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Orientation and organization of agricultural research in Yugoslavia

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Harmonious socio-economic development plays an important role especially in countries that are in a transitional stage of industrialization between being less developed and developed. In such a stage, neglecting the important primary activities, especially the development of agriculture, can often cause a "shock" in the food supply demand/supply balance that results not only in a lack of food but also a lack of essential raw materials for food, chemical, leather, textile, wood and other industries. All of this is true for Yugoslavia which needs to depend on a certain degree of self-sufficiency (80-90%) and growth in food production per year (2.5-3%) compared to 2.1% over the last 20 years. Last but not least there is a demand in agriculture for higher productivity and lower cost of agricultural products. It is well known that criteria for successful industrialized agriculture production are the same as for any successful business or industry:

- a) being the lowest cost producer,
- b) providing a quality product,
- c) meeting the needs of a defined market.

"We don't need higher prices, we need lower costs! Decrease costs... increase yields... increase demand!" That is the challenge of research people working on agriculture in Yugoslavia and the justification for basic and applied agricultural research work.

The application of new technologies is capable of reducing the cost of production. To reduce fertilizer costs and increase yield we need more research devoted to fertilization and water management. Research in biotechnology we hope will provide us with some new possibilities like new seeds that will increase yields, be insect and fungus resistant, require less nutrients and water, and be able to grow profitably under adverse soil and climatic conditions. For crop protection, chemicals should be developed that are more selective, environmentally safe and less expensive.

Yugoslavia has always been concerned with storing food. We still have much to learn to decrease effectively degradation and losses in crop storage.

When all of this agricultural research work is combined into an overall agricultural production system, we should be able to increase yields and reduce production costs significantly.

I - National organization of agricultural research

Self-management communities for scientific research have been organized in the six republics and two autonomous provinces. At the federal level they form the Association of Selfmanaging

Communities of Interest for Research Activities of the Republics and Provinces of Yugoslavia.

This organization was established in 1976 following the basic principle of the constitution according to which decision-making on research policy is the responsibility of republics and autonomous provinces.

The main tasks of the Association are:

- to coordinate scientific policy and research/development programs of mutual interest,
- to cooperate in the preparation and discussion of Yugoslav development plans,
- to define joint projects and financing,
- to inform members and other interested organizations of research/development problems in Yugoslavia and to offer available assistance.

The links with the Assembly of the Socialist Federal Republic of Yugoslavia are maintained by three delegates of the Association who participate in the Joint Commission for Science of the Federal, Republican and Provincial Chambers.

The main tasks of the Commission are:

- to link research with the needs of users and to encourage the latter to support research,
- to intensify links between researchers,
- to discuss and approve international agreements on scientific co-operation.

The Association is linked with the Federal Executive Council by delegates who co-operate in the work of the Federal Executive Council's research/development bodies.

Special links at the working level have been established between the bodies of the Association and the federal Department for International Scientific, Educational, Cultural and Technical Cooperation. The latter is also responsible for a number of administrative tasks related to the Association.

The detailed structure of the overall system of organization at the federal level is presented in **Figures 1 and 2.**

In the republics and provinces, research coordination and financing are ensured by the Association of Selfmanaging Communities of Interest for Research Activities through Special Associations for Research Activity (Republic Slovenia is taken as an example) and Community Associations for Research Activity (64 in Republic Slovenia).

The last two associations deal mainly with programming, coordination and financing of applied development research programs while the first deals with programming, coordination and financing of basic research programs.

An important task of these research associations is also to coordinate and finance the education of research and educational staff through research programs and to organize and promote their contact with development program users. There is a program for Master's or Doctor's degrees for about 100 young research workers and for specialization of about 300 young agriculturalists only in Slovenia by the year 2000. Such programs are also planned in two other republics - Croatia and Serbia.

II - Agricultural research programs and problems

As republics and provinces in Yugoslavia are responsible for decision-making on research policy, it would be hard to describe in this paper all such agricultural research programs. The general orientation of research programs was given above. Here detailed research programs are described for one republic, Slovenia. The list of agricultural research programs for other republics and provinces which are more or less alike, could be prepared separately.

1. Research programs of common interest

To respond to the current technological challenge, it is vital to master the know-how, that, in no time, will become the kingpin of the third industrial revolution. The gateway to the technology of the future lies in information technology, new production technologies, and progress in the life sciences.

Projects:**a) Program for the development of scientific, technical and technological information until 2000.**

The growth of information technology will open the ways for every other field of activity. The objectives of this project are:

- to work on the committee for scientific information system evaluating the steps in working out the project and verifying it, to prepare appropriate decisions for the Research Association Council, and to propose appropriate social measures and legal instruments for the implementation of the program.

- to evaluate the problems of individual subsystems in the information system and the measures necessary for its development and functioning, as well as the problems in integrating information systems in the social systems of information,

- to improve the flow of scientific and technical information between individual socialist republics and provinces,

- to incorporate the scientific and technical information system into international systems of scientific and technical information (technology, financing, organization, legal and socio-political measures); introducing and setting international and national standards of scientific and technical information in Yugoslavia,

- to introduce modern information technology in scientific and research activities, as well as modern equipment for processing and transfer of scientific information,

- to improve the exploitation of scientific, technical and technological information,

- to evaluate problems in the development of information science and information research in Yugoslavia,

- to train information officers for scientific, technical and technological information systems,

- to evaluate problems in using information for scientific and technological exchanges with other countries, especially with non-aligned and developing countries,

- to define the economic and legal status of scientific information in our country,

- to improve information and computerization levels of the Research Association Council and its agencies,

- to provide regular supervision of the project,

- to provide regular supervision of the activities of institutions and publications in the field of scientific and technological information which are financed, or co-financed by the Research Association,

- to cooperate with the social agencies and organizations at the federal level in connection with scientific and technological information,

- to improve methods, programming and reporting on the work of the Information System Committee.

b) Genetic engineering and biotechnology

Of the major challenges that face modern societies, five of them are estimated to be fully, or at least in part, solvable by means of modern biotechnology:

1. Providing raw materials for chemical and other industries from renewable sources (e.g. biomass);
2. Supplying alternative sources of energy;
3. Modernizing agricultural production;
4. Improving health services; and
5. Protecting the environment.

To achieve these goals, basic research in the following fields is needed:

1. Microbiological collections and cultures: Research to isolate and improve existing and produce new cultures by all genetic methods at our disposal, including genetic engineering. It is indispensable to create collections in order to preserve obtained species and enable their exploitation.

2. Genetics of micro-organisms and genetic engineering: A study of the structure and functions of individual genes, which are appropriate for manipulation, due to the fact that recombinant DNA technology enables detailed

study of the structure of genes and their regulatory elements;

- inducing mutations at a specific point in a gene or molecule of DNA;

- bypass the bottlenecks in the bio-synthetic ways of various interesting metabolites;

- produce substances which would otherwise be difficult, expensive, or impossible to obtain;

- improve the abilities of micro-organisms to propagate in new media.

3. Implementation of genetic engineering in the fields of vaccination, plasmoproteins and diagnostics.

4. Physiology of micro-organisms.

5. Genetics, molecular biology and physiology of plants:

- developing the genetic variability of grown plants,

- increasing nitrogen fixation to reduce the use of manure,

- increasing plant resistance to environmental stress,

- increasing plant resistance to pests to reduce the use of pesticides,

- studying the physiological processes in plants,

- developing vegetative micropropagation in useful plant species.

6. Enzymology and enzyme engineering:

- fundamental enzymology, advanced enzyme reactions, enzyme modifications,

- enzyme immobilization and development of enzyme reactors,

- development of protein separation methods and procedures for enzyme isolation and purifying,

- introducing enzymes into industrial processes of food processing, pharmaceutical and other industries,

- development of analytic, diagnostic and curative means.

7. Raw materials: molasses, starch and sugar raw materials, biomass, waste lumber and pulp materials, waste organic matter.

c) Increasing food production :

Given the ever diminishing area of arable land, it is of vital importance to ascertain the ways of producing two crops annually. In this respect production has to be linked to the development of animal production and agro-industries. With this in view, the following research is necessary:

1. Factors that restrict maximum use of genetic potential to produce new plant varieties: climatic conditions, production potential of soils, soil water conditions, applied technology, as well as plant diseases and pests.

2. Study of economic production factors, market organization and processing of agricultural products: economic conditions, socio-economic relations in production units, and markets for agricultural products.

3. Research on cattle breeding in Yugoslavia: long-term guidelines for the development of cattle breeding in the individual socialist republics and autonomous provinces, solving technological and zootechnical problems and the study of factors that inhibit the progress of cattle breeding,

4. Improvement of sheep raising in mountainous regions: test the natural and genetic values of the present sheep population, implement breeding by merino crossing, test genetic characteristics of cross-breeds.

5. Creating new races of chickens by the selection and genetic development of domestic hybrid hens (both heavy and light types).

6. Production and use of fodder plants in mountainous regions: intensifying production of cattle fodder on the main types of grassland, impact of grazing on productivity and plant ecosystems in natural grassland, production of fodder on arable land.

7. Developing production of protein food and its use, research on species rich in protein: canning and food processing, economic use of biomass.

8. Improving use of natural food resources (fruit, fish, medicinal herbs, game animals).

9. Research on defining criteria for agricultural production in mountainous regions.

10. Research on bioecological units and their genetic potential (method of production equivalent for biological units):

d) Overall evaluation of the environment

The socio-economic development of Yugoslavia is marked by inadequate treatment of environmental prerequisites for development. It is necessary to examine the conceptual models of environmental regulation and environmental modelling, by means of a comparative analysis of economic, ecological, social, ethnological and cultural aspects of environmental planning, socio-geographic condition of guiding regional development, environmental deterioration, regional analysis (evaluation for the needs of tourism and industry, agriculture, international migration paths).

2. Agricultural research programs in Slovenia

A. Agricultural research programs

The analysis of developmental possibilities in agriculture shows the existence of actual possibilities to enlarge food production by 90% and cattle breeding by 45-50%. In the year 2000 we could produce enough food for the expected population. The gross agricultural production could be 61% higher which would mean a 2.5% growth of agricultural production per year until 2000.

The key to reaching this goal is a higher intensity of production and changing the production structure while respecting the different regulations concerning land use which are a basic factor in agricultural and forest production. This is also the case for hilly land.

Creating a five-year, long-term plan for the development of research activities, we considered all these aims as well as severe demands for environmental protection, for preservation and improvement of land productivity, for preservation of raw-material sources and for energy savings, i.e. material and energy recycling. Five year programs of research in agriculture are

based on these three long-term goals. So this is the main direction of biotechnical research, which is just one component of the whole research process. Basic biotechnical research programs, as the source of new discoveries and a factor for the development of new researchers, should include:

- Forest function and its maintenance, different methods for economic utilization, menaces due to environmental changes, possibilities to enlarge wood sources, optimal managing, wood production in relation to land use capability, research on the evolutionary processes of native plant and animal species;
- Research on natural and productive land in order to optimize crop production according to biological and economical principles of food production;
- Research on cattle breeding concerning the needs of the market using local feeds (especially proteins) and replacing imports;
- Development of economic models of different agricultural rotations and arrangement of agricultural land according to natural and other factors, establishing complete material and energy recycling, exploitation of secondary raw materials for food production together with environmental protection, and research of alternative forms of food production;
- Animal health protection as an important economic factor in cattle breeding, (prevention, oppression of infectious diseases including zoonoses) and ensuring healthy food.

Some details of different agricultural research programs

Research programs on crop production are designed for higher yields and lower costs. They concentrate on some aspects of up-to-date technological processes based on ecology, pedology, land reclamation and improvement, water control, physiology, genetics and selection, plant and animal nutrition as well as on other problems of production (like mechanization) and finding the most suitable economic models of agricultural production. They also deal with economic land use and preservation of land. Nowadays, this research is also interested in native species and in finding methods for their improvement and use as well as nutritive sources.

Research programs on food technology are concerned with food and beverage production, technology of secondary materials and introduction of modern technology. Its aim is to bring new analytical methods and values from the view of sensoric and organoleptic properties, food intoxication and mutagenic effects of raw materials and additives.

Research programs in animal husbandry include genetics and selection in order to use new methods for improving breeds. Apart from the development of cattle breeding technology and intensive exploitation of domestic animals, we must also take into account physiological and ethnological animal properties as well as ecological properties of breeding systems and the effects of technology on the environment.

The research program on veterinary medicine is adjusted to common efforts of agricultural development. So it includes basic research on animal breeding as well as on diagnosis, prevention and suppression of animal infections; parasitic, metabolic and nutritional diseases; health protection for reproduction; health protection for deer, fish, bees, carnivorous and other animals; and development of veterinary activities in the field of food hygiene, public health services and environmental protection.

All of these programs are described in greater detail in the annex below.

B. Problems of agricultural research in Slovenia

Agricultural research in Slovenia is overseen by two associations: the Special Research Association of Agriculture, Food Processing and Veterinary Science (10 applied research projects) and the Research Association (19 specialized basic research programs)

The first problem faced in Slovenia agricultural research is the lack of funds. At the time of the preparation of the five-year plan, the demands of the two research associations exceeded the means for the 1981 to 1985 period, by some 40%. Regardless of the priority given to agriculture and food processing in all of the plans and decisions of the sociopolitical communities, these sectors get merely 10% of the total research funds. Furthermore, if one were to deduct the resources allocated to research not directly aimed at producing and processing food (eg. silviculture,

lumbering industry), it only amounts to some 8%. The rest goes to the 11 other specialized research associations. This reveals the substantial discrepancy between the needs and demands and the limited financial means of the organizations implementing these programs.

Besides the lack of the resources, the following points deserve special attention:

- according to the Research Association of Slovenia, more than half of the research staff are older than 50 years,

- In 1980, in this particular field, 83% of the research equipment was obsolete and its replacement was virtually impossible,

- the various production branches are not connected to each other,

- lack of interdisciplinary links between various scientific and research organizations in designing and implementing the agricultural food processing program.

A second, but nonetheless important aspect of the program has been the continual development ever since 1982 of an interdisciplinary program of Special Research Associations. In 1984, this represented a total of 19% of the resources for research within the framework of the Special Research Association for Agriculture, Food Processing and Veterinary Science. That was a big step forward in the field of applied research, especially considering the fact that interdisciplinary links were finally established, that other special research associations showed their interest in co-financing research, and that end users of research found an interest in financing it.

The final goal of the proposed research activities for the next medium term, 1986-1990, thus remains to be an increase in the production of wholesome food, an increase in the productivity and more economic agricultural production and food processing. This naturally implies taking into account the overall research needs in the field of agriculture, food processing, and veterinary science in Slovenia, which means that the implementation of the programs depends, not only on the means provided by the Research Association of Slovenia and special research associations, but increasingly on the direct exchange of labour. This particular aspect

becomes all the more clear if we consider the fact that only some 15% of the workers in these branches contribute to the Special Research Association for Agriculture, Food Processing and Veterinary Science, while the independent farmers, who own some 85% of the arable land, have not been included in any way yet.

III - Institutions

A list of all Agricultural Research Institutions with their addresses has been prepared by FAISTEC (Federal Agency for International Scientific, Technical and Educational Cooperation) and is available separately.

There are Agricultural Research Institutions in Yugoslavia that are specialized for certain crops, and there are faculties at universities that are doing mainly basic research, but this is not a rule. They are also doing applied research and also have development functions. Moreover, there are institutes with research and technical activity and also organizations that mainly have an agricultural development function. Table 2 gives the total number of these institutions.

1. Specialized institutions with full time researchers

These institutions have their own research facilities, all full time researchers and their own income, - partly budgets, partly from their own research activities (selling seeds, etc.).

The major ones are:

- Institute for Biological Research, Belgrade,
- Institute for Animal Husbandry, Osijek,
- "Dunav-Tisa-Dunav" - Hydro-Agroindustrial System, Novi Sad,
- Institute for Tobacco, Zagreb,
- Institute for Medicinal Plants, Portoroz,
- Institute for Agroeconomics, Belgrade,
- Institute for Hops and Brewery, 63310 Zalec,
- Institute for Agricultural Machinery, Belgrade,

- Institute for Mediterranean Crops, Split,
- Institute for Meat Technology, Belgrade,
- Institute for Corn, Zemun Polje,
- Institute for Potatoes, Guca,
- Institute for Viticulture and Wine Production, Skoje,
- Institute for Water Management, Ljubljana,
- Institute for Nuclear Energy Application in Agriculture and Forestry, Zemun
- Institute for Vegetables, Palanka,
- Food Technology Institute, Zagreb,
- Institute for Sugar Beets, Aleksinac,
- Institute for Small Grains, Kragujevac,
- Institute for Fruit Production, Cacak,
- Institute for Phytopathology, Belgrade,
- Institute for Soil Science, Belgrade,
- Yugoslav Center for Technical and Scientific Documentation, Belgrade.

2. University institutions

Agricultural faculties at universities in each republic and province deal with basic and applied agricultural research and also have development and/or extension functions (working on feasibility studies, designing different projects, etc.). Professors working in education could be considered as part time researchers (1/2 time) but there also full time researchers at the faculties. It would be hard to distinguish them or to estimate their number without making an exact inventory. The research work at faculties runs in all branches of agriculture. Faculties depend partly on budgets and partly on research by customers (farmers, agricultural conglomerates, other enterprises) on a contractual basis.

At the agricultural Faculty in Ljubljana, Slovenia, income is 40% from education and 60% from other sources - research and development activity.

Agricultural faculties are found in the following cities: Ljubljana (Slovenia), Zagreb (Croatia), Belgrade (Serbia), Sarajevo (Bosnia and Hercegovina), Skopje (Macedonia), Novi Sad (Vojvodina), Pristina (Kosovo). There is no agricultural faculty in Monte Negro.

There are also many other agricultural research institutions with mixed (research, extension) activities, some of them dealing only with applied research and extension, some of them only with extension.

IV - Human resources

1. Scientists

An estimate of the number of full time researchers and others is given in **Tables 1, 2 and 3**. Students preparing theses are not included.

In order to become a researcher, one has to have an engineering degree or a bachelor degree in any branch of agriculture and preferably a scientific degree - a Master's if not a doctorate. Only a scientist with a doctorate can lead a research project.

For the recruitment and promotion of researchers there are post graduate studies in all branches of agriculture at each agricultural faculty in Yugoslavia. The main problems for enrolment are of a financial nature. Therefore, foreign scholarships for attending post graduate-courses abroad are most desirable.

Fortunately, the Research Association of Slovenia (and Research Associations of Croatia and Serbia are following this example) started a program in 1985 for revitalisation of research workers and those working on development programs and they financially support young researchers to achieve post-graduate degrees. Such financing is aimed for three to eight years depending on the degree. Through this program there is a plan to educate around 400 young researchers in Slovenia by 1990.

2. Other staff members

It is obvious that any research project requires other workers or technicians for different tasks. There are on average about three to five technicians needed per researcher for efficient

execution of a research project. This number is sometimes much lower due to low salaries in agricultural research work or for any reason. The exact data on other staff members are not available.

V - Material resources

1. Regional centres

Each Agricultural Research Institute has at least one location available for experimental field (usually there are more) and laboratories for its experimental activity, demonstration of techniques, for seed production, reproductive animals, etc.

2. Equipment and services

Buildings and research equipment are usually inadequate for the implementation of research projects. Research associations have recently given a lot of support to research institutions for revitalization of equipment and/or purchase up-to-date material aiming at improved efficiency.

3. Financial resources

Research in Yugoslavia is financed from two main sources. Approximately one third of the income is raised and distributed by Research Associations at the level of the republics and autonomous provinces. The rest is obtained from contracts between the research organizations and direct users.

In the 1981-1985 period, the total budget of Research Associations in Yugoslavia was approximately 13 billion dinars per annum, i.e. about \$43 million.

VI - Organizational activities and financing in the future

The following organizational activities will have to be undertaken in the future:

a) Special steps aimed at organizing and unifying the potential of self-managing association for the implementation of major projects, especially those directed at the development of the infrastructure of technology at the national level and at

implementing more economic organizing of scientific research work and improving the cost-effective ratio of scientific technological policy measures.

b) Improving the documentation of activities in the republics and provinces and at the federal level.

c) Advancing and coordinating the evaluation system for projects and results of scientific research work.

d) The purchase of the substantial amount of equipment necessary for strategic research directions has to be coordinated. This work will be done by the Research Association and the Federal Agency of Science and Technology.

e) Promoting the use of major world research centres, especially in those fields where investments in specialized equipment cannot be justified.

f) To ensure optimal use of production potential, the general investment policy must emphasize increasing investments in research and development of new technologies, rather than on production capacities. In the present planning period, investments in the development of technology are to be allotted a substantial portion of the overall investments in fixed assets, especially in the high technology fields (microelectronics, computers, communications, process equipment for microprocessors, etc.).

References

1. The basic development of scientific work in Yugoslavia in 1981-1985 (Study), Zagreb, 1981.
2. The plan for development of scientific work in Yugoslavia in the period 1986-1990, Federal Research Association, Belgrade, 1985.
3. The program of Agricultural Research in Slovenia in the period 1986-1990, Republic Research Association, 1985.

Figure 1: Details of the units between research associations and the Assembly and Federal Executive Council
(R & D = Research and Development)

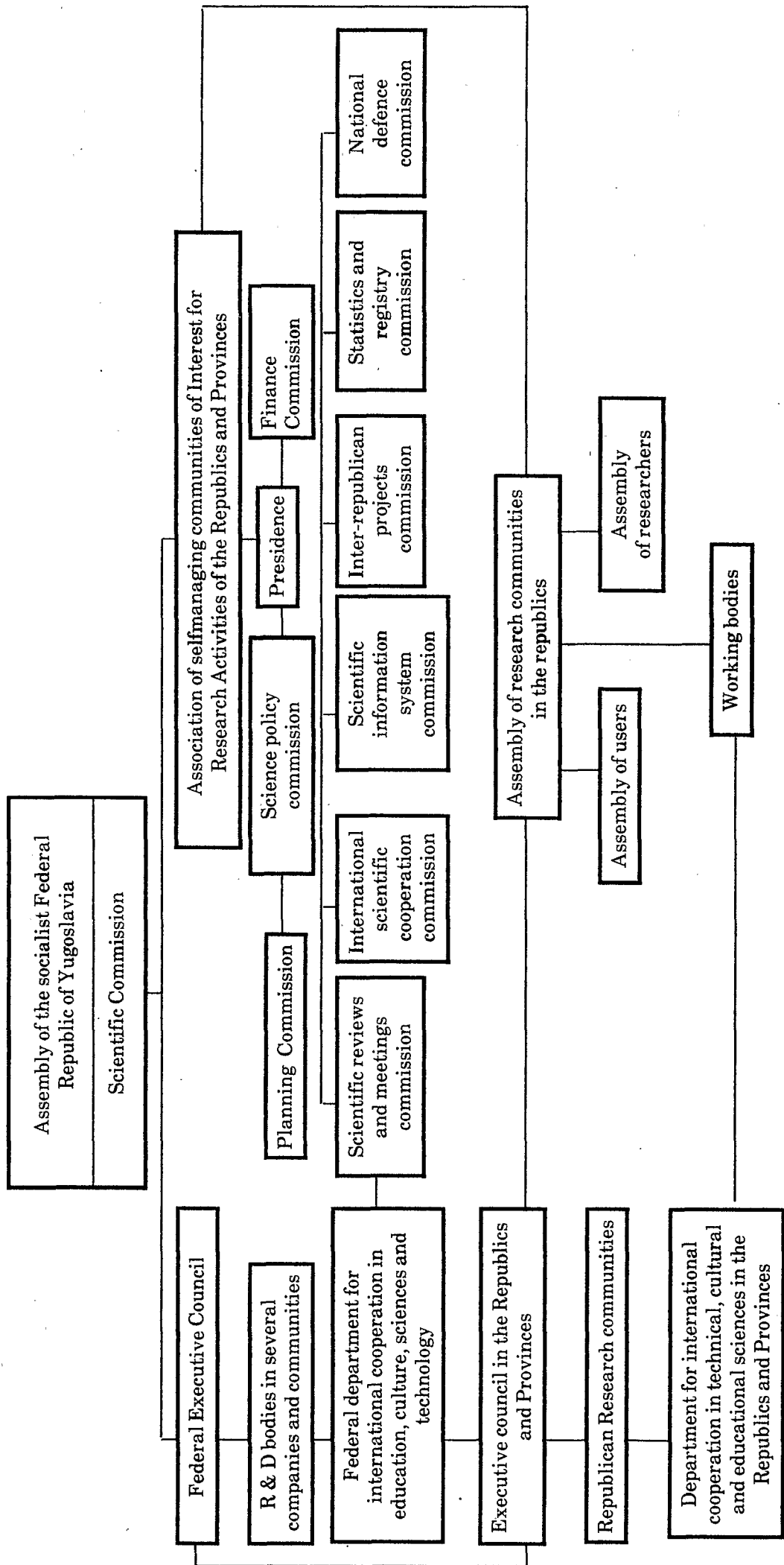


Figure 2: Detailed structures of users and researchers of the Research Association

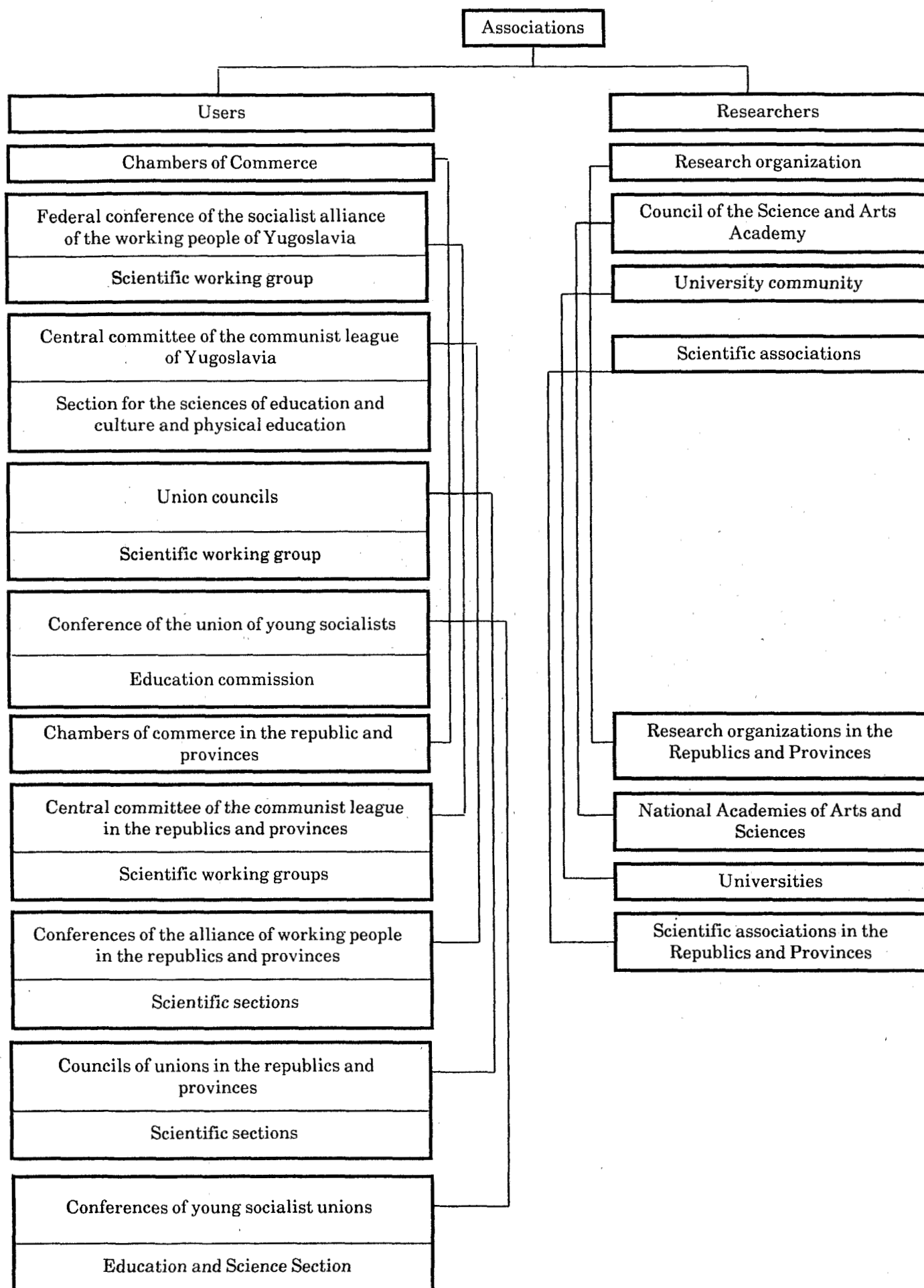


Table 1: General background data on research in Yugoslavia (for the republics and provinces)

N°	Item	Yugoslavia	Bosnia/Herzegovina	Monte Negro	Croatia	Macedonia	Slovenia	Serbia	Kosovo	Vojvodina
1	Full time researchers for 10,000 residents									
	1965	6.27	3.52	1.02	7.64	3.21	11.92	8.97	1.12	2.89
	1979	9.98	5.65	3.93	11.39	6.51	21.22	13.48	3.59	4.75
2	Full time researchers for 10,000 residents									
	1965	33.3	24.5	7.0	34.2	20.4	37.9	52.6	13.4	12.9
	1979	39.0	29.6	19.1	38.2	29.6	49.7	52.4	33.5	17.4
3	Total research financing as % of national revenue									
	1965	1.00	0.65	0.20	0.70	0.76	1.90	1.37	0.76	0.32
	1979	1.29	1.00	0.46	1.19	0.63	1.69	1.68	0.53	0.90
4	Total research financing per capita in dinars									
	1965	40.7	18.4	5.5	34.5	21.1	139.7	54.2	11.5	15.8
	1979	676.3	341.0	159.5	791.3	221.5	1 829.1	879.8	79.3	542.6
5	Total research financing by full time researcher in 1,000 dinars									
	1965	86.9	89.5	100.3	66.2	84.5	139.8	71.2	213.5	94.0
	1979	758.2	741.7	838.7	702.1	424.2	870.4	758.2	400.3	1 071.3
6	Number of researchers									
	1965	2 559	152	7	626	146	334	1 200	26	68
	1979	11 343	811	34	3 563	627	1 528	3 628	255	897
7	Number of publications by full time researchers									
	1965	0.83	0.70	-	1.19	0.95	0.84	0.64	0.98	0.43
	1979	0.85	0.81	0.38	0.96	0.70	0.79	0.78	0.42	1.32
8	Number of agricultural research institutions									
	1978	116	14	1	19	18	10	40	4	10
9	Number of full time researchers by agricultural research institution									
	1978	18.57	17.5	26.00	27.09	8.47	16.64	20.50	8.75	24.03

Table 2: Agricultural research institutes and agricultural institutes with both research and development functions

Year	Specialized institutions					Institutions with research and development functions				
	Institutions		Full time researchers			Institute		Full time researchers		
	Numb.	%	Numb.	%	For one institute	Numb.	%	Nbre	%	For one institute
1978	75	15.4	1 552	12.9	20.69	11	13,4	121	7.3	11.05
1979	61	12.7	1 238	9.4	20.30	4	5,3	22.5	1.5	5.63

Table 3: Agricultural researchers employed in specialized research institutions and those with R and D functions

Year	Specialized research institutions and university research institutions					Institutions with R + D functions				
	Total employees	Researchers				Total employees	Researchers			
		Full time	Half time	Scient. workers	Autres		Full time	Half time	Scient. workers	Others
1965	787	478	55	307	14	3,837	986	83	323	419
1970	-	-	-	-	-	4,794	1,376	138	428	509
1975	-	-	-	-	-	5,285	1,831	58	543	275
1978	2,764	1,290	12	841	160	4,627	1,619	33	594	383
1979	3,630	1,672	45	1,152	137	3,813	1,258	5	430	105

Annex 1: Details of agricultural research programs in Slovenia**I - Research programs in plant production****1. Ecology and soil science**

The following fields are studied: agrometeorology, soil science, plant nutrition and soil fertility, effects of agricultural and non-agricultural waste on soil and plants, pedologic maps of Slovenia, mineral-nitrium metabolism in natural and anthropogenized systems.

2. Land reclamation, water management and land consolidation

Some new technological and technical solutions are studied in the field of water and land improvement and consolidation in order to reduce investment costs and ensure more effective land reclamation techniques to increase and stabilize plant production. Special attention is given to soil water management studies through drainage and irrigation improvements, water balance model studies, evapotranspiration studies, water production function studies, remote sensing techniques for scheduling irrigation and drainage efficiency studies, etc.

3. Biological basis of agricultural plants

New inventions play an important role in qualitative and quantitative factors of crop improvement. These inventions originate from biological studies - genetics, hybridization, selection, physiology and ecology. These studies enable considerable advantage in creating new improved cultivars of agricultural plants and in improvement of technological production. The application of foreign results in our country is a relatively quick solution of problems but it is restricted. It is most important to solve problems under concrete environments and conditions and to make simulation models.

Some details of studies:

Genetic, plant breeding and gene banks of agricultural plants: cytologic, biochemical and biophysical aspects of native plant material. Genetic basis and plant-breeding of some agricultural plants. Comparative methods for evaluation of alternative crops. Growth and development of agricultural plants under biotic and abiotic effects. Collecting of native species of some agricultural plants and their morphologic and physiologic studies.

Ecology, physiology and genetics of agricultural plants:

Physiology, genetics and plant breeding of some crops. Ecology of fruit plants, berries and vines. Biotypes and ecotypes of vines in Slovenia. Physiology of seedlings and reproduction of crops. Physiology of plant evolution under endogene and exogene effects. Collecting native species of some crops and their morphologic and physiologic study.

Genetics and physiology of hops and medical plants: genetics, plant breeding, selection and gene bank of hops. Growth and evolution physiology of hops. Collecting native hops species and their morphologic and physiologic study.

4. Phytopathology and protection of crops

The purpose of this program is to acquire and enlarge our knowledge about phytopathology, entomology, phytopharmacy, analytic remains of phytopharmaceutical substances and heavy metals as well as regional contamination with such substances and to acquire a basis for breeding of crops to be resistant against different diseases. So we will extend our fundamental knowledge needed to perform applied research for plant production.

5. Agricultural production techniques

Technical application of biological findings, theoretical basis for optimising the production of main crops in Slovenia, technical and technological solutions for collecting and reusing of garbage and exploitation of secondary energy sources in primary agricultural production.

When introducing new techniques into agricultural production we must be aware that production must be mechanized so that it eliminates hand labour and can work under different weather and ecological conditions. It must ensure a certain quality of work and rational energy consumption. Energy is included in this research from the view of collecting and using alternative energy sources as well as energy recycling in primary agricultural production.

The aim of this research is:

- to optimise all production technologies of farming, silage and crop conservation,
- to find new technical solutions for the needs of the already mentioned productive branches,
- rational energy exploitation.

II - Research programs in animal husbandry:

1. Animal nutrition

The aim of this research is:

- a systematic study of native forage (nutritive value, digestion, important components of animal nutrition),
- studying new forage sources for nutrition of different animal species,
- to study a protein supply for animals,
- studying interactions between selection and animal nutrition,
- studying ruminal microbiology,
- searching for connections between nutrition and fertility,
- interdisciplinary connections of animal nutrition problems.

2. Genetics and selection

This research is concerned with cytology (muscle fibres), cytogenetics (cariotypes and chromosome progeny) and immunology and will be extended to some cytogenetic research, connected with embryo and live foetus. Heritability, genetics of populations are parameters already evaluated by new methods and new experiments (two-way selection) and will in the future represent the base of all the mentioned activities and selection programs. The last mentioned group, trying to find optimal procedures of animal population selection, will in future have to examine and adapt the usefulness of improved evaluating systems for rational value, called BLUP (Best Linear Unbiased Prediction). In computer centers it is the most popular research field at this time.

Research in the field of genetics and animal studies is supposed to introduce new procedures for animal racial value improvement. In the past, three groups of activities have been formed: laboratory, population-genetics and program-selective.

3. Animal breeding, ethiology, ecology and environmental protection

The aim of this research is the development of animal technology together with intensive exploitation of domestic animals, considering physiological as well ethiological animal properties, ecological properties of breeding and, of course, technological effects on the environment. Such a research program should enable breeding researchers to study development of ethiology, ecology and environmental protection through a model or experiment.

III - Research programs in food technology

1. Technological parameters of food of plant and animal origin

The program of technological processes concerning plant originated food transformation includes essential research on wine production, the fruit transforming industry and silage. Studies also discuss new industrial plant evaluations used in beer production. Technological procedures concerning animal originated food transformation discuss meat and milk transforming processes. The aim of this research is to include up-to-date methods of the food into food transformation industry and their proper evaluation.

2. Qualitative parameters of raw material and final products

In the field of nutritive and sensoric food properties there are studies of macromolecular and enzyme qualities, nutritive value as well as studies of new cultivars. The analysis of new plant and animal products discusses some new analytical methods and searches for new evaluation criteria for food. Microbiological research together with food-technology toxicology deals with technological pests and microbe ecology in technological processes, potentially carcinogenic substances and new biotechnical procedures (immobilised cultures). The aim of this research is the introduction of up-to-date trends in the food transformation industry and their proper evaluation.

IV - Detailed research programs in veterinary medicine

1. Physiology, morphology and reproduction

This program includes the study of endocrine and metabolic animal properties, especially for ruminants, pigs and rabbits as well as their influence on productive and reproductive animal properties. Concerning reproduction we study embryos and sperm together with factors responsible for unsuccessful sperm conservation, embryo transplatation and conservation.

The program is completed by studies of disturbances in embryonic development and natal animal maturity, emphasizing morphologic, physiologic and genetic characteristics of animal embryogenesis. It is also planned to study genetic polymorphology of some proteins, especially enzymes, taking place in cell respiration.

The aim of this research is a better understanding of physiological procedures, important for animal production and reproduction, especially in connection with some subclinical states and less resistant animals. It will also be necessary to study natural body defenses against disease and to improve fertility deficiencies.

2. Epizootiology and animal hygiene

This research program includes studying up-to-date problems concerning bacterial, virus and parasitic diseases of cattle, pigs, poultry and rabbits. There are also diseases common for people and animal (zoonoses) as well as epizootiological and immunological research of high-productive domestic animals and poultry. The other branch of this program is concerned with the contamination of animal-originated food by environmental pollutants, biostimulators and drugs.

The aim of this research is to search for microbial and parasitic causes, which are now present in our country and cause considerable economic damage as they are transferable to human beings. So we want to improve prevention and oppression of these diseases. The studies of food hygiene try to determine the degree of food contamination, methods for proving it and how to determine allowable quantities of residues in food.

3. Preventive veterinary medicine in cattle breeding

Prevention of diseases which can cause economic damage, is an important veterinary activity. It includes prevention against infectious parasitic, metabolic, constitutional and hereditary diseases of animals, as well as prevention against diseases caused by unsuitable microclimate and zoohygienic conditions and unsuitable nutrition and diseases in the perpetual period. So we must widely study all these diseases, their ethiology, which is often composed of many factors, pathology, therapy and find new diagnostic, healing and prevention methods.

The program on "Preventive veterinary medicine in cattle breeding" comprises all the studies concerning the already mentioned themes, starting from essential pharmacologic, pathomorphologic and pathophysiologic research and concrete suggestions for preventive and healing programs. It also includes health protection of all important cattle breeding branches, i.e. cattle, pig production, and sheep as well as health problems caused by unsuitable zoohygienic and microclimatic conditions. The aim of this research is further improvement of complex health protection of all cattle breeding branches which reduces damage because of disease and death.

4. Health problems in zoocultures

This program also studies health protection of fish and bees, carnivorous animals, deer and experimental animals.

Successful raising of bee families, fish, carnivorous animals and experimental animals depends a great deal on their health.

In the field of fish health protection, we study some special health problems of those races of fish in our brooks together with ethiologic and pathologic changes of ill fish and diagnostic methods of fish infection and parasitic diseases. We also study parasite bee diseases, which cause great damage to our bee production. There has recently been a great increase in carnivorous animals in economically developed countries, especially in urban and suburban vicinities. This brings to light some new health problems. We must study cardiologic diseases, cancer, improve oncologic diagnostics and find new ways of cancer therapy.

V - Study of economic models of different agricultural orientations

Essential factors of the agricultural economy, their mutual influences, and suitable economical models are all studied. There is a special emphasis on the microeconomic view, which serves as a direct model analysis for influence of market changes (price, quantity) and influence of technological parameters on production effectiveness.

The growth rate of the agricultural population and the magnitude of production are the most evident indexes of agricultural development. With 9% of agricultural population, Slovenia enters that phase of social-economic development which demands larger substitution of human labour by knowledge. This research project wants to find out the best input-output ratio in different agricultural branches and different production directions according to natural sources, market demands and the need for better productivity and higher production.

Agriculture has a special social meaning and as such it has a great influence on economic stability and its development. The change of autarchy in the market economy brings about some new economical facts which have, beside planning, a very important motive in agricultural activity. An economic view of production processes demands a constant development of knowledge, renewing of technology, saving and concentration of basic productive means. Searching for a new economic model is based on complete knowledge of conditions, in which it will be used, of technological, technical and working parameters to such an extent that a complete display of technology would be possible.