesh, good meat quality and good general appearance.

Housing

Structures used to house poultry should be windowless and well insulated to reduce the effects of climatic extremes or undue noise. Adequate ventilation and heating should be provided. Drinking systems should be kept clear of impurities to avoid damage to the equipment and keep the contamination risk as low as possible.

The chickens are raised either on the floor or in cages, the former method being cheaper. The latter method, however, permits full automation of the production process and manual labour requirements can be drastically cut.

Originally peat-hemp litter (a by-product of the rope-making plant) was used, but now the trend is towards using the waste of sugar-beet production, which once soiled can be used as a basis for cattle feed.

Following the initial period in the brooder area, chickens are utlimately raised on an area of 15 hens/m^2.

Although feeding can theoretically be fully automatic throughout, many combines tend to prefer manual labour at certain stages to improve worker-animal relations and guarantee a certain degree of supervision - an important factor in terms of fowl-pest control.

Ventilation is all-important - 1,000 chickens need 2.6 m^3 fresh air per hour. Mechanical ventilation systems are a necessity for the later stages of development; hen-houses must be kept at the correct temperature. Fluctuations in temperature and humidity, but especially in temperature, have been observed to have a detrimental effect upon the feed-conversion rate.

An illumination rate of 25 W/15 m^2 is gradually reduced to 1 W/m^2 to restrict chicken movement and spare consumption of their energy. Furthermore, chickens should get accustomed to darkness to avoid panic and the attendant difficulties in the event of a power cut.

Feeding

For the first two weeks, chicks are raised on 'starters'; then they move to granulated feed. Mixtures must be standardised; otherwise the flocks will react adversely and scatter their feed instead of eating it. The feed must always contain all the necessary ingredients, since the slightest deficiency can have unfortunate results.

Disease is still the greatest danger in poultry farming. The whole flock is vaccinated against fowl pest at the age of three weeks. Regular tests (haemoagglutination tests, for instance) and strict separation, on the basis of age and strain, are carried out after each stage of production. Care is also taken to ensure that the breeding stock purchased comes from centres where the parents have been inoculated against infections and bronchitis. Much basic stock has been imported from abroad. After each cycle, the lots are sluiced down with a formaldehyde solution (30 per cent) and left vacant for an intermission period of 14 to 21 days.

Productivity

Table 14 gives productivity targets.

Table 14

Productivity targets and cost breakdown

	Planned	Realised
Productivity targets		
Average weight	1.50 kg	1.52 kg
Conversion	2.50 kg for every kg gained	2.33 kg
Mortality	5%	3.75%
Raising period	58 days	55 days
Price	5.81 din/kg live weight	5.89 din/kg live weight
	Per cent	
Cost breakdown		
One-day chick	12.36	
Cost of raising	15.07	
Feed	30.43	
Slaughtering	7.77	
Returns (78%)	15.07	
Packing	2.81	
		83.51
Freight to buyer	2.34	
Trade discount	14.15	
		16.49
	Total	100.00

Egg production

In the last few years the trend has been to invest capital in equipment rather than in buildings, the aim being to set up the battery system of production with individual cages for the laying flock to correspond to the fully integrated system of production

(from chick to egg). In addition to producing eggs, most combines have a steady trade in day-old chicks and prime-quality laying hens. The following figures for a typical combine (in Zagreb) are indicative of the trends in egg production:

	1965-1968	1969	Per cent change
Feed required to raise a pullet	10.10 kg	9.60 kg	-4.5
Feed for hens in-lay	119-121 g	115-117 g	-3.44
Number of eggs per hen in-lay	223-232	250	+10

Regardless of the number of eggs laid, all hens are sent to the slaughter-house after 12 months of active laying life.

The Yugoslav Institute of Technology, Design and Development helps to solve problems relating to programming, design and construction. Basically speaking, however, it is advantageous to locate the plant near large consumer centres and cattle-feed plants, since chicken feed is 50 to 60 per cent maize; an egg-selection station should also be in the vicinity. All other problems are carefully investigated by teams from the institute, who decide on the advisability of switching from small-scale chicken farming to large-scale egg production.

Profitability

Initially, costs were so great that eggs were priced far too high. However, with the achievement of lower costs for breeding chicks and laying hens, higher egg returns, lower costs for feed and more economic feeding rates, it has been possible to bring down the price of eggs (table 15).

Selling prices of eggs vary from the wholesale price of 0.52 new dinars up to 0.69 new dinars paid in the combine's own stores in Zagreb. The important factor is adjusting supply to demand. Thus, the combines aim to produce most eggs when the supplies from the private farms are at their lowest and so avoid a glut in spring, when eggs from private sources are in abundant supply.

Table 15

Cost prices of hens and eggs, 1964-1969
(new dinars)

	1964-1967	1967-1968	1969
Cost price of 1 breeding hen	100.0	84.00	80.0
Cost price of 1 egg for hatching	2.48[a/]	1.70	1.2
Cost price of 1 chick for breeding	9.59	5.70	5.60
Cost price of hen-in-lay	45.0	38.00	30.0
Cost price of egg for consumption	0.54	0.45	0.38

a/ Egg prices based on an output of 163 million eggs.

Productivity

Table 16 gives production figures for the combine in Zagreb.

Table 16

Production of eggs on the combine in Zagreb

	Eggs for consumption
1963	2,858,434
1964	18,022,264
1965	15,846,068
1966	29,000,000
1967	56,031,882
1968	86,000,365
1969/1970	163,000,000

Chapter 9

QUALITY CONTROL

As the standard of living rises there is an increasing demand for prime-quality foods; further impetus to producing foods of this quality is provided by the need to conform to the standards of international trade.

Implementation of quality control

Apart from checks carried out within the industry, outside bodies, such as government bodies or consumer councils, stipulate certain standards that have to be met by every new product that comes onto the market. The bodies responsible for market control follow a vertical pattern. The Yugoslav Federal Market Inspectorate has some 35 university-trained inspectors; in each republic there are seven to eight inspectors with a similar educational background, while those at a provincial or communal level often have only secondary education. The domestic market is also controlled on a voluntary basis by the Chamber of Commerce and similar associations.

Agricultural products for export are classified as follows:

(a) Farm produce, vegetables, fruit and other products, including herbs and similar plants;

(b) Livestock, game, other animals, parts thereof and allied products;

(c) Fish and allied products;

(d) By-products of the forestry industry.

The goods are inspected prior to loading and cleared by members of the Federal Market Inspectorate. If no specific regulations exist with regard to products for export, the standards pertaining to the domestic market are applied.

The Yugoslav Institution for Standardization publishes rules and regulations pertaining to agricultural raw material. Before any standard becomes mandatory, the Institution for Standardization issues a draft standard. For a period not exceeding three months thereafter, interested bodies may submit alterations and make other comments. Disagreements are referred to the Council of the Institution, whose decision is final.

The Federal Secretariat for Industry and Commerce is responsible for the publication of the regulations applying to food products, after consultation with the Federal Council for Health and Social Policy. (In addition, there are general regulations concerning hygiene in the food industry.) By food product is meant anything in a raw or processed state, as well as additives, flavouring etc., that is consumed by human beings.

All food products, including semi-processed products, are covered by a series of standards. In addition to exact specifications for the product itself, comprehensive regulations also stipulate the standards that must be observed in packaging and labelling.

These standards, however, do not apply solely to products produced in Yugoslavia, but also to all imported food products. All tropical fruits are subject to inspection on import, the officials concerned being employed by 'Yugoinspect' and similar organizations. These organizations have offices abroad in countries where turnover justifies permanent representation or they co-operate closely with comparable bodies e.g. 'Amerinspect Corp', New York, to ensure the speedy and hygienic transport of premium products.

Co-operation with international organisations

Yugoslavia co-operates with the Economic Commission for Europe and accepts the latter's standards. The Yugoslav Institution for Standardisation is a member of the International Organisation for Standardisation and is particularly active in the work of its

technical committee dealing with fruit, vegetables, meat and allied products. Yugoslavia is also a member of the FAO/WHO Codex Alimentarius Commission. It co-operates with OECD on the more efficient application of standards.

The actual implementation of the regulation has proved extremely difficult owing to the lack of appropriate equipment at the municipal level. The situation is aggravated by the shortage of adequately trained staff.

Quality control (livestock feed)

In 1964, regulations were introduced stipulating the lower units for protein content and the upper limits for the cellulose, ash and moisture content of livestock feed. Strict regulations have been laid down, regarding the additives (hormones, sedatives etc.) that can be incorporated, since care must be taken to avoid the intake of toxic ingredients by human beings.

Chapter 10

RESEARCH

Application of research

In a country where 50 per cent of the population is closely connected with the agriculture, it is clear that the development and application of modern research methods help to solve the basic problems facing agricultural production and food processing. Socio-economic development as a whole depends on an acceleration of applied research activities, with particular emphasis on the rapid and efficient application of the results of such research in both sectors. Although research results are encouraging, their application is not satisfactory. The reason for this is that scientific institutes may not always be concerned with, or aware of, the practical difficulties related to the application of their findings. Alternatively, the production and processing engineers may be ignorant of such findings or fail to appreciate their significance. This state of affairs is not particular to one country; it is a common malaise, but one that is more readily encountered in developing countries.

Nevertheless, it must not be forgotten that the results achieved by research institutes often cannot be directly incorporated into the production process. Consequently, a service is needed that subjects research results to practical tests or operates pilot plants and then applies the findings to standard production processes. Ideally speaking, this would require teams of qualified personnel capable of appreciating and implementing the latest innovations and prototypes.

Research and development units

The basic requirement for any research and development organization is a means of obtaining information on the latest scientific developments at home and abroad, but a research organization serving agriculture faces many specifically agricultural problems. The industry as such is split up into numerous units, and each new scientific finding has to be adapted to the specific ecological conditions of the individual units. This indicates the importance of the small research units attached to the agro-industrial combines and the food factories.

The precursors of the research and development units attached to the state-run combines were the field stations, which, after an initial period of subsidization, became self-supporting and now supply private farmers with information on, and help in, the latest farming methods. The field stations failed to pay for themselves in the lesser developed areas, so they were closed down there, although their services were more desperately needed in these areas than anywhere else. Table 17 gives statistical data for field stations and agro-industrial research and development units.

Table 17

Field stations and agro-industrial units in Yugoslavia, 1967

Republic/province	Field stations	Agro-industrial research and development units
Serbia proper	23	3
Vojvodina	14	3
Kosmet	3	-
Croatia	24	16
Bosnia and Hersegovina	13	-
Slovenia	7	3
Macedonia	1	2
Montenegro	-	1
	85	28

Emphasis in research and development is laid on the socially owned sector. Private producers can avail themselves of the latest developments by co-operating closely with the combines, with experts specially allotted to advise them. The scientific research units attached to the agro-industrial combines usually have a laboratory equipped well enough so that any necessary analyses can be made. They are also well stocked with books and scientific journals to enable them to keep up with the latest developments.

A planning department is usually attached to the unit to facilitate the incorporation of the latest techniques, and staff requirements are met either by employing younger agricultural engineers, who welcome the opportunity to put theory into practice, or the jobs are publicly announced and the most suitable candidates are accepted.

The problems dealt with by these units are closely connected with the combine's field of production. Yield and economy of production are the two focal points of interest. Thus the basic difference between the work done by the units attached to combines and that carried out by independent research institutes and university faculties is that the former are oriented towards particular problems whereas the latter are more concerned with the general aspects of scientific research and its application in a wider context. The two types of institute, however, complement each other, for the combines do not have the facilities to solve all the problems confronting them, while the experts in the field are often able to supply the larger institutes with answers to specific practical problems. Close co-operation between the various institutes is essential, as are contacts with similar bodies abroad.

Scientific institutes

Above the in-plant control units maintained by the combines themselves, there are the extension services, which are solely concerned with the diffusion of the latest principles, while carrying out micro-tests and pilot tests to examine their application in the field. These centres, over 60 in all, serve the

various republics and obtain their information directly from the various specialized institutes whose scope of activity is often not limited to a geographical area. These specialized institutes include:

Institute for Agricultural Research, Belgrade
Fodder Plant Institute, Kruševac
Maize Institute, Belgrade
Institute for Vegetable Growing, Smederevska Palanka
Fruit Growing Institute, Čačak
Institute for Soil Studies, Belgrade
Dairy Institute, Zagreb
Institute for Agricultural Research, Sarajevo
Institute for Forestry and Wood Industry, Belgrade
Poplar Institute, Novi Sad
Institute for Food Processing and Technology, Belgrade
Livestock Institute, Zemun Polje

Co-operation on such a large scale ensures that research is comprehensive, but there may be some duplication of effort, and some institutes may deal with unimportant problems.

Other institutes closely associated with research are the agricultural and technological faculties at the universities, certain scientific societies and other institutes within the Academy of Sciences. The institutes at this level vary in complexity. Some are concerned solely with one particular aspect of agricultural production or food processing; others carry on more diversified activities. The trend at the moment, however, is towards an increase in the number of specialized institutes, with a corresponding drift away from the more complex bodies.

Before an institute is deemed fully operative, it must be able to justify its existence on scientific and social grounds. It must have a clearly defined task, be fully stocked with the necessary literature and documentation and have at least ten scientists of research associate status on its staff who have technical and financial facilities at their disposal.

Research associates are nominated in the same way as are research associates identical with academicians, university professors or independent research scientists, all of whom must have a doctor's degree and have published scientific treatises of some significance. Research associates and their seniors are ranked equal to university lecturers so that both groups have the opportunity of switching from practical to university work and vice versa. Of the 2,000 research scientists employed in agricultural and food-processing institutes, 1,172 are either professors or assistant professors. However, the number of scientific staff in relation to the total number of employees is far from adequate. In 334 private enterprises in the food industry, the ratio of workers to engineers is 170:1, while in advanced countries it is supposed to be 50:1.

Financing

Some financial support is obtained from federal and communal funds, while the rest of the money needed comes from fees charged for working on projects for various producers and from the sale of products grown on farms of the research institutes. The trend is towards financing research on a self-supporting basis as opposed to dependence on federal funds.

Management

Management in the scientific institutes is similar to the community management practised in the agro-industrial combines. In institutes with more than 30 members the workers' council decides on all matters relating to management.

The institute council, composed of at least eleven members, is concerned with the allocation of funds, approval of programmes and association schemes. A second body, the scientific council, drafts the various research programmes; it selects the research staff and submits general proposals for improving the scientific work.

Co-ordination

A Federal Council for the Co-ordination of Scientific Research maintains a list of all recognized scientific institutes at the communal level. The council is closely linked with the preparation and publication of all the scientific research programmes and it endeavours to integrate the programmes of the various institutes. It is also responsible for intergovernmental contracts with other countries, within the scope of which research has been carried out for China (mainland), Bulgaria, Hungary and the Soviet Union. However, since scientific institutes in Yugoslavia are autonomous, there are no objections to their negotiating directly with other institutes throughout the world.

Results

Table 18 indicates some of the results achieved by the various institutes. It should be borne in mind that the results of all investigations are made available to the agricultural and food-processing industries either directly or *via* their extension services.

Table 18

Average and maximum results in food production achieved by various institutes, 1966/1967

Product	Average	Maximum
Wheat (tons/ha)	2.5–3.5	6.0–8.0
Maize (tons/ha)	3.0–5.0	15.0–20.0
Sugar-beet (tons/ha)	35 - 40	60 - 70
Sunflowers (tons/ha)	2.0–2.5	3.5–4.0
Potatoes (tons/ha)	10 - 15	30 - 40
Lucerne (tons/ha)	8 - 10	15 - 20
Apples (kg/tree)	15 - 20	25 - 30
Plums (kg/tree)	10 - 15	20 - 25
Grapes (kg/vine)	1.5–1.2	2.5–3.0
Milk (litres/cow)	3,000 - 4,000	5,000 - 7,000
Beef (kg live weight)	350 - 400	400 - 450
Eggs (per hen)	180 - 220	220 - 260
Piglets (per sow)	10 - 12	12 - 14

Scope of activities

The larger centres follow closely all foreign developments and test new machines, livestock, seed and plant material. Further investigations are concerned with the application of new fertilizers and breeding methods. The centres organize seminars and provide consulting services in order to disseminate the latest developments.

In 1968, one large centre was concerned with the introduction on socially owned farms of new varieties of wheat with a minimum yield of 6 tons/ha. Another project it initiated was to raise yields on some 100,000 holdings to 4 tons/ha. A similar project was started with maize, the primary aim being to reduce costs, increase output and expand productivity. Uniform varieties of sugar-beet were introduced giving yields of about 60 tons/ha over an area of 3,000 ha. Sunflower seeds of a harder type were developed with the aim of achieving yields of about 3.5 tons/ha.

Considerable attention was devoted to cattle breeding and better feed conversion rates. An increase in the production of milk and the refrigeration of semen were other subjects dealt with in the course of the year. Tests were carried out on certain breeds of chickens with a view to better egg production and broiler qualities.

Table 19 shows the extent to which agro-industrial combines have availed themselves of the findings of research.

Table 19

Average yields per hectare in 1961, 1965 and 1966

(tons)

	Over-all average	Agro-industrial combines
	1961	
Wheat	1.61	3.20
Maize	1.81	3.82
Sugar-beet	21.50	28.60
Sunflowers	1.37	1.78

Table 19 (cont'd)

	Over-all average	Agro-industrial combines
	1965	
Wheat	1.05	3.41
Maize	2.31	4.92
Sugar-beet	32.9	39.80
Sunflowers	1.67	2.01
	1966	
Wheat	2.53	3.97
Maize	3.11	6.23
Sugar-beet	27.90	45.70
Sunflowers	1.93	20.8

Chapter 11

MARKETING

In order to compete effectively on both domestic and foreign markets, the major agro-industrial combines have not concentrated only on improving their mutual economic and technological relations but have also co-ordinated their marketing activities. They have pooled their funds with the aim of setting up a modern marketing apparatus, which will attempt to overcome the current inability of production to keep up with increased consumption.

In the domestic market, certain innovations have taken place, e.g. the establishment of modern supermarkets, while in the export field endeavours have been made to co-operate with importers who are well placed in foreign markets. The latter effort, however, has not completely counterbalanced the negative effect of protective measures adopted by certain economic communities, for instance EEC and EFTA, so it has proved necessary to set up funds to help compensate cattle breeders and producers for losses they may incur in exporting.

Export marketing problems

Owing to the importance of the export market to the Yugoslav agricultural and food industries, a basic reorganization is necessary. Whereas marketing in Western European countries has been directed towards both local and foreign markets, in the Eastern European countries the tendency has been to concentrate on the market abroad. (Thirty-five per cent of all foreign currency earned comes from the sale of food products abroad.) The lack of a systematic export marketing policy has had a negative effect on

the agro-industrial sector. For a variety of reasons, most combines have been apparently loath to initiate their own market research and have shown no interest in marketing services offered by other institutions.

If marketing policy had been co-ordinated, Yugoslav exports could have been much higher. For instance, exports of meat were concentrated on only one or two markets. The United Kingdom, formerly one of the main customers, began to subsidize home production and to obtain beef from other sources. The result was that Yugoslav beef, relatively costly (because of expensive fodder and uneconomical industrial structures), was soon priced out of the market. Another major blow fell when Italy introduced the EEC tariffs, which cut off Yugoslav exporters from the flourishing market for beef in Italy.

Exporters consistently ignored the market research specialists who were firmly predicting the imminent loss of the British market. The meat industry failed to consult the market specialists in their euphoric stage of expansion or to heed their warnings that it should examine the EEC's institutions more closely.

Because of their rigid conception of what their customers wanted, meat exporters were incapable of realizing that the Italian market could absorb meats other than beef. Their persistent belief that the French and Italians were inveterate 'beef-eaters' caused them to ignore openings in the pork market. The whole situation was aggravated by the century-old strife between beef and pork producers on the one hand and the processing industry on the other, with the result that business feuds interfered continually with projects to expand the market. Despite the glowing example of Denmark, with its integrated agro-industrial sector and well-organised market research agencies, Yugoslav exporters preferred to cling to their old ways of doing things.

Despite a certain amount of understanding for the necessity of mass-media publicity and advertising at international fairs, Yugoslav producers have shown little interest in uniform labelling or general brand names. Although they may realise that good

advertising generates customers, they have nevertheless continued to flood the foreign markets with a plethora of titles and brand names. Denmark, for example, has abandoned individual company titles in favour of general brand names.

Domestic marketing problems

Consumer habits within Yugoslavia are also strictly traditional. Although the consumption of fruit may have increased, the consumption of meat has only just reattained the pre-war level. The average daily calorific intake, some 3,200, may be high in comparison with other countries, but it is composed mostly of cheaper, traditional foods, such as bread, potatoes, beans and cabbage.

This situation could be changed, and there are some indications that this is happening. First, the producers could lower the often prohibitive price of meat and at the same time ensure a regular supply of the more popular meats by setting up a large-scale retail chain (as some combines have already done). They could also offer more cuts of meats. In Yugoslavia, meat is offered in seven or eight cuts. In the developed countries the average is twenty or more, and this means that the various income groups are offered a better selection. Reorganization of the retail system in the meat sector would benefit the customer. Retail service in the dairy industry is also inefficient.

Another important factor is the competition provided by the "peasants' markets", characterised by direct contact between producers and consumers. Consumers like to buy fruit, eggs and dairy products from a market stall, since they definitely prefer fresh farm eggs or chickens to the classified, stamped products of the retail trade. Customers also prefer the products of small bakers and home-made breads of various kinds to mass-produced loaves of bread.

Nevertheless, there is definite proof that self-service stores are bringing about changes in consumers' habits. Self-service

establishments alone can offer a wide range of products on their premises at an acceptable price. Furthermore, with the ever-increasing number of women working, there is a growing need for partially prepared and ready-made foods at prices that small retailers cannot offer. Frozen foods on sale in supermarkets also satisfy consumer requirements with regard to freshness. The rational layout of the retail area compensates for the absence of the producer at the time of purchase. That there is room for expansion in the self-service market is clear when one realises that there are only 1,400 such markets in Yugoslavia as compared with 12,000 in Czechoslovakia, 20,000 in Poland and 80,000 in the Federal Republic of Germany.

Current export markets

Exports are very important to Yugoslavia, as can be seen from tables 20 and 21.

Table 20

Yugoslavia's exports of food products to selected European countries, 1967

	Million dinars	Per cent of total exports
Italy	1,734	38.9
Federal Republic of Germany	358	8.0
Austria	291	6.5
Greece	248	5.6
United Kingdom	240	5.4
Eastern Germany	210	4.7

That the greater part of exports by far is shipped to countries with convertible currencies indicates the importance of the earnings from these exports to Yugoslavia's balance of payments, a situation that led to the promotion of the export market at the expense of the domestic market.

As table 21 shows, there are slight variations in the mode of payment. Some countries offer freely convertible currency and others offer currency convertible only within certain areas.

Table 21

Exports of food products to the various currency areas, 1967

Branch	Convertible		Eastern Europe		Clearing[a]		Clearing[b]	
	Value	%	Value	%	Value	%	Value	%
Agriculture	2,538	81.8	229	7.4	268	8.5	69	2.2
Food industry	600	67.1	258	28.8	15	1.6	22	2.5
Tobacco industry	217	58.2	141	37.8	1	0.4	13	3.6

a/ Brasil, Greece, Israel, Spain and Turkey.

b/ Algeria, Afghanistan, Cambodia, Ghana, Guinea, India, Mali, Tunisia and the United Arab Republic.

The developed countries comprise the main bloc on the convertible market, though the clearing areas do include some of the more advanced developing areas such as Greece, Israel, Malta and Cyprus. Exporting to convertible currency markets is not without its pitfalls: EEC's adoption of restrictive policies vis-à-vis exports from non-members has been a particular problem. The Eastern European countries (members of CMEA) comprise another clearing area; but here Yugoslavia maintains a favourable trade balance, probably because the goods marketed in the Eastern European countries cannot be marketed on convertible markets. The income levels and consumer habits in the Eastern European countries differ from those in developed countries elsewhere, and any commodities exported are in the lower-price category.

To avoid a drain on its hard-currency reserves, Yugoslavia has entered into clearing agreements of a different nature, similar to bartering and payment in kind, with a host of other countries.

Chapter 12

STAFF TRAINING

Before an agro-industrial enterprise of any size can really hope to achieve its aims, it must have an adequately trained staff. Labour is one of the main factors in the production process, and the more highly skilled the factor, the more efficient the process. For a long time, agricultural skills were considered to be innate or something that could be picked up by working on the paternal farm. It was widely believed that agriculture was not the place for educated people, and, in fact, most of the people engaged in agriculture were illiterate or, at best, semi-literate.

Agricultural mechanisation, however, did not stand still, and current agricultural techniques require a much higher degree of education and skill than previous ones. Yugoslav agriculture, consequently, was faced with three serious problems:

(a) The low standard of general education;

(b) A surplus of unskilled labour;

(c) A lack of educational facilities.

The problem of unskilled labour was particularly complex because the social aspects of the problem of redundancy had to be considered. The onus of retraining workers was laid upon their employers. The agro-industrial combines introduced training schemes and set up their own training centres.

Training in new skills

The original aim of training was to accustom the workers, including the administrative staff, to the new demands made of

them. Altogether there are now some 202 permanent centres, some of which have gradually developed into large educational centres suited to the immediate needs of the various enterprises.

As far back as 1953, a special centre, the Education Centre for Agricultural Staff, was founded, supplemented by the establishment of eight training centres for teachers a few years later. The former centre is designed for staff who have had eight years of standard schooling; their fees are paid by their employers, who give them leave to attend the various courses and seminars.

Seminars are also organized in the various smaller centres and are very much job-oriented. They are aimed at training workers in one specific operation, e.g. working combine-harvesters or sowing beet. Other seminars, lasting 3 to 15 days, deal with the problems of ensilage and the like. Courses on animal husbandry last considerably longer, 6 to 40 days. The instructors for these courses were initially professional lecturers, but it has been found much more efficient to call upon the services of experts who are permanently concerned with agricultural production, rather than to rely on people who lack the practical experience.

Workers employed in industrial plants attend various courses run by the People's University. Although workers have gained a certain amount of basic skill through these courses it has been observed that they have not always been able to master the theoretical aspects of their instruction.

Basic education

Since workers in industrial plants are also an integral part of the self-management system, efforts had to be undertaken to instruct them in basic business skills. Compulsory courses for all workers under 45 years of age were organized with the assistance of the People's Universities. Workers attend courses in the off-season months in classes numbering 15 to 30. The centres provide full board and accomodation, and the workers attend classes four

to six hours a day, three to four times a week. As in all courses, instruction is given in basic school subjects, with particular emphasis on economics and agricultural science.

For workers who have already reached a certain educational level, special seminars are held in the evening to encourage them to appreciate the importance of their work in the framework of the socio-economic system. Discussion is encouraged, and following lectures of a somewhat theoretical nature, the students consider problems raised by the collectivity of workers and management.

Intermediate technical schools have also been opened with the goal of training qualified workers for the various fields of agricultural production. It was found that young people, on leaving vocational schools that had presumably prepared them for special trades, were insufficiently prepared for the tasks awaiting them. Financial assistance is given to children of needy agricultural workers so that they can receive an adequate secondary education and thus escape the problems their parents are currently facing.

Upper-echelon engineers and executives

The systems described above are designed solely for people who have had only a compulsory education of eight years or in some cases less. The above courses cover mainly practical subjects, i.e. instruction in basic technological skills. Agro-industrial development as such, however, also requires people with university training or similar qualifications.

Special institutes offering two-year courses in agriculture are typical of the emphasis being laid on education in Yugoslavia. Before the Second World War there were only two institutions that offered courses in economics, technology, and agriculture as compared with some 137 institutes of various kinds existing today.

The various combines are well aware of the advantage of having workers who are university graduates, and they help to make it financially possible for their experts to complete their studies.

Workers who previously lacked the opportunity to study [illegible] are given every chance to do so to the limit of their ability. Young workers are given scholarships so that they can study full time at universities or other institutes of advanced education. There has been a marked trend towards the training of technicians and agricultural experts rather than economists and business experts, and now almost all the upper-echelon members of the combines are graduates of some instituion of higher learning, even in such fields as cattle-breeding where workers are often compelled to study on a part-time basis. Post-graduate studies are also encouraged. Since recruitment has become a less severe problem, combines have begun to employ university graduates for an initial probationary period.

On joining the staff of the combine, the young experts are obliged to undergo a twelve months' training period. As a result, staff standards within the combines have risen considerably, though it must be admitted that highly qualified staff is still lacking in certain branches. Qualified teachers are also in short supply; thus every effort is made to give the experts at training college a certain amount of instruction in methodology and pedagogy.

The most remarkable feature of the training programme, however, is that with the increasing stress being laid on self-management, the impetus to study is being provided not so much by the state and the various governmental departments as by the combines and the workers themselves.

Chapter 13

CONCLUSION

The relative importance of agro-industry to the Yugoslav economy can be seen from table 22, which shows a twofold increase in investment over the years.

Table 22

Investments in agro-industry

Year	1,000 new dinars (current prices)	1,000 new dinars (constant prices)
1947-1953	1,275,290	7,393,344
1954	461,140	1,160,520
1955	405,701	947,213
1956	562,600	1,286,003
1957	784,460	1,721,422
1958	1,102,850	2,220,675
1959	1,513,360	2,864,096
1960	1,499,680	2,808,541
1961	1,498,330	2,400,006
1962	1,548,890	2,372,165
1963	1,841,310	2,616,817
1964	2,231,560	2,853,688
1965	2,274,810	2,396,107
1966	2,555,755	2,555,755
1967	2,354,405	2,358,054

The food-processing industry has also shown a positive upward trend, a 137 per cent increase in investment relative to 1957 (table 23). Yet the industry still has room to expand. The flour

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mills, sugar mills, chocolate plants and fish-processing factories, for instance, are not working at full capacity. Such handicaps as unfavourable taxation and import surcharges are being gradually overcome.

Table 23

Investment in the food-processing industry

Year	1,000 new dinars (current prices)	1,000 new dinars (constant prices)
1957	164,500	405,331
1958	163,300	382,119
1959	164,500	344,594
1960	227,300	446,615
1961	290,200	493,925
1962	261,200	405,731
1963	301,100	448,963
1964	295,600	400,560
1965	265,600	301,839
1966	327,400	327,409
1967	383,600	387,460

The most significant aspect of this development is the agro-industrial combine based on the principle of vertical integration. By introducing economic parameters as planning criteria and carefully programming production and processing, the agro-industrial combine may be able to substantiate the claim that it is possible to achieve maximum results with minimum expenditure.

Annex 1

OPENING STATEMENTS

Statement by Mr. George Abu Jawdeh, Deputy Resident Representative of the United Nations Development Programme in Yugoslavia

It would seem superflous today in the late 1960s, when the Development Decade proclaimed by the United Nations is entering its final stage, to emphasize the role of the food industry in the over-all development process. We know only too well what vast problems the developing countries of the world are encountering in this most critical phase of their existence. Owing to rapid industrialization, the need for producing food for an ever-increasing population has led to the development of large-scale agricultural production integrated with the food-processing industry through the use of special industrial methods. The aim of this seminar is to spread knowledge of these methods, which have hitherto not been extensively applied in many developing countries.

The initiative of the Government of Yugoslavia and the United Nations Industrial Development Organization in arranging this seminar is therefore most welcome and timely. I wish to congratulate UNIDO, the youngest United Nations organization concerned with international development, for its choice of Yugoslavia as host country. The Government of Yugoslavia has been a most willing and enthusiastic participant in international technical co-operation ever since its inception after the Second World War. Furthermore, Yugoslavia, through a process of dynamic and rapid industrialization, has gained valuable experience in the food-processing industry. As you know, some 80 to 90 agro-industrial combines are at present operating in this country. This gives an indication of how well this fairly recent trend in food industry has been established here.

I am aware that I am not in a position to make any substantive contribution to the highly technical discussions of the seminar, but I would like to wish all of you great success in your work and in your future tasks in your home countries.

Statement by Mr. A. V. Bassili, Industrial Development Officer, Light Industries Section, Industrial Technology Division, UNIDO

On behalf of our Executive Director, Mr. Abdel-Rahman, I wish to thank the Yugoslav authorities for their kind offer to act as host Government for this seminar, and for their great help in organizing it on such short notice. It is all the more remarkable that the setting and arrangements for our meetings should be of such a high standard.

UNIDO, the United Nations Industrial Development Organization, now established in Vienna, has been assigned the role of promoting and accelerating the industrialization of developing countries. In fulfilling this function, UNIDO not only carries out its own activities but also plays the central role in the promotion and co-ordination of the activities of the United Nations system as a whole in the field of industrial development.

In carrying out the mandate assigned to it by the General Assembly, UNIDO engages in two broad types of work:

(a) Technical assistance activities to assist Governments directly at their request in the solution of problems related to the establishments of new industries or the operation of existing ones;

(b) Supporting activities, which consists mainly of studies, seminars, symposia etc. designed to facilitate the undertaking of operational programmes and increase the transfer of knowledge to developing countries.

This seminar falls under both of the above categories, for it is on the one hand a technical assistance project to impart knowledge and on the other an instrument to further UNIDO's activities in the field of food processing. Our discussions will not be abstract but will be on practical problems facing developing countries.

UNIDO has noted the growing interest of many developing countries in establishing an integrated food-processing industry, a relatively new trend in this industry, but one which is already well established in industrialized countries.

Yugoslavia was chosen to be the host country because vertically integrated food processing has reached an advanced level in this country. We hope that through the lectures and visits organized during the coming three weeks, you will be able to acquaint yourselves with the latest methods of production and organization of agro-industrial combines and introduce this trend, after suitable modifications, into your countries.

Integrated food processing is a field in which UNIDO is establishing close collaboration with FAO, and it gives me particular pleasure to welcome the observer from FAO to the seminar.

May I once again thank the Yugoslav authorities for all their collaboration and assistance in organizing this seminar.

Annex 2

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Annex 3

LIST OF PAPERS PRESENTED TO THE SEMINAR[1/]

The importance of market-oriented policy in integrated food processing
by Novica Mitić

Integration in agriculture and the food industry
by Milan Janjetović

Development of domestic and foreign markets for integrated food processing
by Vladimir Cvetković

Distribution, marketing and export of processed crops
by Vladimir Cvetković

Organization of the agricultural and processing plants within agro-industrial combines
by Besir Boško and Stjepan Lukić

Planning and programming within agro-industrial combines
by Petar Cerović

Co-operation with individual farmers and co-operatives
by Borivoje Drobnjak

The system and technology of crop growing at the Sirmium agro-industrial combine
by Nikola Milutinović

Industrial production of pork and pork products
by Lucijan Krivec

The organization and technology of pig breeding at PIK Belje
by Zdravko Laktić

Industrial poultry production
by Marjan Munda and Marijan Mojsišek

The production of eggs for consumption at the agro-industrial combine, Zagreb
by Ante Todorić

1/ These papers were issued only for the information of participants and are not available for distribution.

Case study of the establishment of an integrated meat-processing plant in a developing country
by Dušan Kresal

Production of beef meat
by Mihailo Milošević

Industrial preparation and processing of meat and milk
by Mirko Nenadić and M. Dokmanović

Integrated production of milk
by Srećko Pečar

Organization and technology of production of sugar, chocolate and candy
by Martin Rozner

Organization and production of margarine
by Marta Gams

Industrial production of fodder
by Vitomir Bekrić

Fruit and vegetable processing
by Živorad Jontulović

Water conservation and irrigation techniques for industrial crops
by Vojislav Bulatović

The role of quality control in the food-processing industry
by Dragoljub Ivanović

Modern equipment for agriculture and the food-processing industry
by Djuro Zmajević

The production and industrial processing of fruit and grapes in agro-industrial combines in Yugoslavia
by Aleksandar Mišev

Problems related to the financing of an integrated food-processing industry
by Boško Tonev

Unit operations, automation and the development of food-processing techniques
by Miodrag Bogosavljević

The role of mioro-organisms in food production
by Vojislav Krajovan

Organization of research in agriculture and food processing in Yugoslavia
by Krsto Rosić

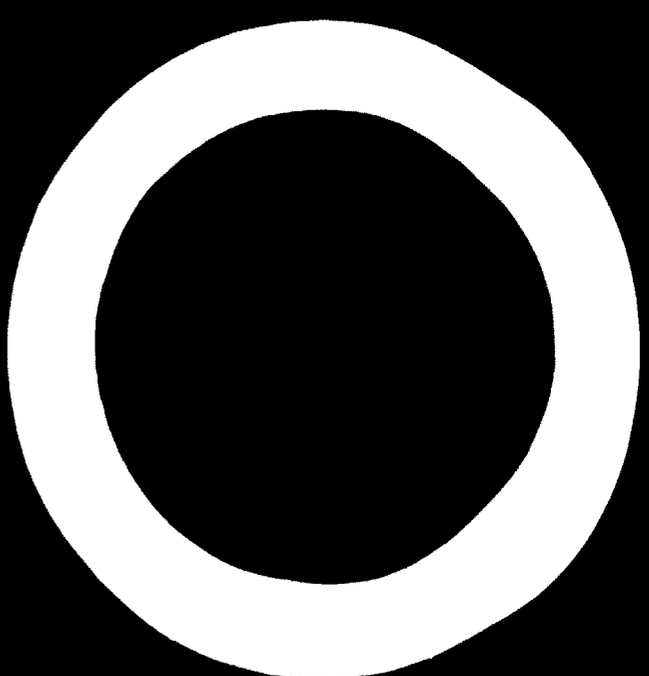
The practical applications of scientific developments
by Josef Pukšic

The organization of scientific and expert work in an agro-industrial combine
by Vladeta Ćirić

The education of cadres in agriculture and food processing
by Ivo Simeunović

The education of cadres in agro-industrial combines
by Vojin Ribarić

Concentrated fruit and vegetable juices and mashes
by Delimir Šulc



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