

Evaluation of Estonian Research
in Agriculture, Forestry
and Veterinary Medicine

FOREWORD

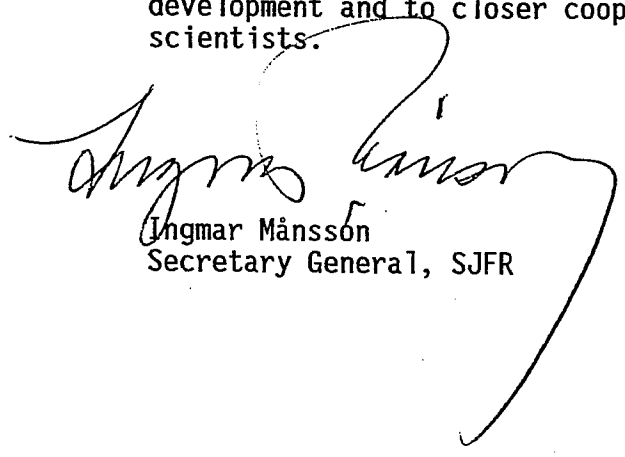
In accordance with a request from the Estonian Science Fund Council and the Estonian Science Council the Royal Swedish Academy of Sciences has coordinated the Swedish general evaluation of all research performed at academic institutions in Estonia. A special grant from the Swedish Government has made the Swedish activities possible.

The Swedish Council for Forestry and Agricultural Research (SJFR) and the Royal Swedish Academy of Agriculture and Forestry (KSLA) have agreed to organize the evaluation of Estonian research within the fields of Agriculture, Forestry and Veterinary Medicine.

During 1991 reports from Estonian scientists were submitted to SJFR. The reports were then distributed to a group of 11 Swedish specialists in different scientific areas. In total about 20 Swedish scientists have been involved in the evaluation. The group visited Estonia in 1992 to discuss the research performed and the plans for future activities. Furthermore information on the working conditions, experimental facilities, laboratory equipment etc was obtained. The visits to institutes etc in Estonia were organized in close cooperation with Estonian scientific organizations and were very successful. The Swedish group is very grateful to the Estonian scientists for their willingness to take part in open and creative discussions. All practical matters in connection with the visit of the Swedish group to Estonia were handled in an excellent way in spite of the difficult times in the country.

SJFR and KSLA also want to thank the members of the Swedish scientific group for their enthusiasm and willingness to take part in the demanding evaluation work.

Last but not least a sincere hope is expressed that the Swedish evaluation report of the Estonian research in Agriculture, Forestry and Veterinary Medicine will contribute to further positive development and to closer cooperation between Estonian and Swedish scientists.



Ingmar Månsson
Secretary General, SJFR

C O N T E N T S

	page:
I. INTRODUCTION	1
II. GENERAL BACKGROUND	2
III. GENERAL ASPECTS	5
IV. EVALUATION REPORTS OF ESTONIAN AGRICULTURAL RESEARCH	19
IV.1 Estonian Research Institute of Agriculture and Land Improvement	21
IV.2 Institute of Experimental Biology of the Estonian Academy of Sciences	51
IV.3 International Plant and Pollution Research Laboratory	57
IV.4 Estonian Agricultural University	59
IV.5 Estonian Forest Research Institute	105
IV.6 Tartu University	113
IV.7 Estonian Research Institute of Animal Breeding and Veterinary Sciences	115
IV.8 Estonian Agrobiocentre	139
IV.9 Tallinn Technical University	147
IV.10 Institute of Zoology and Botany	149
IV.11 Tallinn Botanic Garden	151
ANNEX I: Program for the Evaluation of Estonian Agricultural Research (June 25-July 1 1992)	
ANNEX II: Organizational scheme	

I. INTRODUCTION

At the request of the Royal Swedish Academy of Science the Swedish Council for Forestry and Agricultural Research and the Royal Swedish Academy of Agriculture and Forestry have carried out an evaluation of Estonian Research in the areas of Agriculture, Forestry and Veterinary Medicine. The evaluation has been made by a group of specialists in various fields, according to the following:

Crop science	Prof. Lennart Kåhre, Prof. Vilhelm Umaerus
Soil science	Prof. Jan Persson
Farm mechanization	Prof. Nils Möller
Animal science	Prof. Jan Rendel, Prof. Hans Wiktorsson
Veterinary science	Prof. Ingmar Månsson, Prof. Stig Einarsson, Res. Ass. Bengt Larsson
Forestry	Prof. Harry Eriksson
Economy	Prof. Bo Öhlmer

Chairman of the group was professor Ingmar Månsson. Mr Tord Eriksson of the Royal Swedish Academy of Agriculture and Forestry, Mr Christer Hoel and Ms Eva-Maria Ohlsson from the Swedish Council for Forestry and Agricultural Research were responsible for the planning, organization and practical arrangements.

The group had to evaluate approximately 100 reports from various institutes, laboratories etc. As the written reports were sometimes not very detailed and often in Russian, it was decided to complete the information by visiting the institutes and laboratories in Estonia. The visit also gave good possibilities to meet the scientists.

The group visited Estonia between June 25 and July 1 1992. The program is to be found in Annex I. The visit included institutes, laboratories, experimental stations and farms, of which the main ones according to the following:

- Estonian Research Institute of Agriculture and Land Improvement (Saku)
- Institute of Experimental Biology of the Estonian Academy of Sciences (Harku)
- Estonian Agricultural University (Tartu)
- Estonian Forest Research Institute (Tartu)
- Estonian Research Institute of Animal Breeding and Veterinary Sciences (Tartu)
- Tartu University (Tartu)

During the visit to Estonia, professor Loit Reintam from the Agricultural University in Tartu gave guidance and assistance to the group.

II. GENERAL BACKGROUND

Agriculture is and has been very important for the Estonian economy. To be able to provide the population with foodstuffs without having to increase the import, the production level has to remain at the present level. The agriculture is so far oriented towards large-scale units.

As the industry developed, the subsidies to the agricultural sectors increased. Several collective farms were reorganized to state farms and incorporated in the state budget.

As a result of the strict command economy, the Estonian agriculture is very specialized. The structure is one-sided and directed towards meat and milk production. As a consequence of this, Estonia is very dependent on grain imports.

Estonian Agriculture

The agriculture is today in a severe crisis. During the last two years the number of cattle and pigs has decreased substantially. According to the prognoses, the meat production will fall to 50 % and the milk production to around 60 % of the figures for 1990. In 1990 the meat production was 219,000 tons and the milk production 1.208,000 tons.

In 1990 total sown area in Estonia was 926,000 ha.

The number of cattle in Estonia in 1990 was 758,000 cattle of which 281,000 were milking cows (the milk productivity was 4 170 kg/cow). Pigs and poultry amounted to 960,000 and 6.536,000 respectively. The egg production was 546,000 eggs.

The Estonian Economy

The former centrally planned economy is now being transformed into a market economy. It means a shift in the way of thinking and acting within economics. Prices are going to be determined by supply and demand. The level of supply of various products depends not least on the profitability. The level of demand depends on the consumers' needs, alternatives and amount of money. The level of investments depends on the producers' expectations about future profitability. There is uncertainty about the future prices, i.e., a price risk as an addition to the earlier production risk. Initiatives are not coming from a centralized organization but have to be taken by the individuals.

It takes time to learn the new way of thinking, the new concepts and theories and the new way of acting. The researchers and teachers should lead the shift to the new system. The researchers should identify the new important issues and produce the new knowledge needed by politicians, teachers, producers, agribusiness etc.

Estonian Forestry

Before World War II about one third of the total value of the export came from the timber, pulp and paper industries in Estonia. Today this share has declined to about 9% of the total industrial output from Estonia.

On the other hand the total forest area has increased to 1,8 mill ha with a potential area of 2,4 mill ha, corresponding to 53% of the total land area of Estonia. About 50% of the forest area is moist due to the flat terrain and 25% of this area has been drained.

Many of the forests were clearcut during WWII and the old forests are replaced by self-regenerated mixed forests. The forests are today in average very dense due to postponed thinnings. Today the mean volume is 143 m³ per hectare, representing a high figure in comparison to Scandinavian conditions.

The annual increment ought to be 5-6 mill m³, according to a rough judgement. Annually only 2-3 mill m³ are harvested and some years much less. This means an increase of the total crop and a real possibility to increase the cuttings without any risks for a reduction of the total forest yield. The reasons for this under-utilization of the forests are many e.g:

- labour shortage
- low wages
- inadequate equipment for logging operations
- low lumber prices
- increasing share of small-dimension wood and deciduous species.

Forests represent a renewable resource and they ought to become a much more worthwhile base for the Estonian forest industry in the future. There are many indications emphasizing that the potential of the Estonian forests has not been fully utilized and that there ought to be good possibilities to increase the importance of the forests and the forest products in the Estonian economy.

To obtain this goal research and education dealing with forestry and forest industry will play an important role.

Also heavy investments in modern industry plants e.g. sawmills and pulp and paper mills must be highly emphasized. If this is not performed, the basis for forest management measures will be unclear.

The allocation of resources to different fields in the society is of course a difficult matter to handle especially in an economy entering a market system.

Nevertheless there seem to exist an imbalance between the funding to forestry including forest industry and other agricultural businesses in respect to their potential values for the Estonian economy in the future.

The present situation

The situation for the agriculture is so severe, that Estonia is approaching a situation where its own agriculture no longer can support the country with even basic foodstuffs.

The most important reasons for this crisis are that:

- the import from other former soviet republics of important agricultural products has fallen sharply;
- the system of distribution has collapsed;
- the inflation is very high;
- the technical conditions in the agriculture are bad; and the political instability has led to a slow decision-making procedure.

The Estonian Ministry of Agriculture is aware of these things and says that only a fast and thorough reform can prevent the crisis from becoming even deeper. In their report to FAO, they say that such a reform, which partly has already started, should include the commitments to:

- return expropriated properties
- privatize collective and state farms and reorganize them to private ones
- change the administration and leadership in rural areas
- reinstate the cooperation in rural districts

The organization of Estonian agricultural research

The financing as well as the policy of Estonian research has until 1990 been done mainly from Moscow. In agricultural research the financing of the Agricultural University was done directly from Moscow and for the institutes from the Ministry of Agriculture or from the Ministry of Forestry respectively. The research policy was complicated but mainly formed in the institutions themselves.

Since 1991 the financing of research is done through a Research Fund, which gives money to research through the Estonian Research Council. In 1991 a total of 64.88 million roubles were distributed to all disciplines of research. Out of these 11.37 million roubles went to agricultural research and 1.04 million roubles to forestry research.

The Estonian Research Council also coordinates the research in different disciplines.

The Academy of Sciences which is subordinated to the Research Fund decides over its Institutes but is not much involved in Agricultural research.

A plan of the organization is attached in Annex II.

III. GENERAL ASPECTS

Agriculture is a very important sector for Estonia. The level of production should be retained at the present one to provide the Estonian population with food.

After World War I most of the sown area was owned by private farms. In 1940 when Estonia became part of the Soviet Union the number of family farms was around 140 000. The state farms were low in number. Some years later the Soviet Union started to build up collective farms. In 1947 the number of collective farms was 58. In two years this figure was more than 10 times higher, that is 641. In 1949 80% out of the rural population was involved in collective farm activities. Estonian agriculture became a specialized industry directed towards meat and milk production. Grain and vegetables were imported.

Estonian agriculture is today in a severe crisis. The number of cattle and pigs has decreased, the meat production is expected to be reduced by 50% and the milk production by 40%. The Estonian agriculture also has to consider more than earlier the quality of its products and also the negative effects of the production on the environment.

The Estonian centralized economy is being transformed into a market economy. The centrally planned research activities will be replaced by Estonian initiatives and the costs for the research will also be covered by Estonian money.

The evaluation group has identified some problems common to a number of research activities within the area of agriculture, forestry and veterinary medicine. Most of them might have been caused by the way of planning and doing research which has been dominating in Estonia during the last fifty years. Some of them will be mentioned in the following.

Estonia has been more or less isolated from western Europe for about 50 years. We believe that a long term success of Estonian agriculture, forestry and veterinary medicine will depend on the maintenance of strong and close international relations. We therefore also believe that much higher priorities than at present should be given to improve the contacts with the international scientific community. To be able to do so we think that everybody taking undergraduate training in Estonia must learn at least one western language (English, German etc). Scientists should aim at publishing their papers in international journals, especially if the activities have been made within the area of basic science.

Estonia has today a great number of research groups working at the university and at different institutes. It might be questioned whether it will be possible from an economical point of view to keep all institutes going and, what is more important, to keep the activities at a good scientific level. On the other hand it seems to us that some institutes or equivalent bodies should be kept to do applied research of good quality and help to guarantee that basic knowledge will as soon as possible be adapted for practical application.

We believe that in the near future there will be difficulties to recruit well trained, good and experienced scientists to the institutes. We also believe that an improved scientific cooperation between institutes and the agricultural university is of vital importance. A close cooperation will have a positive effect on the post-graduate training and increase the national mobility of importance to broaden the post-graduates experience.

The number of teaching hours at the Estonian Agricultural University (EPU) per senior scientist/teacher is presently very high (in the order of 600-1000 hours). For instance the teaching load for staff in the Department of Soil Science is on average (1985-91) 820 hours a year. This was said to be due to the combined shortage of suitable text books and teaching staff.

The evaluation group also believes that a radical reform is needed of the post-graduate training in agriculture, forestry and veterinary medicine. First of all national and international mobility must be encouraged.

The evaluation group did not have time enough to carefully study in what way money is given to the agricultural university and the different institutes. However, the experience from Sweden and other countries is very clear: It is important that the way of funding is effective. If the same type of scientific activities are funded from different sources at the same time as there is a great physical separation between the institutes and the agricultural university the situation might be critical and influence in a negative way, closer fruitful cooperation.

We also got the impression that a great proportion of the scientific activities could be found within the area of applied research. More broader basic knowledge is needed as a basis for future agriculture, forestry and veterinary medicine. From this point of view a closer cooperation between the university and the institutes is recommended. The group also wants to recommend a better cooperation between scientists in the area of agriculture and forestry with scientists in disciplines like plant physiology, plant breeding, biochemistry etc at the Tartu universities and at universities in other countries too. A close cooperation between scientists within the same discipline is stimulating and fruitful!

With only a few exceptions the equipment of the laboratories was not satisfactory. We realize the costs and the need for a long term planning to buy new or repair already used equipment. We also think that due to the more and more expensive and advanced equipment needed, it will not be possible to give good and effective equipment to all laboratories. Even from this point of view a concentration of the laboratory activities seems necessary.

To sum up, the evaluation group had the pleasure to meet a great number of good and devoted scientists. A better scientific environment should however in the long run be created. We recommend Estonian authorities in research and in administration (management, ministries etc.) to work out a long term plan which as far as we can see should consider the following:

Will Estonia be willing and able to give a high priority to agricultural research activities?

To what extent will the government be willing to give core funding to university departments and institutes? Money for research should in addition be given to research councils and the scientists should write applications to receive money from the councils. Only applications of the best international quality should be accepted. Money might be used for scientific projects, for post-graduate training etc.

What could and should be done to improve a closer cooperation in research and in post-graduate training between institutes and the university departments?

What steps should be taken nationally and also internationally to promote the post-graduate training?

Further remarks from the evaluation group follow.

Crop Science

Present research

The present crop research projects in Estonia can roughly be grouped as follows:

- Those, which are more theoretical and/or dealing with analytical methodologies. Examples:
Meristem culture technologies at EVIKA.
Mutation breeding at the Estonian Academy of Sciences at Harku.
Studies on endogenous viruses in plants at Harku.
Pheromone communication at the two Universities in Tartu.
Geographical information systems at the Estonian University in Tartu.
- Those, which are related to plant introduction and/or practical breeding. Examples:
The introduction of *Galega orientalis* (Lam.) as a new fodder plant at the Estonian Research Institute of Agriculture and Land Improvement (EMMI) at Saku.
The plant breeding at Jõgeva (EMMI).
The fruit and berry breeding at Polli (EMMI).
- Those, which involve applied research to find optimal input combinations. Examples:
Variety testing of different crops often in combination with different fertilizing, seeding rates, crop mixtures, rotations, etc. at both EMMI at Saku, Olustvere and Kuusiku, and at the Estonian Agricultural University in Tartu.

Some reflections regarding the "frontline of research"

Generally, it seems motivated to conclude that most of the scientific methods and principles applied in Estonian crop research are well known on international level e.g. the mutation and the meristem techniques. However, certain modifications and adaptations to Estonian conditions have been made.

The same can be said about the breeding activities, but, by necessity, the work is concentrated on improved plant varieties, well adapted to Estonian conditions and needs.

The many "agronomy" investigations are typical examples of applied (in some cases adaptive) research. Its validity is limited to national conditions defined mainly, but not entirely, by the agroecological and economic factors (thus a kind of national frontline). A comparison with international standards might in this case be meaningful only as to statistical design of trials, analytical methodologies and significance of conclusions.

Some well managed Estonian projects are e.g. those at EMMI at Saku and those on Grassland at the Agricultural University in Tartu.

Research publication

Firstly, fundamental Estonian crop research results should be published in international, scientific journals and results of other, mostly applied research, must reach its target audience. In this way scientific exchange, critical checking and impact of findings will be improved.

Secondly, long-term experiments must be summarized periodically to check the validity of the original aims, the suitability of the research design and to facilitate practical application of important results. Such a critical evaluation should be a provision for continued support.

Thirdly, many projects have resulted in several patents (mainly within the former USSR). A certain risk is always involved in this way of protecting results of research efforts. It prolongs the time for publication and may even exclude a research team from valuable contacts within the scientific community.

Cooperation in research

The new Director of the Institute of Agronomy at the Estonian Agricultural University, Dr. Juhan Jõudu, expressed his intention to increase the possibilities for university collaboration with all other related institutions in Estonia, and also with collective and private farms. "We must be close to each other,with one source of money". Further, he emphasized that the research must increase at the University in order to improve the education. He hoped to increase the possibilities for students to get summer practise and thesis work at EMMI stations and reversely, to involve some of their scientists as guest teachers.

Similar views were presented by the Director of the Jõgeva Plant Breeding Station, Dr. Hans Kütts, who will be the first professor in Plant Breeding at the Agricultural University.

Not least in a small country a close collaboration is necessary between research, education, extension and farming. Therefore, based on own observations and the intentions mentioned above, the future direction should mean more integrated research and more collaboration than at present. This will increase the quality and validity of results, in particular when the same research design is applied in more than one site. Closer collaboration with the Agricultural University would also stimulate recruitment of staff.

Research objectives

The new Director of the Plant Protection Institute, Dr. Märt Hanso, Tartu, declared that the direction of activities should be based more on the actual problems in the present and near future Estonia. The agricultural research must come closer to e.g. the protection of the environment, the adoption of "mild" technologies in agriculture and forestry, the problems related to the transition from large-scale to small-scale farming.

Naturally, it is up to the authorities, and to the scientific and farming communities of Estonia to decide upon which research activities are most urgent in agriculture at present and in the future. However, we would like to support the views expressed by the Estonian colleagues mentioned above. The agricultural scientists have to face the new situation.

Many of the ongoing projects seem to be well motivated, but now it would be advisable to lay down short-term and long-term strategies for agricultural research, clearly defining the most important problems in present agriculture in relation to the new situation.

In this process the Estonian Research Council which is an independent institution might be a forum for bringing together leading representatives of the Agricultural University, EMMI, the Academy of Sciences, the extension and the farming community (both large-scale and small-scale).

It seems necessary to apply a farming systems perspective as a basis for such an analysis. Then, both interdisciplinary and disciplinary programs can be organized to fit in under the agreed strategies. This will require increased collaboration, but also lead to better cost-effectiveness and further stimulate the awareness of the national needs among all parties concerned.

Promise for the future

The post-graduate students and other young scientists we met at several of the institutions were "fresh", competent, hard working and a great asset for the country. This is needed since many leading positions have to be replaced by new scientists due to retirement. A gap between generations is obvious in some disciplines.

The future farming systems need a more holistic approach and this will be a great challenge for Estonian agricultural research and farm management.

Agricultural economics

Important problem areas

The problem areas can be divided in problems of the:

- primary production,
- agribusiness,
- agricultural sector, and
- natural resources.

Primary production

Primary production problems include the problems of improving the efficiency and profitability of the farm production. Feed planning, decision support systems for crops, business planning, medium range planning, coordinating (optimizing) the production of a farm, scheduling machinery repair and development of book keeping systems are examples of Estonian research projects in this problem area. Many research groups are working in the area. Groups at the Estonian Research Institute and the Agricultural University are even working with the same problems.

Primary production problems also include the structure of production, i.e., number of farms of different sizes. There is research regarding privatization and family farms. However, there is no analysis of the optimal structure nor of the consequences of changes in the existing structure.

Motivational and sociological aspects, institutional environment of the farm, and advisory service belong to the primary production area too. The research about the motivational and sociological aspects is good. The research about the institutional environment should contain analysis of consequences for the farm and the whole sector of various institutional changes. There is no research regarding advisory service.

Agribusiness

There is good research about the economics and management of transport. There is also a need of analysis of the whole food system from the producer to the consumer. How to optimize the whole system? How to avoid losses? How to make the best use of the existing processing plants?

Often a farmer can get a higher profit from trying to get a higher price for his products (i.e., finding a better market) than from using the same amount of time on trying to improve his production. However, there is no research about marketing or market organizations within the agricultural research.

Agricultural sector

There is a group that produces statistical reports about the production results, and such reports are needed. Another group is forecasting and simulating the agricultural production, which is good research. The politicians also need analysis of the goals for the agricultural sector, various means to reach the goals, and the effects on the goal fulfilment and the farms.

Natural resources

There are environmental problems caused by agriculture and by others but affecting agriculture. There is no economic research about these problems or about a sustainable agriculture.

Knowledge areas

One dimension of the research is the knowledge needed to analyze the problem areas.

To analyze the primary production area you need:

- production theory
- investment theory (including consideration of inflation and tax)
- financial theory
- decision and management theory
- risk management theory
- organization theory
- marketing theory.

These theories were not used in the primary production research. Some groups had good research based on their knowledge about mathematics, statistics and optimization methods, but they had difficulties in the economic interpretations of the figures.

The same theories are needed to analyze the agribusiness area.

To analyze the agricultural sector area you need production theory, micro- and macro-economics, agricultural policy theories and welfare theories.

To analyze the natural resource area you need production theory, micro- and macro-economics and natural resource economics.

These theories were not needed in the former centralized planned economy. It takes time to acquire all the knowledge, but it is needed in order to avoid all the mistakes that have been done in other countries and to learn from their experiences.

Organization of the research

All problem areas should be covered with at least so much research that the researchers are able to follow the research in other countries. The research groups (or departments) may for example be:

- production economics,
- farm management,
- agribusiness,
- agricultural policy and sector analysis, and
- natural resource economics,

where the primary production is divided into the two first groups. The groups should be big enough to allow for a broad scientific environment. In order to keep the size of the research within reasonable limits, the economic research at the Estonian Research Institute and the Agricultural University can be put together. The research and the teaching should have close links in order to vitalize each other. Teaching is also an important channel for implementing new knowledge into practice.

Recommendations

The researchers need more knowledge in relevant economic theories.

The research should be enlarged as for the important research problems regarding:

- primary production - specifically the structure of production,
- agribusiness,
- agricultural policy and sector analysis, and
- natural resource economics.

The organization of the research should be revised:

- the research at the Estonian Research Institute and the Agricultural University should be put together, and
- new research groups should be organized in order to cover all the important problem areas.

Forestry

General recommendations

The recommendations given below are based on the following assumption.

Research and education in Forestry means questions dealing with

- establishment of new forests after clear-cutting or other regeneration methods
- development of forest structure under different management regimes

- effects on stand development of different treatment regimes
- different forest operational techniques when cutting trees in thinnings and clear-felling
- wood quality for different species for different industrial utilizations
- relationships between wood quality and forest management regimes (e.g. spacing, pre-commercial thinning, commercial thinning, species mixture, rotations ages, fertilization)
- dependence of seed quality and stand vitality
- the economy of different management and operational options in terms of net revenue in short and long perspective in a market economy system.

Research in Forestry

The main parts of forestry research are related to

- the use of forests for production of raw materials e.g. timber assortments; pulp wood; chips for fuel purposes
- the use of forests for other purposes e.g. the conservation of flora and fauna; landscaping; recreation.

Research in forestry ought to be focused on the following main items:

- it is essential in the first step to implement research results in forestry obtained abroad and to adapt them to Estonian conditions
- in order to be able to value results obtained abroad, there must be skilful researchers available to make these evaluations before the findings are recommended for practical use in a broad scale in Estonia.

Researchers making these judgements must have had a research background in the actual field

- there is not a need today to put priority to genuine basic research in forestry in Estonia.

Some ways to fulfil these goals are:

- to make research results obtained abroad available for researchers in Estonia e.g. subscription of e.g. well known international research magazines; research reports for the libraries
- to make it easier for younger researchers to participate in research congresses and meetings abroad

- to facilitate for younger researcher to visit universities and research institutes abroad in order to follow graduate courses there and to collaborate with foreign researchers in special research projects
- to use all efforts to be able to use modern equipment for calculation purposes (PCs with manuals); devices for automatic data collection; copying facilities; chemical analyses equipment with chemicals
- to state which research projects should be run in the future now when the former all-union Soviet research programs can be abandoned
- a more decided approach to improve forest operational technique with regard to the special soil conditions in Estonia (moisty soils); the use of economic decision making when ranking different forest measures in the forests.

Under-graduate and post-graduate education in Forestry at the Estonian Agricultural University in Tartu.

Under-graduate education

The under-graduate courses in forestry at the Faculty of Forestry are given by researchers at the three departments there. Each teacher at the Faculty has an extremely heavy educational responsibility, more than 800 hours a year, which must be pointed out as inadequate. The reason for this situation seems to be

- lack of textbooks in Estonian, so students have to take their own notes during the lessons.

This is an old-fashioned method and much time-consuming for both the students and for the teachers.

- there seem to be few teachers and those are responsible for very broad fields in different forest subjects.

This situation ought to be changed by publishing textbooks or arbitrary compendias in the Estonian language.

Another way could be to ask researchers at the Forest Research Institute to give lessons in well-defined sub-fields in forestry.

The researchers at the Faculty have little time for research due to the educational duties. This is not a situation which is regarded as favourable for the quality of the education, nor for the researchers possibilities to follow what is going on in research internationally. In comparison to other countries the Forest Faculty has few departments, even if there is a tendency today in other countries towards forming departments with a broad range of responsibility.

The direction of the education on the under-graduate level in Forestry ought to be examined as a consequence of the introduction of a market system. More attention must be paid to e.g. operational techniques in forestry; wood quality aspects originating from the demands in the forest industries and the market for forest products; forests both as a raw material resource and a resource for multiple use (e.g. conservation of flora and fauna; hunting; landscaping; recreation).

Post-graduate education

In order to enhance the interest in post-graduate studies there must be indications to the students that a scientific education is worth a lot of personal efforts. There must also be a system of graduate courses given regularly at the EAU or other universities. When the organization for the post-graduate educations has been stabilized, there must be a stimulation for the students to pass through post-graduate courses ending with a doctoral thesis and possibilities to achieve an employment afterwards. Methods to stimulate students for post-graduate studies are e.g. guidance committees; funding during the post-graduate studies; access to libraries with textbooks and international scientific magazines; possibilities to take part in international congresses and meetings; to follow post-graduate courses in other countries; participate in research projects in other countries; use of modern equipment and new research technology; to train students to publish their results in international reports.

The requirements for achieving a PhD ought to be equal to the requirements in other countries.

In recruiting skilful scientists to the universities and research institutes it is essential that the post-graduate education has a high quality and a stable organization.

In our opinion much effort must be made to reorganize the post-graduate education in Estonia.

Farm mechanization

Control of economy and technology were some of the means to establish communism. In the former Soviet political system the owner of the state farms and the research resources was the same; the state. Through the Ministry of Agriculture the agriculture engineering research was used to support and solve the practical problems on these new large establishments. Maybe the demands and the control of research and development activities have been more pronounced here than in other agricultural subjects.

New and better farm machines will be of great importance for the Estonian agriculture, for both large and small farms. Many small manufacturers plan to build farm machines and may be competitive due to lower costs than in western countries. Both food and farm machines are supposed to be sold to countries in the former Soviet Union.

There are, among other, at least three main problems in Estonian agriculture today:

- The lack of energy and the fast growing prices on energy. There is a general awareness of saving energy but almost no interest in producing e.g. bioenergy.
- Environmental concerns are concentrated to the large animal production units. The pollution problem has to be solved or the large units have to be split up in to smaller ones.
- The ownership of land and the investments in buildings etc has to be solved. No general laws in this field exist today, which hampers the establishment of new production units.

During the Soviet period large and highly mechanized units were the goal. Still several persons are talking about the optimal mechanization without paying attention to all the problems with the present machinery situation.

It is obvious that the mechanization has been too stereotype. Not the best machine for the purpose, machines of deficient quality and low maintenance standard have led to low efficiency and sometimes to loss of production.

In the new situation with a growing number of small farms many of the departments stress the importance of dealing with the small farm mechanization. However, most of them argue in a way inherited from the former system. The demands from the family farm sector can not prove all the present research activities, however important. Further there are many problems to correct also in the remaining large farms.

There is almost no basic research in agricultural engineering. Most of the activities are applied research and testing.

Due to lack of modern research equipment (instrumentation, computers) the investigations are rather unsophisticated, however in some cases with high accuracy.

The testing of farm machinery is mainly reports of experiences from machines used in practical farming.

We met only a few young people or graduate students working on a higher academic degree. Most of the research staff was aware of the situation and wanted to improve the situation. Not all of them realized that to reach western standard in agricultural engineering research will take time. However, with appropriate conditions and in narrow fields high standards may well be realized.

To create high quality research they, among other things, need to

- establish high quality undergraduate training,
- attract excellent people to research training,
- establish international contacts,
- attain an agricultural engineering library and research equipment.

The present problem of textbooks and computer possibilities should be solved.

In order to promote the development in Estonia the extension service to both large and small farms has to be revised.

Animal Science and Veterinary Medicine

The problems related to animal science and veterinary medicine are the same as in the other fields. The equipment in laboratories and institutes is poor and the general lack of resources is obvious, e.g. chemicals are difficult to obtain. The scientists have very few international contacts and often limited knowledge of English. There exists however a genuine interest in improving the international contacts.

The research institute for animal breeding and veterinary medicine (ELVI) is presently very large in comparison with animal research institutions in western Europe. The institute has large herds and flocks of farm animal and now covers areas which in non-socialistic countries normally are handled by private cooperatives (e.g. milk recording) or private or governmental services (e.g. advice to farmers). It will be necessary for the Estonian authorities to gradually reorganize this and other research institutes. Parts of them may best be incorporated in the agricultural university other parts may be privatized or handled over to farmers cooperatives. The review team cannot have an opinion about how this reorganization should take place in detail.

Soil Science

Even in the area of soil science the same problems have been identified as in several other areas. The quality of the equipment is not satisfactory and there is a documented need even to buy new equipment.

However, the Department of Soil Science in spite of the poor equipment made to us a very good impression. The theoretical questions were of western standard and the international contacts well developed. We recommend the best support available to this important area of science.

IV. EVALUATION REPORTS OF ESTONIAN AGRICULTURAL RESEARCH

page:

IV.1 Estonian Research Institute of Agriculture and Land Improvement
(Saku)

Soil and crop sciences	no. 23, 76-79(90), 80-82, 85-88, 92-94, 96-99	21
Mechanization	no. 83-84	42
Animal science	no. 89, 91, 95	44
Economy	no. SS 3-5	48

IV.2 Institute of Experimental Biology of the Estonian Academy of
Sciences (Harku)

Soil and crop sciences	no. 24, NS 49, NS 51	51
Animal science	no. 25	55

IV.3 International Plant and Pollution Research Laboratory
(Kloostrimetsa)

Forestry	no. NS 60	57
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IV.4 Estonian Agricultural University (Tartu)

Soil and crop sciences	no. 26-28, 35-41, 61, NS 58	59
Mechanization	no. 29, 31-33	71
Animal and veter.sciences	no. 42, 47, 49, 43-46, 48, 50-60	78
Economy	no. SS 12-15	101
Forestry	no. 34	103

IV.5 Estonian Forest Research Institute (Tartu)

Forestry	no. 62-67	105
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IV.6 Tartu University (Tartu)

Soil and crop sciences	no. NS 17, NS 19	113
------------------------	------------------------	-----

IV.7 Estonian Research Institute of Animal Breeding and Veterinary
Sciences (Tartu)

Mechanization	no. 4-6	115
Animal and veter.sciences	no. 1, 7, 10-12, 16-18, 3, 13-15, 19-20	120

IV.8 Estonian Agrobiocentre (Tartu)

Crop science	no. 75	139
Animal and veter.sciences	no. 68-73	140

IV.9 Tallinn Technical University

Food Science	no. 21-22	147
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IV.10 Institute of Zoology and Botany

Crop science	no. NS 2, NS 10	149
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IV.11 Tallinn Botanic Garden

Crop science	no. NS 39	151
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IV.1 Estonian Research Institute of Agriculture and Land Improvement

23. Research and application of meristem culture and microclone propagation (EVIKA)

The EVIKA Plant Biotechnical Research Centre became independent in 1991. It is working with studies and practical application of meristem cultures and micropropagation, mainly of potatoes but also of horticultural species. The centre has a sizeable working collection of 300 potato, 35 fruit-trees, 35 carnation and 30 varieties of Chrysanthemum.

The methods developed for meristem culture and micro-propagation are appropriate and stable. Propagation of pathogen-free seed potatoes is carried out in plastic rolls with peat as substrate. Meriplants are grown in open fields, aiming at a higher multiplication rate than the usual.

The Centre has developed methods for in vitro propagation of root-cuttings of fruit and berry species. This might be expanded to propagation of forestry species.

In future, further improvement of seed potatoes and development of related technology, particularly meristem culture, cell techniques for breeding, and microclonal propagation of different plant species are planned.

Comments

This new centre is under dynamic leadership, it has a half-commercial activity (sale of meriplants, methods) but also development of new techniques based on recent results in the area of biotechnology. The EVIKA-program has a key function in the national program for controlled supply of disease-free planting material of several clonally propagated species, not least seed potatoes. It has also an international reputation.

It is recommended that in first hand the national seed potato scheme should be entirely based on meristem cultures and that the following tuber generations should be carefully, officially checked both by inspection of seed growers fields and in control plots. In this way the number of tuber generations - involving risks for disease and pest attacks - can be reduced, safe-guarding both the yield and harvest quality.

76. The study of Estonian soils and soil cover

Department of Soil Science

Principal activities

A main duty of the department is to classify the soils of Estonia. A national research is necessary in that field as the soils to some extent are unique for the country and the variations are large. Some of the methods used are worked out at the department. Later on these have been used by the Estonian Agricultural Design Institute when mapping the soils of Estonia.

Studies concerning urban effects on soils are included in the program: acid rain, compaction, liquid manure. When characterizing soils the Russian system is used. The work of the department is to a high degree performed in the field. Field trials are in common with other departments.

Because of lack of money the staff is very limited at the moment. Therefore it is necessary to give priority to a small number of projects. The head of the department declared that one must take into consideration what is important, what technical resources are available, knowledge at the department and possibilities for collaboration. At the moment iron chemistry of soils is one preferential subject.

Staff

At the moment there are only 3 scientists working at the department.

Equipment

The equipment of the department is weak. Chemical analysis have to be done in service laboratories.

Evaluation and recommendations

Characterizing soils is important as a fundament for different applied sciences. Such work is performed also at the University of Agriculture at Tartu.

The main tool of the department is the field experiment. Our experience of the field experiment at different departments are that they are well performed and also an important part of the research.

There are many ideas at the department but the activity is restricted by a too small staff. Such a small staff may also restrict the scientific atmosphere and the exchange of ideas. It is possible that this can be overcome by putting together two or more departments at the Institute.

77. Improvement of the basis for drainage projects

Section of Land Improvement

Based upon scientific investigations, the main objective is to work out regional recommendations for designing tube draining systems. Investigations are mainly carried out as field experiments close to practical conditions, the section is working with mineral soils as well as organic soils. When performing investigations local climatic, soil, hydrologic and economic conditions are taken into consideration.

An important task is to give recommendations concerning drain spacing. On the basis of results from a number of European countries the relation between drain spacing and average yield has been described - European standard of drain spacing.

The results are often formulated in mathematical terms, for instance the relation between drain spacing and average yield. The report contains a number of equations, some of them not used by us. The equation concerning potential evaporation does not take the wind speed into consideration. That is questionable.

Investigations have also been performed concerning filter cover of tubes - sawdust and straw. Also irrigation experiments are included in the research program.

A number of meetings have been organized.

Staff

The staff includes 14 researchers, 5 of them have finished cand.sci.

Equipment

The instrumentation is weak.

Evaluation and recommendations

There is a good knowledge at the section around drainage and water movement in Estonian soils. The section has an important task in giving guidelines concerning drain projects. Land improvement projects are actual and need regional investigations in Estonia as long as agriculture exists. Therefore activities performed at the section should remain in the future. But the equipment should, if possible, be improved. Basic soil physical research should be given priority. Especially processes related to urban activity should be taken into consideration. Collaboration with the Agricultural University in research and in educating young researchers is recommended.

78. Elaboration of the balanced and economically well-grounded bases of the use of fertilizers

Department of Agro- and Radiochemistry

The program of this department is very broad. Plant nutrition is a main task. The activity is highly applied and "close to the farmers".

The program involves research on macronutrient, micronutrients and organic manure. Nitrogen fixation by legumes is investigated as well. The department is engaged in soil mapping. Soil mapping is a fundament in extension service concerning fertilizing. All soils in arable land are sampled once every six year.

The department is also aware of ecological problems which have been a result of urban activities. Liquid manure is subject to different investigations.

Testing new fertilizers and soil amelioration substrates is an important part of the activity.

The main method used is the field experiment. But also pot experiments and lysimeters come to use.

Although the applied research is dominating, there are more fundamental investigations at the department. Thus isotopes have been taken in use for some investigations. Phosphorus, nitrogen and to some extent selenium are involved in those investigations. A PhD student from the Agricultural University is working with selenium at the department.

Staff

There are six academically educated persons working at the department.

Equipment

The equipment is weak. There are, however, instruments for determining radioactive as well as stable isotopes.

Teaching

One PhD student from the Agricultural University performs his thesis at the department.

Evaluation and recommendations

The research is mostly applied. The main aid is the field experiment. The experiments are well kept. This empirical research will be of great value for the farmers still for many years. However, it is very important that the fundamental research can continue and if possible increase. It is a source for renewal and academic thinking which is necessary in a scientific department. International contacts should be stimulated.

79/90. Breeding, improvement, agro-technology and fodder quality of the new fodder plant goats rue (galega), Galega orientalis Lam.

Goats rue has been introduced as a new fodder plant, but also to improve soil fertility and to resist soil erosion. After establishment, the crop has several years' duration. Appropriate cultivation methods have been tested and the fodder value at different development plant stages has been determined both for silage and hay and with grass mixtures.

The future seems promising for this crop as a complement to other herbage legumes. It might be tested and used also for other purposes. Future work is planned for further selection, improvement of cultivation techniques and solving problems in livestock feeding.

Comments

This project is unique and should continue due to its interesting potential. It takes time to get a new crop introduced and adapted to the different agroecological conditions and uses in Estonia and elsewhere. The continued activities should involve also adaptive research on selected family farms. The program has a good research team, which seems appropriate for refinement of present objectives and development of new application areas. Special attention should be paid to the fodder value and balance in mixture with grasses.

80. Elaboration of scientific ground for rational tillage systems on cultivation of field crops

Kuusiku Experimental Station

Group of tillage and rotations of crops

Principal activities

The work is concentrated around practical soil management problems. The main instrument is the field trial. The research is very applied and has an empirical character. Several practical soil management problems have been worked up: Time for plowing, deep management, sub-soiling, effects on weeds, oil consumption etc.

Evaluation and recommendations

The field experiments are well done. Presumably valuable results for the farmers have appeared. In the future there is a need to complete the field trials with experiments which can explain the results in a more exact way. Different analyses will be necessary: Soil physical analysis, soil chemical analyses, determinations concerning germination biology etc.

There is a will to increase collaboration with other departments in Estonia and abroad. That is promising.

81. Elaboration of structure effective sowing areas and system rotation of crops in intensive cultivation for different soils and producing areas of Estonia

Four types of long-term rotations of crops at Kuusiku Experimental Farm have been studied since 1967 on different soils and with application of various fertilizations. A number of conclusions have been drawn from these interesting experiments.

The future is planned to take up different green fertilizers on fallow in the rotation and more detailed study of tillage, mineralization and fertilization in rotations combined with ecological agriculture. Further, the product quality will get more attention as also economizing of resources and low costs.

Comments

This long-term experiment has given valuable results. However, for different reasons the necessary scientific publication of results and conclusions achieved in the past 25 years has not been done. This is now a must. In this context and also for the future it would be interesting to look closer into also the pathological and other quality aspects in e.g. monoculture of crops like potatoes at different applications of fertilizers. The constraints and possibilities of family farming should be further considered. Contacts with related research at the Agricultural University (projects 36 and 38) would promote possible collaborative actions and stimulate the research environment. A small advisory panel with representation of some leading, relevant scientists and farmers would be fostering desirable teamwork and linking research, education, extension and farming closer in a two-way communication process.

82. Formation of yields and their quality of barley varieties depending on the seeding rate and mineral N fertilizer

The aim of this project is to study the response of new barley varieties to different seed rates and N levels, to estimate the economical output and to meet ecological demands. The yield amount and quality is being determined for each combination, the efficiency of "Kemira" fertilizers is a special objective for the trials.

Up til now 21 conclusions and recommendations have been made.

Comments

This investigation has already given a substantial amount of information. Again, it is necessary to summarize the experiences gained from 1966 in a scientific publication. This must be done before decision will be taken as to the future of this work. In addition, the Department of land tillage at the Estonian Agricultural University has a project, which partly covers the same area (project 37). It seems necessary to coordinate these two projects. In this way better use of available resources and safer results would be achieved. Therefore, close collaboration between the two research institutions is recommended for planning and performance of future, related investigations.

85. Plant breeding and varietal improvement of potatoes and vegetables

Breeding of potatoes and vegetables (like tomatoes, onions, beans, peas) has a long record in Estonia. In recent years three new potato varieties, one tomato and one garden pea variety have been launched from Jõgeva Plant Breeding Station and widely used.

Disease resistance under field conditions, in addition to high yielding capacity and good crop quality, have been obtained in different respects in the latest varieties. - In the near future a potato chips industry will be established in the neighbourhood (collaboration with Denmark).

The future breeding aims at developing i.a. nematode resistance in high yielding and high quality potatoes. Maintenance breeding and production of breeders seed will be continuously strengthened.

Comments

These breeding programs have high quality, good leadership and are sound and should receive full support. The breeding targets correspond to the required development of Estonian production and consumption of both potatoes (the "second bread") and vegetables. The research methodologies are appropriate. In the future, more international contacts will be of mutual benefit.

With reference to the report on EVIKA (No 23, page 21) it is essential that the close collaboration between the two organizations will be continued and that all newly approved potato varieties will be multiplied and put on the market in a healthy condition and under strict control.

86. Plant breeding and varietal improvement of fodder crops

Plant breeding of the most common herbage species started more than 70 years ago and has resulted in a number of varieties. Some examples: In the last five years one new variety of each lucerne, perennial ryegrass and red clover have been put in final value testing. One variety of each red fescue, timothy and white clover came on the recommend list and another timothy variety was mentioned as promising. Production of elite and breeders seed has been made at the station or under its supervision in close collaboration with the nearby state farm. In the near future some new varieties of 4 n early red clover and smooth stalked grass will be tested in state trials. The main breeding material of fodder crops will be further developed and tested in the coming years.

Comments

Considering the importance of animal production in Estonia great emphasis must be put on breeding and production of fodder crops. Therefore, this programme is important and should be supported.

Breeding of fodder plants is difficult. However, this competent section of the Jõgeva station has made substantial contributions to the fodder crop improvement and has interesting breeding material under way. The new lucern hybrids suitable for grazing after some three-four (even two) years are of special interest. The variety specific fertilization will be further elaborated in complementary, applied research. Here collaboration with the Experiment Stations at Saku and Kuusiku as well as the Agricultural University in Tartu would be helpful for division of work and concentration of specialized efforts on agronomy and plant breeding respectively.

87. Plant breeding and varietal improvement of cereals and pulses and breeders seed production

Jõgeva Plant Breeding Station has a considerable breeding program of cereals and pulses. Their varieties are dominant in Estonian cultivation of winter rye and pulses, and considerable of oats. Barley varieties are increasingly coming from Jõgeva. In the last years six new varieties of this crop have been included in state trials. Some of them are already released.

The production of breeders seed in the period 1985-1990 was highest of barley, followed by winter rye, winter wheat, oats and pulses.

Some important targets in the coming 20 years, a natural perspective for plant breeding, will be:

High yielding varieties with good straw-stiffness and disease resistance in barley; earliness, and rust and nematode resistance in oats; stable yield, straw-stiffness and winter hardiness in winter rye, improved varieties in winter and spring wheat etc.

Comments

This work has brought good results, and is well responding to the needs of Estonian agriculture because e.g. the winter hardiness of foreign varieties of winter rye and winter wheat has not been sufficient.

The possibilities for growing more wheat should be explored and, accordingly, the breeding of this crop should be strengthened. The possibilities for cultivation of Triticale and winter barley should be further explored.

Existing collaboration with the Nordic countries and, in respect of Triticale, with Poland should be further developed.

The Jõgeva Plant Breeding Station (general conclusions)

A short summary of the tasks, staff and organization, information on new varieties and a table on the utilization of varieties used in practise in 1989 and 1991 (not only Estonian varieties) were presented.

A general impression is that this station, under its dynamic leadership, has a dedicated staff working in a positive spirit. The staff composition shows a fair distribution of ages.

The plant breeding activities at the station are completed by production of breeders seed at the nearby state farm. This symbiosis is practical and has facilitated the financial management for both. The technical supervision of the initial seed multiplication is also easy, due to the neighbourhood.

The station has good facilities both as to fields, houses and equipment. The timely purchasing of machinery for sowing, harvesting, drying, cleaning etc has meant that the station has only very limited demands for up-grading in this respect for the next 4-5 years.

The director will take up the first chair in plant breeding at the Estonian Agricultural University in September, still keeping the leadership of the breeding station. His intention is to strengthen the collaboration between the two institutions. That would increase the opportunities for students at that university to do investigations on breeding and also stimulate guest-lecturing by the Jõgeva scientists.

As to publications it is interesting to note that almost all references listed in the Jõgeva reports (85-87) have summaries in English.

The plant breeding activities are in line with the main demands for Estonian agriculture. In respect of e.g. resistance breeding it would be desirable for the station to get involved in more research work.

The conclusion is that this breeding station merits full support. It has a key function for Estonian food and feed production.

88. The elaboration of agrotechnique of potato growing and storage technology. The influence of research methods upon the basic indicators of table potato.

Potatoes are the "second bread" in Estonia and here potato research has a long tradition, all from the time of the well-known Dr Julius Aamisepp.

In the past five years the influence of different potato varieties and fertilizers on yield, tuber quality and storage has been studied at Saku and followed-up in practical farming. Since two-three years different seed preparations have also been tested.

The future of the project is planned to deal with

1. growing techniques in both large- and small-scale production.
2. fertilizer influence on yield, nutrition and storage
3. storage conditions
4. pre-sprouting and thermoterapic shock
5. use of small seed tubers.

Comments

This project is important and should be strengthened. The research intention to adapt methodologies also to small-scale farming is vital. The staff behind this project is very competent and the field experiments are well performed. Therefore, the project is in good hands and should be supported.

If possible, this experiment should be duplicated in some other part of Estonia e.g. at Jõgeva. The linkages to the Agricultural University should be strengthened to increase the transfer of knowledge and in this way to promote development of potato research and education.

Scientific exchange not least between Estonia and the Nordic countries should be further stimulated.

92. Growing of legume crops and oilseed rape for protein supplements and dietary fats sources.

So far, only imported plant fat has been used in Estonia. This project is exploring the possibilities for growing protein rich fodder for self-supply, namely of peas, field beans and rape. It started about ten years ago.

Newer varieties have been received from other countries in Europe to be tested under Estonian conditions. The studies aim also at improving related agrotechnology. In the coming years the Estonians are likely to demand more protein and fat from plants. At the same time soil fertility and crop balance in Estonian agriculture will be more and more essential.

Comments

It is important that Estonia explores the possibilities for self-supply of vegetative protein and fat, and that its agriculture be sustainable through suitable crop rotation and diversity.

The research group at Saku has good ability for this type of applied experiments as manifested in experienced staff and well-managed field plots. On this total background, this project should be supported.

It should be coordinated with the project on agrotechnology of rape at the Agricultural University in Tartu (project no 40).

93. Liquid manure application on grassland: the effect of fertilizing on bottomland meadow yield

Group of Pasturing Studies

Principal activities

Large amounts of liquid manure are produced in Estonia. Furthermore, the manure is unevenly distributed over the country. There are at least two grounds why the liquid manure is of fundamental interest in Estonia. Because of economic reasons it is an urgent task to use the manure in an efficient way and environmental problems in connection with manure use must be avoided. Many institutes and departments in Estonia are working with liquid manure but they have different aims. At Kuusiku the effects of differently treated manure on grassland yield and quality are studied. Soil analysis are hardly included in the project. The experiment is performed as a small-plot field trial. The different manure qualities are quite different what concerns nutrient content. Probably this is not mainly an effect of the treatments. It is rather an effect of the fact that the manure is taken from different animal stocks. Probably the manures have been diluted with water to a different degree. It is likely that the "weak sewage" has lost ammonia as a consequence of the treatment. As an example, 30 ton/ha of manure contains between 46 and 0,3 kg/ha of ammonium nitrogen.

The botanical composition of the harvests are determined in a careful way. Determination of hay and silage quality is included in the project.

Evaluation and recommendations

The field trial at Kuusiku is well kept. It is managed by a young and enthusiastic researcher. Competence and field resources seem to be suitable for continued manure experiments. Equipment for analysis is not satisfactory. However, it is doubtful if the effect of differently treated manures is the most urgent problem. The large differences in nutrient content (depending on other causes than the manure treatment) make the results difficult to interpret. Besides, it is difficult to continue the trial because of transport problems. The field trial should be supplemented with soil analysis. Furthermore, the liquid manure should be analyzed before starting the treatment (aerobic and anaerobic respectively). In addition to the nutrient content the dry matter content should be determined.

Cooperation with other institutes working with other aspects of liquid manure should be initiated. This will make it easier to get a total view of the manure problem: effects on harvest, soil and external environment.

The effect of fertilizing on bottomland meadow yield.

Principal activities

A long-term field trial was started in 1956. The experimental plan includes different fertilizer regimes. Manure is also included. Harvest, crude protein and botanical composition are determined. The yield increases are large as a consequence of PK-fertilizing.

Evaluation and recommendations

The experiment is well kept. As a rule long-term field experiments are valuable as soil changes as well as interaction between crop yield and soil status can be studied. Because of that soil analysis should be performed to a much higher degree.

P and K are linked in the experimental plan. Therefore, it is not possible to distinguish between the P-effect and the K-effect. This is important as the PK-effect is so large. It can be done in complementary trials, e.g. pot experiments. It is not proved that the best NPK combination is 60, 39 and 100 kg/ha respectively as that is the only alternative that was tested.

All experimental data should be put together if this has not been done yet. After that it is possible to make a decision concerning the continuation of the experiment.

94. The baking qualities of wheat grain in Estonia and their dependence on species, growing place and agrotechnology.

The aim of this project is to study the opportunities for growing bread wheat in the country. Results are not yet available, since the working group was established only a year ago. Earlier studies go back to the 1920s-1930s. As yet, there is no cereal laboratory at disposal and the staff is limited.

Comments

This is an important area, which must be supported, because Estonia needs more bread wheat from its own production. Adapted varieties of both winter and spring wheat should be tested in combination with appropriate cultivation methods.

A good start has been made at Saku, whose research team should strengthen the linkages with the wheat breeders at Jõgeva and Olustvere, which partly have similar experiments. This project must deepen the studies of the most essential baking quality factors and make own baking tests. Establishment of adequate facilities must receive high priority. A cereal laboratory, central for Estonia, is needed for research, control and prognosis. Collaboration with e.g. Finland and Sweden could be of value.

96. Control of insect pests, diseases and weeds in agricultural crops.

The main diseases, pests and weeds in the major crops are the objectives of this program. The present aim is to develop an integrated plant protection system. Field observations have been made to determine weed occurrence as a basis for rational crop rotation, effective tillage and appropriate use of herbicides.

The frequency and pathogenic influence of the major microfungi on cereals and potatoes have also been studied as well as the action of different fungicides. New types of pesticides have been synthesized and tested on greenhouse cultures. Aphids, thrips and ear leucochroism on cereals and seed fields of grasses respectively have also been studied. The future research will be aimed at improvement of integrated plant protection methods. Research on agricultural systems in small-scale farming in order to achieve sustainable production and to safeguard the environment is planned.

Comments

Integrated plant protection is vital in a sustainable agriculture. Due consideration to residual substances in soil and plant products must be paid. A certain concentration of the scope of the investigations is recommended. The section "Plant Protection" has a key function within the Institute (EESTI) with its own responsibilities of pesticide control, development of non-chemical methods, extension service (diagnosis, prognosis and warning, information) as well as service to other programs of the institute and its experimental stations. The staff is limited and virology, bacteriology and nematology is not represented within the section. It seems necessary either to increase the number of scientists or to find constructive ways of cooperation with personnel at the Agricultural University, the Academy of Science and specialized institutions e.g. EVIKA.

97. Fruit and small fruit breeding. Apple rootstock breeding

Polli Experimental Station started to work in horticultural species in 1945. The fruit breeding program today includes sweet cherry, pear, apple, plum, small fruits (currant, strawberry, raspberry, gooseberry) and rootstocks.

The apple breeding has been most successful, but good progress has been achieved also in plum, pear and raspberry. Resistance breeding has high priority as well as good storability of the harvested fruits and berries. - A reduction of staff is expected to bring breeding of raspberry and gooseberry to an end. More international cooperation is a desire. The collaboration with the Agricultural University is good (practise and taxonomic work). Plant production according to the EVIKA meristem methodology is used as a routine in several species.

Comments

This programme is important for both the large-scale and the small-scale growers in the Baltic region. The breeding has high quality. This station keeps impressive genetic stocks and must receive high priority for future support.

The industrial fabrication of juice, jelly, jam etc from fruits and berries such as apple, plum, Aronia, black currant and raspberry would be further stimulated in Estonia. Already, a certain export exists and its potential expansion should be explored.

Under the aegis of the Nordic Gene Bank a close network has been established between the fruit-breeding institutes in Denmark, Finland, Iceland, Norway and Sweden. Contacts for collaboration would be of mutual value.

98. Investigation of regulation of plant-microbe association for stable agricultural production of high quality

The influence on yield and quality of grass and legumes by microorganism is being studied. The present work deals with nodule bacteria on legumes and microfungi on grass and legumes. The crop seed is inoculated by cultures of such growth stimulating organisms. The wider studies involve plant diseases and plant protection. A huge number of microfungi are found, on grasses about the half are parasitic.

Comments

The work on stimulating root microbes is of great interest and has a potential for establishing more biological and less chemical cultivation methods, not least in small-scale farming. This research work should receive support.

Considering the wide scope of the investigations of the microflora on Graminea and the limited staff, it seems necessary to concentrate and focus on the most important parasitic fungi, bacteria and viruses, causing major diseases in Estonia. The total number of species found on cereals and grasses present very little understanding of their beneficial or deleterious effects unless each is individually studied.

Scientific exchange e.g. visits by post-graduate students from the Agricultural University in Tartu and from abroad should be of mutual value.

99. The agrotechnique and breeder seed growing of flax

Like Sweden, Estonia had a considerable flax production 60-70 years ago. Now, Estonia has three large processing factories for flax. Only eight per cent of their capacity has been utilized by national production and the rest brought in from outside.

This project started four years ago, as according to information received motivated by a growing demand for natural fibres on the world market. French and Belgian varieties have been the starting point this time.

So far, the experiments have resulted in production methods for at least 1000 kg/ha of fibre and 500 kg/ha of seed. In 1990 breeders seed of the new varieties started to be produced.

The target is now to elaborate cultivation methods allowing higher yields both of fibre and seed, improving the harvest and post-harvest technologies and increasing the production of breeders seed.

Comments

Considering the new market situation both within Estonia and abroad (competition with other fibres) it is necessary to make a firm prognosis of the need for fibre and seed of flax both for traditional and alternative uses of the products. The market investigation should consider also the export potential. If the outcome will be positive, the project is justified.

83. Working out and determination of land cultivation machinery and set of tools for Estonian Agriculture

Mechanization Research Centre

Leader: Dr. Arvi Kallas
 Staff: 18 persons (decreased from 24), 5 candidates
 Resources: Office building
 No machine shop (sold to private car repair company!)
 Only very simple instrumentation.
 Objectives: Testing, design and adjustments of field machinery, and
 storage equipment for mainly big farms but now also for
 family farms.

Present work

Testing of Soviet field machines. Redesign and adjustments of soil tilling equipment to the stony soils of Estonia.
 Problems with soil compaction and how to avoid it.
 Harvesting of grass crops and grain.
 Spreading of fertilizers and ash. Machinery for potato growing.
 Studies of permanent electric fences.
 Arrangement of an International Conference on Soil Compaction and Management in June 1992 in Tallin.

Evaluation

The testing is carried out on machines in practical work. As no laboratory or advanced instrumentation is available, the results will be of limited value.

The redesign and adjustment of Soviet manufactured machines to Estonian circumstances may be more important and in some occasions absolutely necessary as the stone releases mechanisms on plows.

The group is well aware of all the limitations, such as international contacts, lack of instrumentation, computer facilities and especially the loss of the machine shop.

Due to cost, lack of transportation but probably also to the applied-basic research syndrome the cooperation with the Tartu institutions is limited. The head of the Research Centre, Dr. Arvi Kallas, has been to Sweden several times and has a close cooperation with Agr. Lars Newman, Jordbruksverket and Agr. Tord Eriksson, KSLA.

Dr. Kallas has worked out a program for the coming work at the centre as well as for the need for updating the research capabilities. In the program, high priority is put on recruiting new staff members and the possibility for further education e.g. in Sweden.

In order to meet the demands from private farmers as well as from the small scale industry, the Centre is transferring ideas and plans from Sweden and Finland to develop an industry in Estonia to supply the small farmers with suitable machinery. The Centre is doing extension work, however hampered by lack of gasoline for transportation.

Summary

In general, insulation, lack of young staff, insufficient instrumentation and research methods, and recently the loss of the machine shop limits the output of the Centre.

However, the new head of the Centre has established international contacts, is working on an operational plan for the Centre and on transferring modern technique from Scandinavia for small scale farming.

The Centre has good contacts with practical farming and its problems.

Recruitment of new staff members, further education of present members and better instrumentation and computing capabilities are badly needed.

89. Investigation of microbiological and chemical agents for preservation of grassfodder

Program leader: Mr. Riho-Jaak Sarand, candidate on technical sciences.

The microbiological research work is particularly geared towards silage preservation studies with grass and legume forages. The microbial and hygienic quality aspect of the feeds are very important, as it affects the animal health, feeding value as well as the product quality.

Testing of silage preservatives in Estonia started in this laboratory. Through collaboration with international preservative producers as well as Estonian (Kohtla-Järve oil-shale plant), several comparisons between additives have been done. Byproducts from benzoic acid are commonly used. Additives containing formaldehyde are also used. The testing and analyzes performed are relevant.

The chemical laboratory is responsible for the analyses of samples coming from the different research groups. The facilities are relevant, while the instruments and apparatus are a mixture of modern and oldfashioned. A special problem is spare parts and repair of instruments, particularly those coming from east European countries.

There are three scientists working in the microbiological and chemistry laboratories. The two at the microbiological laboratory have candidate degree, while the head of the chemical laboratory is a postgraduate student.

Conclusions

The work with preservatives and silage additives are mainly development work of value for Estonia. The group has fairly close contact with international industries and other research institutions. The risks of using products like formaldehyde should be considered. The instruments in the chemical laboratory need improvements if they shall be able to serve the scientists. It is also recommended to establish contacts with other laboratories for testing of methods etc.

91. The intensification of grassland management and raisening the nutritive value of grass feeds

Laboratory of feeds

Program leader: H Older, doctor of Agriculture.

The paper summarizes the research activities within the field of forage and pasture production systems in Estonia as a basis for improved cattle feed supply. More emphasis will be put on studies of the quality aspects of the feeds through selection of grass and legume species, more frequent harvesting of forage, improvement of pasture and conservation methods. The research program reflects a sound re-orientation and will show the possibilities to improve the nutritional supply to the cattle in spite of the shortage of concentrates.

The laboratory of feeds has an experimental cattle farm aprox 2 km from the centre at SAKU, relevant for applied feeding studies. The standard of the facilities is fair, but the equipments for more intensive feed intake and digestibility (and metabolism) studies needs some improvement. The present rumen cannulated heifers were well managed.

The staff list includes 8 scientists (2 Dr. of Agr., 2 candidates, 3 postgraduate students and 1 junior student). Dr H. Older is the program leader and also national coordinator for the research program on forage and grassland production (see No. 7 and No. 93).

The team seems to be well established with both experienced and young scientists. They have comparatively well established international contacts with several countries (Finland, Germany, Netherlands and Sweden). One postgraduate student is at present in Sweden (Department of Animal Nutrition and Management, SUAS) for 6 months.

Conclusions

This area of research is of great importance for the improvement of the utilization of forage as feeds for ruminants. The studies are of applied nature and of particular value for Estonia. The methods used are adequate, but new analytical techniques have to be tested against reference laboratories and through contacts with experienced scientists.

95. The influence of post Harvesting processing - preserving upon the quality of fodder grain

Program leader: Mr. Ants Linnutaja, candidate of veterinary science.

For 20 years the group has been dealing with research work on the quality of fodder grain using chemical and biological research methods. The moisture content of the grain at harvest is generally high, which makes it expensive to dry it to relevant dry matter content for storing. Thus the interest for storing of moist grain or whole grain crop (straw and kernels) is great. Close contacts have been established with Finnish and German research centre.

Conclusions

This field of activity is relevant for development and extension projects. Research experience can be gained from already reported studies.

General conclusions

(Projects no 89, 91, 95)

Re. research related to roughage production and utilization at the Estonian Research Institute of Agriculture and Land Improvement (SAKU)

The studies are mainly of applied type, and of relevance and importance for the development of fodder production, quality of feeds and feed utilization.

The research program has been renewed and is more oriented towards quality and environmental aspects. (e.g. early harvest of forage; effects manure and slurry on the hygienic quality of fodder).

The research facilities are of fair quality, while a rather common impression is that there is a need for new, or repair of existing, instruments in the laboratories.

The staff working with fodder related research is a good mixture of experienced and young scientists. At least seven post-graduate students are involved in this field of research.

It is important to have close(r) contact with the Estonian Agricultural University for teaching and training of students, for the development of analytical methods and for feed evaluation systems (nutritional and hygienic). The expressed interests to have closer contact with Swedish and other international universities should be supported.

- SS 3. Development and introducing of the mathematical and statistical models
- SS 4. Recommendations for a better use of the productive potential of agriculture
- SS 5. The study of agricultural economy and rural sociology

Sector of management problems

The sector group worked mainly with the following issues:

- Privatization in agriculture.
- Regulating the economic-legal formation between (i.e. the institutional environment for) different kinds of new organizations.
- Development of a new book-keeping system for family farms.
- Studies of the social infrastructure and the satisfaction of rural inhabitants.

Privatization in agriculture

One way for privatization is to form new family farms on the basis of acreage from state or collective farms. Another way is to transform state or collective farms into share companies. The group investigates various organizational forms on a practical level and have suggestions about it. This kind of work is important, but estimations of the aggregated consequences for the country and the long run consequences for the farmers should be added.

Regulating the economic and legal conditions for new forms of organizations

The group takes part in development of new laws in collaboration with juridical expertise, e.g., laws about the land reform, leasing and bankruptcy. This work had to be done, but the aggregated and the long run consequences of the suggested laws should be estimated.

Development of a bookkeeping system for family farms

The development is an implementation in practice of basic accounting methods. The same type of work was done at the department of accounting and analysis of the Agricultural University, but there was no cooperation. This kind of development work is necessary.

Studies of the social infrastructure and the satisfaction of rural inhabitants

The farm family satisfaction, motives to become a farmer, social and psychological problems, locus of control and similar problems are studied. Data are gathered with the aid of observations, interviews and questionnaires. Data are analyzed with factor analysis, grouping analysis and other statistical methods. This research is good.

Sector of economics

The sector group has developed recommendations for the use of various variable and fixed resources in agriculture, especially in plant production. The results have been used in the governmental agricultural planning. The methods have been based on mathematical models, regression analysis and basic calculations on data from production statistics. The economic reform means that the government is not any longer interested in this kind of production planning at a national level.

The sector group has also produced statistical reports about the production results. Statistics about production, efficiency and profitability in various farm types and sizes will be needed in the future too, so this kind of basic work is necessary. Methods to produce these statistics have been developed in other countries and are described in the literature.

The government needs analysis of the goals in the agricultural policy and estimations of the consequences at the farm level and the aggregated level of various means to reach these goals. This should be a future task for the researchers in this field.

Sector of economic mathematics

The sector group was applying data processing, LP (linear programming), and methods within mathematical statistics to agricultural problems. Some earlier issues concerned centralized planning tasks, but the group is no longer working with them.

The group is developing a model of the agricultural production in Estonia. The model consists of two parts: 1) a simulation model with a production function for each production branch, and 2) a linear programming model for family farms. The model structure is based on a similar Finnish model. The model estimates the production of various agricultural products and the need of variable resources. Many countries have such models in order to estimate consequences of changes in the Agricultural Policy, such as price support for product or resource prices, subsidies, changes in fixed resources, or changes in the institutional environment. This research is good.

One member of the group has developed a method to do business plans for small firms. The aim of the method is to estimate if the conditions for getting a bank loan are fulfilled. The researcher was not present during my visit, and therefore the method couldn't be evaluated. It is important that all projects are discussed with at least the sector group, so new knowledge can be shared within the group.

Linear programming was applied for medium range planning of a family farm, i.e., optimizing the production level in each enterprise. Linear programming was also used for feed planning. This research is at a basic level. The economic interpretation of the output from the LP-program can be developed with the aid of production theory.

The group was applying computer technology to agricultural problems by development of the consulting system "Agrokonsult" for farmers and by transferring a manual bookkeeping system to Personal Computers. Agrokonsult was a system for supporting decision making in crop production. This is a basic development work that is necessary.

Mathematical statistics has been used, e.g., for developing a catalogue of experimental designs, and for analyzing differential rental incomes of arable land. This research is good.

The group has collaborated with other groups when the other groups needed knowledge about economic statistics. This kind of cooperation is necessary.

IV.2 Institute of Experimental Biology of the Estonian Academy of Sciences

24. Stability of microbial associations in soil and their antropogenic dynamics

Department of Microbiology

Principal activities

The activity is organism oriented rather than process oriented. The microbiological situation on soil is described in different extreme situations: Low temperature, high amount of mineral fertilizers and manure, oil, compacted soil. Effects of such treatments are characterized by the microbial situation: The occurrence of different species as well as enzyme activity. Also lake sediments are included in the program. The investigations are to a high extent based on soil treated in different ways and incubated in big "biometers", large frames with homogenous soil and placed outdoors.

Another part of the activity concerns Rhizobium. The occurrence of Rhizobium in Estonian soils has been inventoried. Different species have been characterized concerning morphology, infection capacity and other properties. Rhizobium strains isolated at the department were included into "World catalogue of Rhizobium collections".

An interesting study is performed in closed microecosystems. Different ecosystems are established what concerns species of microorganisms, energy and light. The results are described in mathematical terms.

Staff

The staff consists of about 6 scientists, all of whom have finished Cand.Sci.

Equipment

The department is lacking advanced instruments. For instance, there is no possibility to include heavy metals in the investigations. But there are facilities in order to make sterile cultivations of microorganisms in an accurate way and there are also facilities to treat the soils outdoors.

Teaching

The distance to the universities is too large to permit regular teaching. However the department receives students making diploma work. There is a wish to increase collaboration with the universities.

Evaluation and recommendations

The activity is characterized by enthusiasm. The restricted resources are used in a good manner. Because of that, and as it is the only soil microbiology department in Estonia, the activity should remain and, if possible, be strengthened.

The activity is much organism oriented. It should be changed a little in favour of process studies. In that manner analysis of consequences will be easier to do. It is especially wished that studies of carbon are included in the investigations. This can be made with rather simple methods.

NS 49. Biosynthesis of phytoviruses in Solanaceae and the problem of plant susceptibility/resistance

The department of virology combines basic and applied research in a constructive way.

The research interest is to a large extent focused on studies on endogenous virus infection in plants based on a hypothesis formulated nearly twenty years ago. Endogenous viruses are known in animals (including man) and in bacteria. This research team is particularly concerned about the presence of endogenous virus on potato seedlings and the need for resistance breeding.

Studies are also made on "in vitro" techniques (callusformation, regeneration of plants), mechanisms of resistance, mechanisms of infection and new viruses.

This laboratory also produces the antisera needed for the country (400 000 tests), performs the official testing for freedom from viruses in the meristem propagation program and serve the country's need for virus diagnosis.

The group works closely with personnel of the EVIKA-program and the breeding stations at Jõgeva.

Comments

The virus group at Harku has a key function for Estonias need of competence in this field. It is of great importance to maintain this competence until other alternatives are within reach. The dimensions of cultivation of vegetatively propagated crops (potato, fruit trees, berries, ornamentals) calls for the presence of virus specialists.

The results of the program on endogenous viruses should be made available to a broader audience and subjected to international evaluation either by an expert in this field or in scientific meetings. The validity of the proofs of the hypothesis needs to be tested before further work along this line continues. The applications for the breeding program and multiplication program seems rather extraordinary and have no similarities in other programs known to us.

Additional comments

A hypothesis about "endogenous virus infection in plants" has been put forward. It is not possible to draw any conclusions from the report about the nature of the viruses believed to be of "endogenous origin". The report is in general rather vague.

There is no support in the international literature for the hypothesis of endogenous viruses in plants. If such an idea were to be tested it requires competence in molecular biology and gene technology. There is no indication that the persons involved are competent in these fields.

NS 51. Chromosomal organization, intergenomic relations and biochemical features in induced mutants and wide hybrids of wheat and its relatives

This research group is at present mainly studying induced mutants and interspecific hybrids. In order to increase the genetic variation in respect of disease resistance in wheat (mainly leaf rust and *Helminthosporium*) wide hybridization has been made using different *Triticum* species. Some mutant lines of spring and winter wheat have high grain protein content, disease resistance and good yield. Sixty well defined and selected mutants are kept as a collection. Work on establishing hybrid rye is under way, but not yet completed. Detailed cytogenetic work concerns e.g. homoeologous pairing in interspecies and intergeneric hybrids, aneuploids etc. Special laboratories are at disposal for the different kind of studies (genetic, physiological and biochemical).

All promising material is handed over to the Plant Breeding Station at Jõgeva for utilization. The group has got increasing international contacts with scientists in different parts of Europe and USA. The publications are more and more made in international press.

Comments

This work is of high quality and has many merits, not least because it produces advanced breeding material to the plant breeding at Jõgeva. However, it is now timely to review the mutant work and also to establish other ways for increasing the genetic variability, when planning for the coming 10-15 years.

The group has no interaction with the Agricultural University in Tartu. Such a cooperation would facilitate both thesis work of students at the Institute, thus helping future recruitment, and guest lecturing and research contacts with the University. This would facilitate new ideas. The laboratories are apparently sufficient for present work.

For more detailed and refined analyses newer equipment should be added. The international contacts are relatively good and could be utilized e.g. for mutual exchange of postgraduate students and other scientists.

25. Heritability and selection of animal quantitative characters

Department of Animal Physiology and Genetics

Project leader: Professor Rein Teinberg

The department has a staff of one professor, one research associate and three junior research associates, of which two are graduate students at the Estonian Institute for Animal Breeding and Veterinary Sciences (ELVI), Tartu.

The Department has four lines of research: (a) selection of dairy cattle, (b) cytogenetics, (c) genetics of stress and hypertension in rats and (d) genotype - environment interaction.

(a) Selection studies in dairy cattle

In cooperation with scientists at ELVI a data bank on cattle production data has been built up. Computer programs have been developed and adapted to the USSR computer, available and genetic parameters such as heritabilities and genetic correlations for the essential production characters in Estonian dairy cattle have been calculated. Selection indices have been constructed. Methods for breeding value estimations have been adapted to Estonian conditions. In the breeding value estimations of the bulls, contemporary comparisons of daughters were first used, thereafter programs for Best Linear Unbiased Predictions (BLUP) were developed and used. Breeding programs, which should give optimum progress in cattle production have been worked out in cooperation with staff at ELVI and put into practical use for the Estonian Black and White and the Estonian Red cattle breeds.

The project makes use of one computer at the department and a central computer with large capacity at ELVI. Contacts have been established with the Department of Animal Breeding and Genetics, Swedish University of Agricultural Science, Uppsala, Sweden. The two graduate students located at ELVI have visited Uppsala for about 3 months each. Considering the isolation of the Estonian science, the research program on selection in Estonian dairy cattle was able to apply western ideas and knowledge very early. The basic genetic parameters of Estonian dairy cattle were estimated 5-10 years ago and used in the design of national breeding programs. The research in this area has had a great influence on the development of the Estonian dairy cattle breeding program, which now has a theoretical foundation of good international standard.

(b) Cytogenetic studies

The project first involved the cytology of cattle with the intention to eliminate a well known Robertsonian translocation which reduces fertility. As this translocation was not detected in Estonian cattle and this species is under close study in many other countries with much better technical facilities than available in the laboratory, it was decided to concentrate work on the Estonian quail, which has several interesting attributes. Standard cytological techniques have been adapted to work on the Estonian quail. It was found to have five pairs of macrochromosomes and 63-68 microchromosomes. Using various banding techniques the macrochromosomes have been described in some detail.

The laboratory is poorly equipped and the single researcher (a graduate student) works in isolation. She has been in correspondence with laboratories in Lund and Uppsala.

(c) Genetics of stress and hypertension

The studies are made on rats. We were able to see the experimental facilities but could not have any discussion with the scientist in charge as she had just got a baby. The general area of genetics of stress is of great interest and may have important applications in animal breeding and production. The facilities available for experimental research in this area in the department is evidently very limited and the research is carried out by one person only.

(d) Genotype - environment interaction

This is an area where knowledge in farm animals is rather limited. Existence of non-linear genotype-environment interaction will hamper genetic progress by ordinary selection methods for additive genetic variation. The studies in the department are made on *Drosophila* using quantitative traits such as bristle numbers and wing measurements. Significant genotype environment interaction was obtained in selection for these traits in contrasting environments. The magnitude of interaction did not differ in males and females.

The facilities for this research in the department are very limited and the research is carried out by one person only.

Concluding remarks

The research on quantitative genetics in cattle is of good international standard. The results have been applied in the development of national breeding programs. Good cooperation seems to exist with the organizations and institutions responsible for practical cattle breeding in Estonia. Textbooks explaining the theory and the applications of the results have been published in Estonian and Russian. International contacts have been established and should be strengthened.

The other three areas of research have a weaker base in the department and are each handled by one single person only. It is doubtful whether the department should continue spreading its resources over such a wide area of topics. Selection experiments in *Drosophila* have been and still are carried out in many other internationally well established laboratories in several countries. The stress research would require much more resources to become internationally competitive. The cytogenetics is an area which is under very rapid development since the introduction of DNA techniques for the location of individual genes. This area is likely to get increased importance as a link between qualitative and quantitative genetics. Should the Institute wish to put more emphasis on cytogenetics, it will be necessary to acquire the equipment needed for research in this area. The young scientists should also be sent for training abroad. We were informed that preliminary contacts had been made with professor Ingemar Gustavsson, Uppsala.

IV.3 International Plant and Pollution Research Laboratory

NS 60. Air pollution effects on vegetation including forest ecosystems

This institute was established one year ago. Earlier it had a responsibility to co-ordinate all research activities dealing with pollution effects on ecosystems in former Soviet Union. The laboratory belongs, from the organizational point of view, to the Academy of Sciences and is financed by funding from the Ministry, contracts with enterprises and earlier funding from Moscow.

The laboratory seems to work with monitoring to a great extent and is now building up its organization.

A collaboration between the laboratory and a university in the USA is established. Up to now relatively few contacts exist between the laboratory and universities and institutes in e.g. Germany and Sweden working with pollution research in forest ecosystems. In the future the laboratory ought to create a closer contact with researchers working with forest ecosystems at the Forest Research Institute in Tartu in order to implement the scientific competence there of forests development under "undisturbed" conditions.

IV.4 Estonian Agricultural University

26. Biological productivity, properties, chemical etc relationships, genesis and recultivation of soil in ecosystems
27. Influence of prime and repeated limings and systematic application of powdered oil-shale ashes on soil and crop yields

Department of Soil Science and Agrochemistry

Principal activities

The main research field concerns properties of soils, evolution of soils and classification of soils. There is an ecological approach when characterizing soils. Natural as well as urban factors are considered. Thus effects of too heavy amounts of liquid manure, crop rotation and other measures are considered. The properties of soil types are linked to the yield of agricultural and forest yield.

Soil organic matter research is central at the department. These studies are connected to the soil formation processes rather than to plant nutrition dynamics. The nitrogen turn over is not linked to the carbon turn over.

The soil classification follows the FAO-system. Soils in whole Estonia are included in the classification work. The department has at its disposal a complete collection of Estonian soil types. It is used for instance in the education.

Acid soils are common in south Estonia. Because of that, liming is necessary. Oil shale ash is tested as a liming material. It works well in increasing soil pH but it contains radioactive substances. They are conscious about that.

The research at the department is fundamental as well as applied. According to state directions they have to give priority to applied science. Because of that, mineralogical research is at the moment stopped.

The department has rather good international contacts. Earlier they were involved in the International Biological Program and now they are involved in a network concerning crop rotation trials in different European countries (ISDV).

Staff

In total there are 22 persons working at the department. There are 3 professors, 2 ass.prof. and 3 PhD students.

Equipment

The equipment is weak for research as well as for education. They have to use oldfashioned gravimetric methods instead of e.g. modern atomic absorption methods.

Teaching

The department is responsible for teaching at the Agricultural University. Besides that, the head of the department is teaching at the Tartu University. The teachers have a high educational load. There are 3 PhD students at the department.

Evaluation and recommendations

The department represents a very good competence and knowledge concerning Estonian soils, which it is necessary to take care of. It makes a good fundament for other subjects in relation to soil and crop. The department favours education of young researchers. The fundamental research (mineralogy) should be started again as soon as resources can be available.

Collaboration should be started with the Department of Agronomy concerning analysis. That department has modern instruments for analysing nitrogen and metals at its disposal. However, this cannot help the situation for the education.

28. Improvement of the foundations of planning and reconstruction of drainage systems

Department of Soil Reclamation

The main task of the department concerns drainage of arable land. However, in recent time the activities have been broadened and concerns now quality problems in relation to land reclamation. Research about environmental problems have been important.

Primarily the work is performed in the field. An urgent task is to find out how old drainage systems should be repaired and how new should be performed in order to work for long time. Heavy machines are a serious threat against drainage systems. Subsoiling cannot be used as it destroys natural drainage channels.

Research has been started about remote sensing as a tool for diagnosing faults in drainage systems and for planning new systems.

There is collaboration with biochemists in investigations concerning decomposition of organic covering material. In collaboration with other organisations guidelines for practical draining has been worked out.

Staff

The staff consists of 7 persons with academic exams. 1 person works on a PhD.

Teaching

The department is responsible for teaching at the Agricultural University. The teaching load is heavy for the teachers.

Equipment

The scientific equipment is weak. There are facilities for physical analysis but for chemical analysis service laboratories have to be used.

Evaluation and recommendations

The quality of the work seems to be good. The department is ready to attack new research methods. Basic soil physical research should be given priority. It is necessary to find out why there are problems concerning draining properties of some soils. There is a wish to increase research education. This has been prevented because of lack of money. It is important that this can start as soon as possible. Collaboration with the Estonian Research Institute of Agriculture and Land Improvement is recommended.

35. The quantity and dynamics of fungal diseases and agrotechnical protection of barley.

This research is focused on diseases on cereals and grasses but has a wide scope of interests, e.g. crop rotation, soil treatment, fertilizer effects, herbicide influence, varietal differences, seed treatments. The intention of the future work is to continue studies on varietal effects of the most important cultivars and evaluate yield losses due to diseases.

Comments

The scientific leader of this project has a very heavy teaching load (1 000 hours/year) in plant pathology and general biology. It was apparent that the majority of experimental work was made by students originally published as diploma papers and summarized as contributions in scientific journals and at conferences. The list of publications against this background is impressive, the results of the investigations are in general in agreement with other similar published works.

36. Improvement and elaboration of agroecological fundamentals in land tillage

Research on land tillage has a long tradition in Estonia. The present investigations started two years ago. Their objectives are to find ways for sustainable production and protection of agroecological ecosystems.

The background for this cropping system research is partly the previous situation in Estonia with weed infestation of fields by imported seed, soil package by heavy machineries and strong influence by chemicals.

The factors under study involve different land tillage and agro-techniques. 14 scientists from several institutions both inside and outside the Agricultural University compose the research team. Due to present financial constraints only 1/3 of the research plans have been realized. The project is scheduled to last up to 1998.

Comments

This study aims at finding scientific bases for better management of the land resources for sustainable production than at present. The influence of different treatments, residues in soil and plants etc are being thoroughly studied in one place. Quite many variables are included, thus making the study rather complicated.

The holistic approach to the tillage system by this multi-discipline team is quite interesting. However, similar problems and economical constraints have brought scientists from 8-10 countries in western Europe to rationalize their research plans through collaborative efforts 1). The team is recommended to contact this group. A European collaboration would facilitate a flexible operation of this long-term program, which in itself is well motivated and needed due to the described background.

1) IOBC working group on Integrated Arable Farming Systems
Convenor of the program: Dr P. Vereijken, Center for Agrobiological Research, Postbox 14, 6700 AA Wageningen, The Netherlands

37. An improvement in the quality of grain crops in Estonia

It is found necessary to expand the area under cultivation of grain crops in Estonia. Therefore, studies are being made to improve the yield and quality of the own rye, wheat and barley production. Since 1986 the Department of land tillage at the Agricultural University in Tartu has performed studies on different varieties of barley and spring wheat in respect of yield, N-response, protein and fat content, 1000-seed and volume weights etc. A number of agronomic factors have been observed of importance to achieve optimal cultivation methods.

The future research target is to further improve the grain yield and its quality for different uses. Variety testing, crop sequences, fallow types, fertilizers, sowing and harvesting times, post-harvest technology, maturation prognosis and baking quality are listed as relevant objects for this decade.

Comments

This type of research is important. Firstly, an objective variety testing for release and extension is necessary. Secondly, crop production methods must be adapted to the new, approved varieties. The evaluation of the product quality is an interest for the whole society as the nutritive value of the agricultural products more and more will be taken into account. Therefore, this work needs support. It should be expanded and must be coordinated on a national basis, closely linked to the plant breeding activities and connected with other applied disciplines e.g. plant protection. Initially, concentration of efforts to the most important species and needs is recommended.

38. Agro-economical evaluation of yield influencing factors

This long-term, multifactorial experiment started in 1982. The principal factors under study are crop rotation incl. monoculture, fertilization, plant variety, cultivation method and plant protection, altogether 288 variants. Yield as such and its relations to weather, dynamics of increase, elements of structure and certain quality parameters are being recorded. The plan is to get sufficient data for mathematical crop yield modelling taking into account mainly agroecological and agroeconomical aspects. The investigation is made in one location.

Comments

Models of this type need to be based on many data preferably from a longer period and under well defined conditions. Otherwise, complicated, dynamic processes are difficult to catch in a meaningful way. Also quality aspects need to be considered e.g. in potato production, where certain combinations of fertilizers might bring the highest yield, but reduce the tuber quality and storability, thus decreasing the potential for optimal utilization and the economical output.

A review of the results obtained after completion of one rotation sequence would be helpful for drawing conclusions about the future of this project.

39. Investigation of pest populations and factors influencing their dynamics.

The studies have followed three different main aspects.

1. Conditions for winter dormancy (mainly influence of temperature) on various pests attacking forest trees.
2. Nutrition conditions of host plants with influence on the physiological state and development of the insects. As test model cabbage butterflies and white head cabbage have been used.
3. Control of synthesized pheromones as to their specificity on leafrolling insects in fruit tree orchards.

Comments

This is good basic research focused on phenomena of importance for better pest management and thus with clear practical applications. The list of publications include, besides customary report in Russian or Estonian also reports presented at international congresses.

The laboratory activities gave a very positive impression. The sophisticated measuring devices, mostly automatized, seemed to be more or less home made or put together from various sources. It was a sign of "do not give up if you cannot buy the most modern devices" or "difficulties must be solved".

The project leader, Anne Luik, has good contacts with other research groups in her field of research. She attended, during our visit, an international congress in China.

The research group consists of dedicated researchers, produces good results and is a valuable resource for Estonian entomology.

40. Working out agrotechnology of rape in Estonian conditions

Production of vegetative fat and protein is essential in Estonia. New varieties of rape and turnip rape are being tested as also appropriate cultivation methods. The winter resistance of the new 00-varieties of winter rape is critical for the outcome. This depends partly on the date of sowing (the plant developmental stage at in-wintering). The seed rate should be higher when winter rape is intended for green fodder than for oilseed. The harvest of fodder should be 100-105 days after sowing. The future research is planned to continue testing of 00- and 000-varieties of both winter and spring rape for oil and protein production of seed and also green fodder.

Comments

This study is in line with the needs of Estonian agriculture. However, it should be closely coordinated with a similar project at the Estonian Research Institute of Agriculture and Land Improvement (project 92).

In the Nordic countries special fodder rape varieties are available to the farmers. It seems much easier to grow separate rape varieties for green-fodder than to try to get varieties with double uses.

41. An influence of fertilization on the yield and its quality of vegetables

Vegetables are important as healthy, nutritive food components. Different applications of fertilizers in cultivation of white cabbage, carrot and red beet have been tested in this programme. Varietal responses have been recorded both as to yield and nutritive value. Red beet can accumulate great amounts of nitrates and, thus, should be moderately N-fertilized. A number of other vegetable species are also being cultivated in Estonia and included in this research. Good collaboration is established with related institutions at Saku and Jõgeva, thus opportunities for post-graduate students. At present, quite many students participate in field studies of vegetables.

The future research will pay more attention to the product quality and to sustainable agrotechniques using more organic fertilizers.

Comments

The research team is competent and the programme is essential. Therefore, this area needs increased support. The research on methodology and quality of also other important species like peas, tomato, cucumber, spinach, onion etc should be selectively strengthened. More use of renewable resources ("mild" horticulture) should be further investigated. Old landraces of onion still exist in eastern Estonia. If not done already, these would be of interest to collect, describe, conserve and utilize in plant breeding (gene bank aspect). A similar action has recently been taken in Finland.

61. The investigation of the energy-saving methods for the increasing and improving of the quality of the biological and zootechnical (utilized by cattle) yield of the intensive grasslands

The Estonian areas for production of perennial herbage are covering almost half of the arable land. Related research is coordinated between three centres (the Estonian Agricultural University, the Estonian Research Institute of Agriculture and Land Improvement and the Estonian Research Institute of Animal Breeding and Veterinary Science). The Department of grassland husbandry and botany at the Agricultural University in Tartu is working with establishment and improvement of cultivated pastures and meadows, their fertilization, irrigation and utilization. Botanical composition of swards relevant to the growth conditions and the way of utilization. N-supply (also considering NO_3 in grasses), goat's rue in pure and mixed stands, white clover-grass mixtures, grasses on eroding hills, interaction between irrigation - fertilizers, and quick methods for grass fodder analysis are at present the main field of interest.

Future work is planned on i.a. seed production of grasses and white clover, humus and N-accumulation and increased utilization of herbage by animals.

Comments

The rational utilization of herbage is important to the animal production and also to the biological balance and sustainability of soils. Thus, the problems taken up in the Department's research are relevant.

The close collaboration with animal research is valuable and should be further stimulated in order to evaluate the utilization of the fodder by animals.

The activities in this Department are characterized by good scientific standard, well managed and designed field trials and several progressive post-graduate students.

NS 58. Pheromone materials for pest monitoring and male insect mass trapping

In 1986 a research team of chemical ecology started work at Tartu University and a year later a second group of the Estonian Agricultural University started work on pheromones. The two groups have a joint target: a) to provide pheromone monitoring and pest control for all essential pests in the region, b) to expand the use of pheromone mass trapping and introduce pheromone disruptants, c) to initiate study on hostplant odour components, egg-laying deterrents, antifidants and other ecochemicals.

The work is mainly for Estonia and the neighbouring areas. Earlier the Estonian pheromone program was aimed for the Southern parts of the Soviet Union and the leading pheromone producer was the "Flora" Chemical Plant, a commercial factory of ecochemicals in Tartu with an impressive output of chemicals for the Soviet Union before the independance.

Comments

It is obvious that Estonia has had an important role in the past as center for agrochemistry in teaching, research and development of industry in this field as demonstrated in this particular program as well as others seen during our visit of the country. Now the immediate goals is Estonia's own need of "know how" and products for its own use and perhaps neighbouring areas. It would be a waste of competence and investments if research groups of this quality are facing shortage of money for the future work as limiting factor. The various aspects of control measures in plant protection by biotechniques is environmentally sound and should be promoted.

29. The creation of bases for most efficient of energy, electrical equipment and labor in Stationary Processes of Agriculture in Estonia Department of Electrical Engineering

Contact

persons: T. Peets & E. Kokin

Resources:

Office building
Laboratories
Lecture rooms with outdated training equipment
Four 286 and one 386 ordinary computers!
Almost no "western" literature

Objectives

Research and teaching in the field of energy use, electrical equipment and labor in Estonian agriculture.

Present work

Improvement of Soviet manufactured electric motors.

Control of microclimate in cattle-sheds and greenhouses.

Optimization of electrical load on local distribution lines.

Possibilities to reduce the electrical energy consumption in large farms.

Energy efficiency in farm production.

Teaching courses in electircial engineering.

Evaluation

This group is very much hampered by the lack of modern equipment, such as instrumentation, computers, literature and international contacts.

The almost complete lack of western literature is probably the reason for the somewhat outdated research projects and scientific methods. Another reason might be the urgent need to handle technical problems on the large farm and vegetable production units equipped with low quality equipment.

Problems with old fashioned equipment in practical farming has been one of the arguments for continued training of students in outdated techniques. The renewing of the teaching is urgent, but must be in some relation to the development of the practical farming.

There are only a few young scientists and students working on a higher academic degree.

The available computers are placed in a computer laboratory, which is probably the best utilization during a start up period.

The need for modern scientific instruments is urgent.

One of the young ass. professors has attended a computer course at the Department of Agriculture Engineering in Uppsala in the spring of 1992. Otherwise there has hardly been any international contacts.

Summary

The department has been very isolated, which has had a great impact on research and teaching.

There is a great need for upgrading research methods, equipment and undergraduate teaching.

The new leaders of the department seem well aware of the situation and they want to change the objectives of the department.

31. Elaboration of methods to estimate labor efficiency in dairy farms and its technolines

Animal Husbandry Mechanization

Leader: Prof. Vambola Veinla

Resources: Office building
4 persons

Objectives: Management efficiency of dairy farms

Present work

Determination of efficiency of milk production.

The efficiency of management of 272 dairy state farms has been studied during 1981-87.

The evaluation has been by a complex method using indexes. Later system analysis has been used.

Teaching for both agr. and vet. students is 700-800 hours a year.

Evaluation

The group has good contact with practical farming.

Apparently a comprehensive evaluation of the efficiency of dairy farming in Estonia has been fulfilled. Data from this investigation is stored in a data bank.

The scientific methods used seem to be rather simple. However, the results according to the method may be very precise.

If it is due to the former political system or not the results of the work for practical farming were not clearly demonstrated.

Prof. Veinla has written several textbooks on mechanization of animal husbandry.

Many diploma works have been supervised.

Summary

The group seems to be very dedicated to the task.

The scientific methods must be reevaluated and further developed.

32. Methods of security determination and efficiency guarantee in dairy farms as biotechnical systems

Faculty of Engineering

Department of Animal Husbandry Mechanization

Leader: Ass. prof. B Reppo

Resources: Office building
Laboratories

Objectives

Research on the dairy farm as a man-machine-animal system.
Reliability of dairy farm systems and equipment.
Efficiency of dairy farm equipment.

Present work

Working on reliability of dairy farm equipment. Notebooks on the malfunctioning of the equipment are prepared on the farm. The results are analysed statistically to determine the optimum maintenance. New machines are tested when introduced.

Machines for dismanuring as well as milking parlours and milk cooling equipment are being studied.

The working capacity of farm workers is studied by the use of simple physiological tests (heart beat rate, memory, reaction time and hand grip force).

The overall efficiency of different dairy farm equipment has been determined.

Evaluation

The group seems to have good contacts with practical dairy farming. However, there was no discussion on how to improve the overall efficiency in Estonian dairy farming.

The reliability studies apparently are of a great importance due to the low quality of the dairy farm equipment.

The reliability as well as the management studies have to be upgraded scientifically.

The working capacity studies have used a physiological test, which has been an important way to reach objective results.

The group is in great need of contacts to discuss and compare own results to international standards.

In general there is a need for better instrumentation. However, some ideas of how to use simple yet valuable instruments were demonstrated.

The group wants to pay more attention to social and ecological farm efficiency.

The group is in great need of contacts to discuss and compare own results with international standards.

In general there is a need for better instrumentation. However, some ideas of how to use simple yet valuable instruments have been demonstrated.

Summary

The group needs contacts with similar international work for the evaluation of their own work and for new ideas.

The group has good contact with real dairy farms and has worked with important problems.

Some of the staff members should have the opportunity of upgrading their scientific methods.

33. Research in use of enhanced technical level tractors and other agricultural machines

Faculty of Engineering

Department of Machine Repair

Contact person: Ass. Prof. H. Olak

Resources: Office building
Tractor testing laboratory
Fuel injection testing equipment
Instrumentation from 60-70:ies

Objectives: Tractor testing
Reliability studies
Fuel injection equipment efficiency
Turbo charger reliability

Present work

Problems developed in turbo compressors of a certain tractor engine as carbon deposits on the impellar.

Procedures for repair and maintenance have been worked out.

Work on tractor injection equipment to improve fuel efficiency.

Future plans for working with rape oil as a tractor fuel.

Evaluation

According to the presentation very little scientific work is done.

The laboratory equipment is at least 20 years old.

The main task for the moment seems to be teaching courses for the students.

Summary

Very little scientific work, mainly teaching courses for students, however with outdated equipment.

84. Complex mechanization of potato cultivation

Agricultural Machinery

Leader: Ass. Prof. Meeme Karolin
Staff: 7 persons
Resources: Office building
Laboratory
Sufficient instrumentation

Present work

The group is mainly working with applied research in potato research in potato production. Their work is well-known to the agricultural engineers in Saku.

Earlier much work on potato harvesters and their improvement has been carried out.

The possibilities to sort out stones and debris has been explored in the same way as internationally.

Interesting and valuable is the mapping of Estonian arable soils suitable for potato growing. Several parameters were used, such as soil type, stoneness and so on.

Recently, potato seed growing in wide rows has been investigated.

The group has contact with the potato breeding group in Saku.

The group has worked for five years with growing and storage of potatoes affected by earth magnetic fields according to the Steiner theories.

Evaluation

Prof. Karolin and his group are very dedicated to their task.

The goal to improve the potato production in Estonia seems to be quite clear.

They are using field tests for evaluation and have a laboratory for support.

Apparently their work are of significance for potato growing in Estonia.

The work of this group doesn't seem to be as far behind western development as some others.

No comment on the magnetic fields.

Summary

This group is dedicated to their task.

Maybe they are too convinced of their results - international contacts would be of value.

The group need to be complemented with young and scientifically trained people.

Institute of Animal Husbandry (general introduction)

(Projects no 42, 47, 49)

In the recent restructuring of EPU an Institute of Animal Husbandry was formed to include all animal science teaching and research in one unit. The institute comprises four departments (a) small animal husbandry, (b) animal husbandry (large farm animals), (c) animal nutrition and (d) chemistry. The latter department covers all agricultural chemistry and is responsible for teaching students in all "streams" within the university. The teaching responsibilities are considerable. Professors were said to teach at least 600 hours per year and assistant professors around 900-1000 hours.

42. The study of an effective way of producing human food protein in animal husbandry

Department of Animal Husbandry (large farm animals)

Leaders:	Rector.	prof. O. Saveli
	Prof.	L. Lepajoe
	Ass.Prof.	I. Nommisto
	Assistant.	T. Heim

The theme of the submitted report for evaluation was: Study on effective way of producing human food protein in animal husbandry in Estonia. This topic was also expressed to be one of the two major research interests for the department and all listed dissertations (1 Dr.-diss. and 2 Cand.-diss.) concerned this topic. The report includes calculations and comparisons of feed protein conversion into food protein in meat, milk and eggs from the different livestock species.

The paper indicates that lots of efforts have been put into the area. However, with regard to the complexity and all variables involved, it seems to be necessary to have a system analysis approach. The other area which was expressed to be of research interest, was chemical polymorfism in cattle. The overall responsibility of the department covered breeding, feeding and management of large farm animals. The staff at the department includes 2 professors, 2 docents and 2 assistants. This Department together with the Department of Animal Nutrition and the Department of Animal husbandry of Small Farm Animals (breeding, feeding and management) is responsible for the teaching of animal science subjects.

47. Saving of deficient and expensive protein feeds in feeding of domestic animals and fowl

Department of Animal Nutrition

Leader: Prof. U. Oll, Dr. of Science

The Department has during the past decades worked with energy, protein and mineral metabolism in cattle, pigs and poultry as well as special studies on summer feeding of cows. Prof. U. Oll has been professor and head of department since 1968. Many scientific publications and some textbooks have been written on Cattle feeding, Swine feeding and Feed tables together with co-authors from the Department and from Estonian Research Institute of Animal Breeding and Veterinary Sciences (see papers 14, 16, 17). Fourteen dissertations have been prepared under the supervision of prof. Oll, the latest one in June 1992 (Mineral Element Content of Feedstuffs and Dairy Cattle Diets).

The theme of the paper for review concerned feed protein utilization, metabolism and evaluation in domestic animals and fowls. The prestatation given in the paper clearly indicates that the Department has very well followed the international literature and also actively worked with own research within the same field. In view of the Estonian situation for feed and nutrient supply to their livestock, this is a very important field of research.

The Department has already international contacts (Nordic countries, Holland, Canada) and both prof. U. Oll and his successor (from Sept.-92), Dr. O. Kärt, expressed clear wishes to have closer contact with the Nordic group working with protein as well as feed energy evaluation research and system development.

The present staff included four scientists and two post-graduate students. They have a heavy teaching load with approx 40 students in regular courses and several students doing diploma work every year. The Department has at present sufficient rooms for general chemical analysis of feeds, but the instruments were of variable standards. They expressed wishes for a special protein laboratory for modern analytical methods. This idea is fully supported, but the importance of coordination of the analytical work with other institutions e.g. at ELVI must be stressed. The Department has recently lost its animal experimental unit, which was handed over to a private farmer who now has the right to that farm. Another unit is urgently needed.

49. Breeding of Estonian quail and white farm mallard

Department of Small Animal Husbandry

The department is responsible for teaching and research on feeding, breeding and husbandry of sheep, swine, poultry and fur bearing animals. It is composed of 1 professor, 2 assistant professors, 2 research assistants and 2 graduate students. The teaching of undergraduate students takes about 80% of the available staff time. They have access to computers but no other laboratory facilities. There is close cooperation with the Research Institute for Animal Breeding and Veterinary Science (ELVI). In the past much of the work has been directed towards poultry production under research contracts with the poultry industry. Due to the economic situation there is no such contracts at present. The graduate students work on problems related to egg quality in chicken and quails. The project under review represents a minor part of the activities of the department.

Project

Breeding of Estonian quail and white farm mallard.

Project leader

Prof. H. Tikk.

The Estonian quail has given rise to some international interest as it is bigger than the common Japanese quail and has high egg production. In the project techniques for large scale incubation of quail eggs, the raising of quail chicks and the breeding, feeding and management of quails have been worked out. Through selection, egg production has increased. Average laying intensity during one year is said to be 86%. Feed conversion and egg quality have been studied. The project should be classified as developmental research, with the aim of producing quails which efficiently convert feeds into valuable products such as quail meat and eggs. In this sense the project has evidently been successful. The project has been at the focus at two meetings in the former USSR and at one international meeting held in Tartu in 1991.

The mallard part of the project was carried out at the Kaarepere Forest Experiment Station. A white plumage variety happened to appear in the populations. This variety was multiplied and the colour inheritance and the behaviour, growth and carcass quality was compared to those of the common mallard. It was said that pleasant exterior of carcass and early slaughter age make the new variety a promising future table poultry. Also these studies should be classified as developmental research.

Although it never became completely clear about the responsibility for research and teaching in feeding of small farm animals, it seems to be important for the Department to have close cooperation with those research stations and Departments within ELVI which deal with small farm animal product (pigs at Kehtna, sheep at Puka and poultry at Kurtna) for teaching and research in pigs and poultry (inc. student's diploma work).

Institute of Animal Husbandry (general comments)

(Projects no 42, 47, 49)

Considering the very heavy teaching load of the staff, the research activities in the animal science parts of the Institute are of reasonable magnitude and quality. In research, extensive cooperation has taken place between the Department of animal husbandry (large animals) and ELVI. The cooperation should cover also other areas including undergraduate teaching and advice of diploma works. The ELVI scientists have much to offer in this regard. Common use of expensive equipment and animal experimental facilities should also be considered. The Department of animal nutrition had recently lost its animal experimental unit. It would be worthwhile looking into the possibility of letting the animal nutrition department utilize ELVI facilities rather than acquiring a separate unit for the EPU department.

The Department of animal nutrition has made a good contribution to applied animal nutrition. It is desirable that the department also takes up more basic subjects in order to give coverage to the important area of nutrition - physiology. In the case of animal breeding and genetics the applied parts of animal breeding are covered by the two husbandry departments (large and small animal husbandry). The more theoretical parts have been covered by the Department of Animal Physiology and Genetics at the Institute of Experimental Biology, Harku. It is desirable that research in animal breeding theory and in basic animal genetics is taken up at EPU so that the students can be provided up to date teaching in these subjects.

With regard to the chemistry department, its placement in the Institute of animal husbandry seems artificial. Chemistry, with its many branches is so important for the agricultural sciences that it warrants a more prominent place. We had no opportunity to discuss this matter with the leading staff in the chemistry department. One additional possibility which might be considered would be that EPU and Tartu University look into the feasibility of establishing joint units for chemistry research and teaching.

43. Investigation of a typical mycobacterial infections in pigs under natural and experimental conditions etc.

Atypical mycobacteria belonging to the avium-intracellular complex cause diseased conditions in pigs. The allergic reactivity has been investigated and some experimental work carried out. Normally no generalized tuberculosis in pigs is produced-mostly local tuberculosis, like changes in regional lymph nodes have been noted. It has been found both in human beings and in animals that diseases caused by a typical mycobacteria have considerably increased in number. The main reason seems to be decreased immune-respons.

Comments

The leading scientific person is professor N Kozlov. The Swedish experience in the area (pigs and human beings) was told the group. The work going on in Estonia seems to be of great interest to the country-internationally the problem does not seem to have been observed to the same extent. Scientifically the project has a good standard. A young scientist was member of the group and an intensified, if possible, post graduate training within the area of basic immunology was recommended as well as closer contacts with groups in western countries working within the same area or within the area of basic immunology.

44. Electroaerosols, laser-technology and electrochemical processes in veterinary

Disinfection of swine farms, poultry farms, incubator and incubatory eggs etc. is a problem because the effect of cleaning must (should) be 100%. Experiments have been made to use electroaerosols instead of aerosols. The main idea is that the capacity to really cover an area is improved in the electroaerosol compared to the aerosol. Doctor Evald Pärnaste, the leader of the project, agreed that the use of aerosols could not replace a careful mechanical cleaning. But in addition to a careful mechanical cleaning the use of aerosol might be recommended. In Sweden we have no experience of the use of electroaerosols. The control of the effect of the electroaerosols was noted.

45. The quality of milk produced in large-scale farms and prophylaxis of mastitis

It is necessary to be able to produce milk for human consumption of a good microbial quality. However, there are a number of problems to be solved before being able to do so. Mastitis is a big problem, the milking of the cows and the keeping of the milk in a proper way is another one. Professor K. Peterson and his team has for a number of years selected bulk milk from a number of state farms. The samples were taken after the milk had arrived to the dairy and the temperature of the milk during the transport etc. might have been about 10 C. The total numbers of different microorganisms were high clearly indicating an active growth in the milk.

Even if some improvements have been noted during the years the figures are still very high. The composition of the microbial flora of milk seems to indicate that the milk after leaving the udder might not have been handled properly. There are a number of questions: How are the milking machines working? Are the hygienic conditions in the farms satisfactory? Is the milk cooled and kept at 4 C immediately after milking and during transportation. The different steps of the whole chain should be carefully looked upon and evaluated.

The group is recommended not only to collect and examine a number of milk samples but also to use the figures received "in both directions":

1. back to the farm to find out the reasons why and where in the chain the high figures are received.
2. forward to the consumer to see if the quality will remain acceptable during the rest of transportation. Representatives of the Estonian team was invited to Sweden to study our scientific activities within the area of mastitis in cattle and also how we try in Sweden to check and control the mastitis problem in the different farms, how the activities are organized and so on. Further comments see report No 8.

46. The correlation between the antimicrobial activity of the blood serum and the livability in cows

Background

This evaluation is based on report 46 and on a publication related to this report (H. Noorsalu et al., 1990: On Population Immunology of Estonian Red Breed Cattle: Proc. Estonian Acad. Sci. Biol., 39, N 2, 77-82). The project deals with population immunology and the purpose is to divide cattle into various so called phenoclasses based on immunological and other parameters in blood and to correlate these phenoclasses to resistance and production of the animals. The authors report a positive correlation between the antibacterial activity of serum to 2 bacterias and the production of milk fat, and between high levels of serum haemoglobin and protein and high production of milk fat. High haemoglobin and protein levels were also correlated to high percentage of stillbirth in heifers.

Comments

The purpose to find relevant immunological parameters which correlate to a general resistance of animals has been a veterinary dream for decades and is still modern; such parameters might be used in breeding in order to improve the herd resistance. However, the results obtained in the study are not too convincing and no theory which explains the results is presented. The immunological and other blood parameters used, are influenced by various factors, are crude and not up to date. The research is hampered because of lack of financial resources, equipment and a heavy teaching duty. It also appears that the knowledge in the field is not fully up to date, mainly owing to lack of international periodicals. The group is planning to send a young scientist to Denmark for training in this area, which is positive.

Recommendations

For further studies in this area, also the use of modern immunological techniques on cellular and molecular level are recommended. This will mean improvement of methods, equipment, postgraduate training, access to relevant literature and international contacts. If this is not possible, termination of the project should be considered.

48. About clearing up of using enzyme preparations system in agriculture

Project leader: A. Nummert, Assistant professor, Candidate of Veterinary Science, Department of Internal diseases, Laboratory of Biotechnology at Estonian Agriculture University.

A general review of the metabolism of farm animals with special reference to the enzyme systems is given in the introduction of the report. It is claimed that addition of proteolytic and amylolytic enzymes into the feeds fed to chicken, geese, hens, calves and piglets enhance general metabolism of the organism and improve the feed utilization under certain conditions. Dr. Nummert has worked particularly with chicken.

Addition of enzymes is claimed to be particularly effective in systems where the animals are under stress when there are bigger risks for disturbances in the digestive tract, indicating that the environmental conditions and/or the management systems of the animals are sub-optimal.

The Department has the teaching responsibility for veterinary students in internal diseases.

50. Research on the biological and cybernetical basis to automatize dairy husbandry technologies for high productive cows

Institute of Engineering

Engineering of Animal Husbandry: Laboratory for dairy husbandry technologies.

Project leaders: Ass. Prof. Arnold Ruutel, Dr. of Agric. Sci. and Ass. Prof. Jaan Praks, Cand. of Vet. Sci.

The studies focus on the two themes: 1) Automation of physiological and health control of dairy cattle, and 2) Automation of concentrate feeding by free stall technology for dairy cattle. The formation of large scale dairy herds has caused the need for mechanization and automation of the technology for health control, milk recording and other production related parameters.

The program was formed to further develop the principles of individual control of animals kept in groups by use of computers, microprocessors and electronics. The studies are focused on: Cattle adaptation and behavioral pattern in relation to concentrate feeding station, development of skin seismics measurements capacitive method, methods for measurement of breathing rhythm and rumen contractions, heart rhythm and several other physiological parameters.

The interdisciplinary scientific group, built up by both senior and younger members has reached many interesting results and seems to work with great enthusiasm. Among the 14 scientific staff members, there are animal scientists, veterinarians, ethologist, engineers (programs, electronics, chemist) and biologist. The results obtained are comparable to what has been achieved in the leading laboratories in other countries. The scientific work generate new knowledge and is of great international interest. This kind of work will be of great importance for the future. They have so far only had limited international contacts, but have obviously been influenced by similar developments in other countries.

The experimental base (cow shed, workshop, laboratory building) is comparatively good, while there is an obvious lack of instruments. The group has in many cases made them themselves.

51. Studing physico-chemical and microbiological bases the technology of swiss-type cheeses

Institute of Meat and Dairy Technology

Subproject leader: Sen.scientist P. Elias

This research has been focused on improvement of the Emmental cheese production. This production is of great economic importance, but a very large proportion of the cheese (75-65%) is low graded. From the studies have been drawn the conclusions that the reasons for the low grading of the cheese is low milk quality and problems with starter cultures. The cultures are internationally well studied and developed and more experience into this field can be gained through international contacts.

The low milk quality indicates needs for improvements of previous steps in the milk production chain. Development work is here of great value for Estonia.

52. Improvement of the milk and meat technology of production and working out of new products

Sub-project leader: Ass. Prof. A. Kiis

In a sub-project has been studied the possibilities through electro-chemical and eletrophysical methods to remove protein from water waste from dairy plants. The studies include basic protein coagulation experiments, and construction of a pilot plant based on this results. It is claimed that this method is better and cheaper to run than the present systems. The new system is patented. The technique has not been applied in practice yet. The project and the results obtained indicate a high level of technological and scientific skill.

53. The investigation of possibilities to improve the quality of pork produced by intensive technology.

Project leader: Assistant professor Meili Rei, she was away on study leave in Roskilde, Denmark so the project was presented by Mrs Virge Kirikall.

The project involved studies of the quality of pork from farms of different sizes and the quality of boar meat. Standard quality characteristics, such as content of water, protein, ash and fat in the carcasses as well as muscle pH, heat loss, water holding capacity and meat colour had been measured. The results indicate that from an international point of view the pork quality was poor (very fat carcasses with high frequency of the quality defects PSE and DFD). The work done should be classified as necessary quality control rather than research in the true sense. The staff was aware that some of the quality deficiencies (PSE and DFD) were caused by poor handling and slaughtering techniques at the Tartu slaughter house, while the unsatisfactory carcass composition was due to the feeding systems and the genetic material available. Staff at both the Tartu slaughter house and in the farms concerned were informed of the situation.

The equipment and facilities available for research were in general rather limited.

54. Selection of biologically active starter cultures for indirect biological culturing of butter

Sub-project leader: Ass. prof. H. Eller

This sub-project has dealt with applied aspects of improvement of quality and economy of butter production. Parameters related to the pasteurization of cream, different types of starter cultures and the storing effects on aroma and taste, have been studied. Two patent letters have been received as results of the work. It is also indicated that this type of work is now finished.

General comments

The activities should be classified as development research and quality control. The laboratory has worked in close contact with the dairy industry, which is commendable. Its influence on the meat industry seems to have been more limited. The equipment available for research needs improvement and renewal.

Meat and Milk Laboratory, Tartu (general conclusions on projects 51, 52, 53, 54)

The Meat and Milk Laboratory had just (June 1992) been changed into an Institute of meat and dairy technology which in the future would get its budgetary means directly from EPU without any faculty intermediary. However, for the time being, this structural change did not seem to involve any radical change in internal organization or program. The institute is composed of three units a) the meat division with one professor, b) the dairy division with one professor and c) the research division. The two first divisions are responsible for the teaching. The last division is a common unit with pool of 10 people (7 with an academic degree) who assist in the research directed by the senior staff in the meat and milk divisions. Each year about 20 students are enrolled (10 specializing in meat and 10 in dairy science). After one year of common basic studies they study for 3 years at the department. During the last few years there have been about 5-6 diploma works per year in meat and about the same number in dairy science. At the time of the evaluation visit, the institute had no graduate student working for a higher degree.

Research is mainly directed towards butter, cheese and meat. The dairy research is largely financed by the dairy industry with which there are close links and cooperations.

55. Metabolism of carbohydrates and protein in high yielding dairy cows

Background

Metabolic diseases of cows are common in agricultural countries and cause economical losses. This project deals with metabolic disorders in dairy cows in large herds. The levels of ketonbodies, free fatty acids, glucose, amino acids, acid-base balance etc have been analysed in cows sera during various lactation stages and during different seasons. A young scientist has spent some months at the Agricultural University in Sweden and is planning to study the levels of thyroid hormones and cortisol in relation to metabolism.

Comments

Investigations and research in this area are needed since it help to elucidate the importance of, and in future help control, metabolic disorders in Estonian cattle. The research group is open for international contacts. They have also prepared a manuscript in English about ketosis for submission to an international journal. The research is hampered because of lack of financial resources, equipment (old), chemicals, spare parts and a heavy teaching duty. It also appears that the knowledge in the research field is not up to date, mainly owing to lack of international periodicals. There is no, or only little cooperation within this field with other Estonian researchers.

Recommendations

Continuation of the project is recommended. However, this research group is rather small and has scanty resources. Therefore, cooperation to some extent with researchers at the Institute of Animal Breeding and Veterinary Science and at the Agriculture Biotechnology centre is recommended. Improvement of postgraduate training, methods and equipment and access to international literature are needed.

56. Helminthoses in games, their control and connection with helminthoses of domestic animals

Report No 56 was given to us in a new and improved version when we met Dr T.Järvis and his group. The main scientific project is to clarify the situation as far as parasites are concerned in farm animals and in some wild species of animals. Investigations have been going on for a number of years. The knowledge of the situation seems to be very good. One problem is that a high number of wild animals as roedeer, elk and wild boars have parasites of importance to farm animals and to meat used for human consumption. Systematic investigations in farm animals as cattle, pig and sheep are going on.

Comments

It was noted that the group has good international contacts and a couple of post graduate candidates are going to Denmark to Prof Peter Nansen for postgraduate training. With great satisfactory it was also noted that the group was willing and able to stimulate young scientists to improve their international contacts and their postgraduate training. This training should include enzootic aspects of parasites in farms, wild animals etc.

57. The influence of some tissue preparations on the growth, development, resistance and wound healing of sucking pigs

Background

The project deals with the development and evaluation of "Biostimulators" prepared from blood or spleen or combinations of these two tissues in young pigs and calves. The effect of 3 injections 2 weeks apart in young pigs with these biostimulators on growth rate, death rate, wound healing amongst other parameters was evaluated in large-scale trials.

Comments

The author claims for instance that the spleen-blood preparation stimulates growth and development of suckling pigs, hastens the healing of wounds and reduces death rate. No attempt to determine the mechanism of action is presented. The reported advantageous effect is surprising and not easily explained from scientific point of view, which invites to scepticism. The research can not be considered as up to date. There is also a risk that such biological preparations contain infectious agents.

Recommendations

Before any further research in this area is performed, the results should be presented and accepted internationally, for example by submission of articles to periodicals with referees. Otherwise, termination of the project is recommended.

58. Prophylaxis and Treatment of Gynaecological Diseases

Faculty of Veterinary Science

Department of Surgery and Obstetrics

Head of the Department: Ass. professor Madis Aidnik (Cand.Sc.).

Principal Activities

The Department is responsible for teaching veterinary students in obstetrics, gynaecology, mastitis, andrology, artificial insemination, embryo technology in farm animals.

The research work has proceeded from needs of cattle breeding in Estonia. During the past 5 years the research has been concentrated on four projects: (1): uterine infections in dairy cows and their prophylaxis and treatment. This project is performed in cooperation with microbiologists, pharmacologists and specialists in clinical medicine. Estonian is very short of medicines for farm animals - this project has therefore also been directed towards manufacturing of suitable drugs for treatment and/or prophylaxis of endometritis in close cooperation with the Chemical Industry in Estonia as well as Latvia. (2): Clinical studies of subclinical mastitis in cooperation with microbiologists at the Faculty of Veterinary Science. (3): Clinical studies on the efficiency of a synthetic analogue of prostaglandin F2a, manufactured by the Estonian Institute of Chemistry. (4): Early pregnancy diagnosis etc using a method to estimate the progesterone concentration in cow milk. This project is run in close cooperation with the Estonian Research Institute of Animal Breeding and Veterinary Science (compare project nr 19).

International contacts: None at the moment. One of the staff members has applied to the 9 months postgraduate course in animal reproduction to be held at the Department of Obstetrics and Gynaecology, SLU, Uppsala 1993.

Scientific staff: two ass. professors and 2 research ass. (working part time on their thesis).

Buildings, equipment: A new clinic with laboratories is constructed and the Department is supposed to move in in September. Very short of modern research equipment.

Evaluation

Completed as well as current research is very relevant to the national needs and of satisfactory quality. The amount of research is very limited due to shortage of staff members and laboratory resources. No international contacts are established. The contacts with Tartu University as well as the Estonian Research Institute of Animal Breeding and Veterinary Sciences for research cooperation and postgraduate training are sparse.

Recommendations

The scientific work and the postgraduate training of young staff members must increase. Increased economic support for this is very important and necessary. Closer contacts must be established between this Department and the Estonian Research Institute of Animal Breeding and Veterinary Science. Equipment to the new clinic for scientific work must get high priority. International contacts should be established - young staff members should spend shorter periods at corresponding Departments in Western Europe.

59. The ageing and functional changes of gut and female tubular genital organs

Estonian Agriculture University in Tartu

Faculty of Veterinary Science

Department of Anatomy, Histology and Physiology

Head of the Department: Professor Hanno Kubar, (Doctor of Science).

Principal Activities

The Department, which has three sections (anatomy, histology, physiology) is responsible for teaching veterinary students. The research work evaluated here is from the section of Histology. The research work has been concentrated to three different projects: (1): Histology and pathohistology of the bovine and porcine endometrium, using light microscopy. (2): Morphology and cytology of the bovine and porcine oviduct, using light- and electron microscopy. (3): Ageing and functional changes of the digestive tract in growing pigs, using light microscopy, scanning electron microscope and transmission electron microscopy. Especially the last current project is done in cooperation with Tartu University using their transmission electron microscopy.

International contacts: The late professor (Thehver) made a couple of study leaves to Edinburgh and kept close contacts with the research group within his field of interest. Professor Kubar attended the 1968th ICAR in Paris. One postgraduate student is supposed to spend 2-3 months at the Department of Anatomy and Histology, SLU, Uppsala 1993 (agreement with professor Drevemo if she receives a scholarship from Sweden).

Laboratory equipment: Technical basis for research work is satisfactory (see above). Short of spare components and chemicals.

Scientific staff: One professor, one ass.professor, one postgraduate student.

Evaluation

The scientific work is of good quality and part of it should have been accepted for publication in international journals. The laboratory is rather well equipped and has moreover close cooperation with Tartu University and possibility to use their equipment. They are very short of chemicals necessary for preparation of material for electron microscopic investigation. The staff is small, but there is a spirit of enthusiasm.

Recommendations

Strongly recommend a continuous support for their research which is not only of national but also to a certain extent of international interest. International contacts should be established especially for the only postgraduate student (see above).

60. Bovine enzootic leucosis (BEL) problems research, improvement of diagnostic measures and elaboration of eradication schemes for Estonian cattle.

Enzootic bovine leukosis is caused by a retrovirus, bovine leukemia virus (BLV). Most of the infections are subclinical but a few percent of infected cattle may develop tumors which usually leads to death of the animal. Several countries in western Europe have an eradication and, or control program for this disease. The aims of the project were to set up methods for detection of antibodies to BLV and to work out a strategy to eradicate BLV infection. Serosurveys were also performed in order to estimate the prevalence of animals with antibodies to BLV in Estonia. The project also include a preliminary investigation of a possible relationship between pollution of environment with nitrogen compounds and development of tumors. This part of the project is not further commented since the report gives only a few preliminary data and the project was interrupted because the scientist in charge has terminated his employment.

Comments

The method used, immunodiffusion in agar, is an internationally accepted method for detection of antibodies to BLV. The serosurveys show clearly that BLV-infection is wide-spread in Estonia and the project is therefore of importance for the country. The research group aims to set up an ELISA-test for detection of BLV antibodies in milk and serum and a young scientist is planning to go to Denmark to learn the technique. ELISAs for detection of BLV-antibodies are available on the international market.

Recommendations

If a national program for eradication of BLV is to be set up, contacts with experts in other countries with experience from this field is recommended. However, since the cost of BLV infection is generally thought to be minor, the potential benefits of a program should be carefully evaluated. The set up of an ELISA-test is recommended irrespective of a program or not. Contacts and cooperation with Agriculture Biotechnology Centre for development of an ELISA is recommended since this centre has such plans. Improvement of postgraduate training is also recommended.

- SS 12. Working out recommendations for creating and introducing models of economic accounting for organizing self-dependent units in agricultural production and for developing rural social infrastructure.
- SS 13. Creating and updating the data base of agricultural specialists and using it for carrying out different analyses.
- SS 14. Economics and management of transport in agriculture.
- SS 15. The ownership in the Estonian agriculture (farms, their reestablishment and setting up: a technological, economic and bioenergetic model of a farm).

Department of agroecconomics

The department has an interdisciplinary group with participants from biological and technical departments within the university. The aim is to analyze how to restore the ownership in the Estonian agriculture. The group studies how to restore large production farms, how to reestablish family farms, and the possibilities to compete with western farms.

The group has done economic calculations on family farms. However, the instability of the rouble caused difficulties in the economic analysis, so the group is now developing energetic models of various types of family farms. The coefficients of energy output and input are calculated, and compared to the same coefficients from western countries in order to conclude on the productivity and competitiveness of the Estonian farms.

A comparison of energy coefficients will express future competitiveness only if future prices of the products and resources will correspond to their energy content. It would be better to base the analysis on forecasts of future prices or price intervals. In the literature there are methods described about how to deal with the price uncertainty. Economic analysis of the best organization and production in both family farms and large farms is necessary and it is good to have an interdisciplinary group in this work. It is important to base the analysis on the relevant economic theories and to include marketing aspects.

The economics and management of transport in agriculture are also studied at the department. This research is good and the project group's extensive contacts with western countries is promising.

Department of information science and management

Statistical, mathematical and Operation Analysis methods are applied to agricultural problems.

Linear programming was applied to (1) coordinate the overall production in labour taking collectives, (2) medium range planning of a farm, i.e., optimizing the production level in each enterprise, and (3) feed planning.

A renewal theory was applied in scheduling machinery repair. An analytical method based on Laplace transformation was used.

Regression analysis, factor analysis, analysis of principal components and similar statistical methods were used in collaboration with the sector of economics, the Estonian Research Institute of Agriculture and Land Improvement, in order to analyze production statistics.

The research projects of this department are good from a methodological point of view. A database of agricultural specialists has been developed and maintained by the department. This work is of little value, and the department is going to finish it.

Department of accounting and analysis

The department develops accounting systems for both state and collective farms and for family farms. It is discussed to transform the state and collective farms to share holding companies and the department develops accounting systems for these companies. It assists the interdisciplinary group of the department of agroeconomics to develop models for family farms. The department participate in the design of production statistics and statistics about farm profitability.

This kind of research and development work is necessary.

34. Improvement of prediction and planning rules for automated control systems of forest management.

Faculty of Forestry.

Department of Forest Management.

In total about six researchers/teachers are employed at this department. Most of the time is used for educational duties on the under-graduate level. This situation is commented earlier in this report.

Research must to a great extent be done during leisure time.

There is a lack of equipment and the PCs at the department are gifts from abroad to a great extent, but good manuals for running the computers are often lacking.

A wish is forwarded to increase the number of doctorates, but the possibilities are restricted due to circumstances commented earlier in this report.

A recommendation is to limit the educational duties in order to give the researchers time for research. Ways to handle the situation are discussed earlier.

IV.5 Estonian Forest Research Institute

62. The management regime of protected areas, principles of protection etc.

The protected areas in Estonia was said to be about 15 % of the total land area. There are different kinds of the total land area. There are different kinds of restrictions in the protected areas and in some areas forest harvesting is permitted if special methods are used. In comparison to other countries in Europe the share of protected areas seems to be very high. It was said that there is a need to protect still more areas in the future.

A lot of projects are running dealing with different management measures in the protected areas. This includes monitoring of vegetation, site types, species composition.

Another research project dealt with the development of lingon-berries in dry sites and the dependence of e.g. temperature on pollination; density of over-shelting pine stands; suitable forest types.

Other project was focused on migration of birds in the protected areas and the changes in species composition in the protected areas.

Another project dealt with bats in protected areas and for Estonia new species of bats has been found.

The impression is that a high quality work is performed even if the equipment is in some way oldfashioned. Some of the researchers have participated in congresses abroad and in general there is a good awareness of research results abroad. The researchers have good contacts with colleagues in the same field in other countries.

A question is, if it is the responsibility of the Forest Research Institute to run some of the projects or if some other authority should have this duties. It is not possible after a short visit to advice what is the most adequate location of this projects, but the question ought to be considered.

63. Measures for management of forests on drained lands and a system of forest fertilization

As earlier mentioned the share of drained forest area is very high in Estonia in comparison to e.g. Sweden.

Research projects dealing with the management of the drained forests are of great importance. Ocularily it seems that a program for complementing the old drainage system will be needed in the near future to avoid a re-embogging of large areas. Investigations are performed, focused on different fertilization regimes on the drained areas and recommendations are given to the forest districts. It seems that the increase in increment will vanish relatively soon after fertilization. The interest in fertilization of forest on drained areas has decreased during the last time.

Results from the Estonian Forest Research Institute are published in "Report from the Forest Research Institute" mostly in Estonian and in monographs with special themes.

64. Complex measures for recultivation of lands damaged by industry and for raising the resistance of stands to pollution

Kohtla-Järve

In the field examples of reclamation of devastated areas was demonstrated in the NO part of Estonia. Different tree species were tested on areas where oil shale had been exploited earlier.

The result indicated that even on soils which were lacking almost all humus contents, some tree species could develop astonishing well. Besides common figures about yield capacity of the different tree species, the experimental plots could demonstrate the growth rate of the humus layer, the immigration of different herbs, plants and trees. There ought to be an interest to follow the development of the whole ecosystem including the trees also in the future. The question is if there will be funding enough to make repeated recordings of all field experiments. Perhaps it would be wise to select those experiments which are most interesting, to follow and to limit the recordings to the tree height development of the dominant trees.

In general when working with field experiments in research, there is a tendency towards very rapid increases in costs. The situation seems to be the same in Estonia as in other countries. If there will be reductions in funding for observations on the field experiments, it will be necessary to select the most important ones for future treatment. It seems that the measurements on the field experiments are performed by students in many cases and that the system of numbering trees and marking of breast height level is neglected. According to international experience one would prefer fewer experiments and a higher precision in the recordings in order to avoid large errors in the determination of treatments effects.

65. The Seed-Growing of the Main Tree Species

One project dealt with micro-propagation of trees and the researchers responsible for this project were well informed about results obtained in this field in other countries, especially Finland. There were great difficulties to get the chemicals needed for the work in the laboratories. The method used was to take meristems from buds. The method with somatic embryogenesis with seeds was not practised yet.

Another project dealt with the task of increasing the cone production in tree orchards. Different fertilizers and combinations of fertilizers had been tested. The method used in e.g. Sweden with indole acetic acid (IAA) to promote flowering in spruce tree orchards had not been tested.

66. An integrated system of measures for management of forest with multi-purpose utilization

One of the projects was focused on the classification of the productivity level of the forests on different soil types. Large materials were used as a data base for calculations, including multiple regression analyses. Tree radius increment was analysed as a function of e.g. climate, geographical location, humus layer.

The project has some similarities with projects earlier run in the Nordic countries. They had good information about research performed in other countries on the same theme.

It was mentioned that they had difficulties to do research effectively due to lack of proper equipment, computers and laboratory apparatuses for soil analyses.

Up to now the funding for running the project came from the Government, 80-90 %. The research program was also decided by the State Forest Department.

67. Forest monitoring

A number of projects were presented under this umbrella project dealing with forest monitoring.

One project dealt with monitoring of forest decline in observation plots scattered over Estonia. The crown decline was observed on these plots and showed a special pattern over the country.

Damages on plants by different beetles were studied in one project. Different beetles had other preferences of tree species in Estonia and the western part of Russia than in Scandinavia. This indicates that results obtained in other countries can not be transferred directly to Estonia.

In a project dealing with predators to bark beetles one tried to find prognosis instruments to predict the probability for attacks of different beetles in the forest.

The use of pheromones was studied in a special project in order to find methods to reduce the damage of bark beetle attacks. Pheromon traps imported from Norway were compared with traps developed in Estonia. Good contacts were established with entomologists also in the Nordic countries.

A research project focused in fungi attacks on leaves, shoots and neddles was run. Here the identification of fungi was included on materials sent in from different forest districts. In this way one had a good picture of the pattern of diseases from the whole of Estonia. Prognoses were also made for the outbreak of fungi attacks and it was said that these predictions were good. Results from the investigations had been presented at symposias abroad and the researcher responsible for this theme knows colleagues in the Nordic countries.

Root rot due to the fungus *Heterobasidion annosum* was studied and one main issue was to find natural antagonists to this fungus. As this fungus has three different strains it was essential to find antagonists for each strain. It was said that they had succeeded in their efforts. Research results and researchers working in the same field were known in Scandinavia.

Estonian Forest Research Institute (general conclusions)

The main impression of the activities at the Estonian Forest Research Institute is positive. A lot of projects are of great importance for forestry measures and the quality of the research is satisfactory as far as can be understood from the presentations of the different projects and the earlier delivered project descriptions.

It seems that the choice of research subjects earlier had been made on a central level. In the future, the determination of which research projects should be handled by the Forest Research Institute ought to be decentralized to the Board of the Institute in cooperation with representatives of the forest enterprises. If a large area of the state forests should be privatized in the future, the management principles of small forest holdings will be of growing importance also for the Forest Research Institute.

We are aware of the earlier discussion about a merger of the Forest Research Institute and the Faculty of Forest at the Estonian Agricultural University. It is however difficult after a short time to have a definitive idea of what is most effective. For the educational situation a merger seems to be favourable and also for the access to information about field experiments to a wider spectrum of researchers than today.

IV.6 Tartu University

NS 17. Pheromone communication of insects as part of chemical communication in ecosystems. Synergistic effects and isolation mechanisms in pheromone communication.

Research on insect sex pheromones started 20 years ago at the University in Tartu. The outcome of this program has been considerable, not least in the southern regions of the previous Soviet Union.

In order to improve the program and to overcome some experimental and theoretical constraints a special research team on chemical communications has been established jointly at the two Tartu universities (some joint staff). Pheromone dispensers for 12 pest moths have been introduced for production. Further applications of pheromones in insect control are being developed. Different blends are being screened, also with some additives and some fungal smell constituents. At present pheromone mass trapping of male moths is used in orchards in the Baltic states and some parts of Russia.

A 40 hours course on chemical ecology has just been started at the Tartu University.

Comments

This work gives the impression of high scientific value. It seems now timely to make an in-depth external review of its impact on Estonian horticulture (research, education, practise), potential for export, trade, etc.

The research on chemical communication in a wider sense should also be emphasized in such a review due to its both scientific and practical potential (see further comments under project NS 58).

NS 19. Elaboration of GIS for landscape ecological research and territorial management

Station of Ecology

Laboratory of Geoinformatics

Principal activities

Elaboration of GIS (Geographical Information Systems) for landscape ecological research and territorial management started in 1986.

Most of the GIS research at the Department of Geography at Tartu university has been theoretical. However, the recent objectives to elaborate agroecosystem simulation models, to develop required data bases for this, to make a conceptual scheme for computer mapping of Estonia and the Baltic region, to prepare for thematic maps and to compile an end-user-oriented GIS for local environment impact assessment and management are quite relevant considering the obvious needs to map e.g. pollution and for restoration of national cartography. Schemes for protection and sustainability of natural resources can then be constructed.

Comments

Geographical information systems research is important, not least in order to establish national cartography on ecosystems and pollution areas. This will facilitate activities for environmental protection and improvement. To get models of ecosystems requires collaboration with other institutions to get data on e.g. water cycling, nutrient migration and transfer. Not least soil, crops and hydrotechnical scientists need to be involved for the data collection and interpretation. Cropping systems and agricultural measures should be involved in the program.

This work should receive priority. The group is creative, enthusiastic and skilful. Besides, it has good computer equipment to its disposal. An advisory group with members from relevant disciplines would be of help for planning and performance of this fairly long-term program.

IV.7 Estonian Research Institute of Animal Breeding and Veterinary Science

4. Research into the handling, treatment, composting and effective utilization of manure on cattle & pig farms

Leader: Dr Valjo Masso

Staff: 7 persons

Objective: Improving the handling and utilization of animal manure

Present work: Will be completed after discussion with Kalju Valdmaa, Uppsala.

5. Investigation into the number of cows in dairy groups

Leader: E. Pettai, Cand.Agr.Sc.
 Staff: 4 persons
 Resources: Office building
 Objectives: Management of large cow herds
 Present work: Following up the efficiency in cow herds of different size, grouping and management
 Evaluation: Hardly any scientific work however important under these conditions.

6. Improving and evaluating technolines in dairy farms with the aim of rising labor productivity and save energy

Department of Mechanization

Leader: O. Vutt
 Staff: 6 persons of different professions as engineers, agronomists and work scientists.
 Resources: Good buildings
 Machine shop
 Affiliated "Design office" and Machine building capacities
 Limited instrumentation
 Objectives: Testing, design and adjustments of farm equipment for cattle breeding on large and small farms such as equipment for: feeding, dismanuring, milking
 Automation
 Electronics
 Energy

Present work

Adaption of Soviet cattle breeding equipment for Estonian conditions. Design and building of machinery in the same field. The adapted machines have often been much better than the original ones.

Accumulators for energy saving in cowsheds. Means of preventing corrosion has been worked out.

Automation of the use of different electrical equipment in the cowsheds.

Electronic equipment to determine the change of electric properties in milk from cows affected by mastitis.

Investigations on the importance of milking producers.

Work on energy saving but not on production of bioenergy as use of straw or biogas production.

No work in the area of working conditions and work safety.

Evaluation

Low quality of Soviet machinery and low adaption of these to local conditions is a major problem. Machinery for family farming is lacking. Both problems are important to the future Estonian agriculture.

The knowledge and experience of this group will be of great value for future practical work in this field. Two young members have completed dissertations, one on the importance of the procedures in milking work for the quality of the milk and for the health of the cow.

There seems to be a great need for more young scientists dealing with the management of dairy farms especially in the coming transition period.

An equipment for diagnosing mastitis has been developed. The proposed possibilities to market this equipment in Europe ought to be questioned. The group has a great need for international contacts. Although the future of Estonian agriculture is extremely unclear, the goal for the group has to be defined more consistently.

Summary

The group is working very applied, however, the width of the work is unclear.

The field of work has to be changed, especially if the structure of Estonian farming changes.

There is an ultimate need for international contacts.

New scientists should be introduced in the group.

The Cattle Breeding Centre (general introduction)

(Projects no 1, 10-12, 16-18)

The objective of the Cattle Breeding Centre is to improve cattle production through breeding and through improved feeding and husbandry. The centre is divided in to four major units

- a) Department of cattle breeding.
- b) Department of reproduction biology.
- c) Department of data processing.
- d) Laboratory of milk analyses.

All units have worked in close collaboration with the state and collective farms and are in addition to research also responsible for developmental work and advice to the staff in the collective sector. There is an increasing interest in developing contacts with the growing private sector.

After the collectivization the Centre reorganized milk recording during the 1950:ies. About 80% of all dairy cows are now milk recorded. Data from the milk recording scheme and from the milk analysis laboratory are fed into the computers in the department of data processing and used for breeding value estimations. The Breeding Centre is now trying to organize milk recording among private dairy herds. About 15-20% of the cows in that sector are milk recorded. Efforts are made to give advice to the new farmers on cattle husbandry techniques through the A.I. centers and the collective farms.

1. Studies of blood group and blood serum protein polymorphism in cattle

Department of Cattle Breeding

Project leader: T. Okva, Cand.Agr.Sci, Laboratory of immunogenetics

The immunogenetics laboratory has a total staff of 6 persons of which 2 have Cand.Agr.Sci. degrees. The objectives of the laboratory are to control the pedigree of breeding animals and to do research on the population structure of Estonian Cattle breeds and on associations between blood markers and production traits.

The laboratory uses both immunogenetics and electrophoretic techniques. In all 49-59 blood grouping reagents are used of which the majority are bought from a biofactory in the former USSR.

Under the management system used in the large Estonian herds, pedigree checking is evidently necessary. In 1988-1990 the parentage of 3186 young bulls was checked by the laboratory and no less than 11 % were found to be incorrect.

The research activities in the laboratory are rather limited. The finding that the Estonian Red Cattle are immunogenetically similar to Angler and Red Danish Cattle is interesting though not surprising, considering the use of these two breeds in the formation of Estonian Red Cattle. The studies on the relationship between blood markers and production characteristics would require the use of adequate statistical methods. The staff is recommended to seek the advice on statistical analyses from the Department of data processing.

The equipment used in the laboratory is old. No work has been started in the rapidly expanding field of DNA genetics for obtaining suitable markers in parentage tests, studies of population structure and gene mapping. This was said to be due to lack of resources. The laboratory has had some contacts with the International Society on Animal Genetics and participated in some international reference tests. One of the younger staff members will make a three months study visit to the Swedish University of Agriculture Sciences, Department of Animal Breeding and Genetics, Uppsala, during 1992 on a grant from the Royal Swedish Academy of Agriculture and Forestry.

10. The improvement of milk handling and cleaning milk-dairy equipment

The Laboratory of Milk Analyses (Dairy Laboratory)

Leader: Dr. A Olkonen

The major responsibilities of the laboratory are:

- Routine analyses of milk samples from the milk recorded cows (in all 260.000 milk samples per year). Milk fat, milk protein are analyses and somatic cells are counted.
- Control laboratory for dairies in Estonia.
- Research into milk hygiene and milk quality.

From the report (No 19) it is obvious that the bacterical quality of the raw milk is in general not very good. The contamination can in many cases be brought back to the cleaning and disinfection of the milking equipment and installation in the farms. Development work with regard to improvement of the hygienic quality of the milk are reported. This is an important area as such, but has very little to do with actual research work.

Four staff members with academic degree are working in the laboratory. They have cooperation with the Institute of Meat and Milk Technology at the Est.Agric. University.

11. Studies on influence of Holstein genotype in Estonian Black and White herd

Project leader: Laine Kallas, Cand.Agr.Sci.

The project is a part of an all-union undertaking for improving milk production in the existing cattle number in what was then the USSR. In the first stage of the project (1981-1985) the population of Black and White crossbred cattle with Holstein Friesian genes was increased through the use of semen from Holstein Friesian bulls and bulls with high portion of such genes. In the second phase (1986-1990) the productivity of cows with varying portions of Holstein Friesian inheritance was studied. Twenty experimental farms and very large numbers of cows were involved in the study, which showed that milk yield and total fat production increased very significantly with increasing proportions of Holstein Friesian genes, while fat percentage decreased somewhat. These results have led to an increased use of Holstein Friesian semen all over Estonia. In 1990 52,3 % of the cows were Holstein Friesian crossbreds.

The project has formed the basis for two theses for the Cand.Agr.Sci. degree, one diploma paper and a large number of publications. The project should be classified as development research and has undoubtedly been very useful to the country.

12. Improvement of the milk production traits of the Estonian cattle breeds

Project leader: H. Idarand, Cand.Agr.Sci.

The project is rather a program than a well delineated project. The report gives, in addition to a general description of the improvement program for dairy cattle in Estonia, the results from the use of semen from foreign dairy breeds on the productivity of Estonian Red Cattle. The general objective of the Estonian dairy cattle breeding program is to increase the genetic production potential through applied breeding systems and techniques. The breeding program developed is very similar to those being used in most western countries. It is based on progeny testing of bulls, the selection of calves from the best cows and the best progeny tested bulls, raising the bull calves in special station for the registration of growth and fertility and the early use of the better performance tested young bulls in test matings for progeny testing for milk production. The breeding program has evidently been developed in close cooperation with other scientists in Estonia (cf. project No 25). The results have been encouraging. The knowledge of the breeding values seems to have been much better in Estonia than in most of the former USSR republics, which for a long time gave rise to a profitable export of Estonian bull semen to other republics.

Estonia has also been used for trials for studying non-USSR breeding material. In the report a description is made of the results of using semen from Red and White Holstein Friesian, American Brown Swiss, Danish Red and Finnish Ayrshire bulls on Estonian Red cows. These results will obviously be of great value when determinating the future breeding policies for Estonian Red cattle.

The project has resulted in one Cand.Agr.Sci. thesis and many publications of Russian or Estonian.

16. Feeding of record-cows for the purpose of achieving high life-time productivity

17. The research into local and non-traditional feeds

Department of Feeding and Feed Research.

Leader: Mrs Helgi Kaldmae, Cand. of Agric. Sci.

The department is mainly working with research and development into feeds and feeding of cattle. The two papers (16 and 17) cover in principle the present program areas:

Basal feed ration to dairy cows
Non-traditional feeds to cows and calves
Studies on *Gallega orientalis*.

In the past, feeding rations to the dairy cows were developed in the direction towards use of high proportion of concentrates in addition to pasture and preserve forages (silage or hay). Paper No 16 describes such a study where selected cows were fed well balanced rations during several lactations. It resulted in high milk yield from the cows, which is a good demonstration that the cows have a high genetic milk production potential which can be utilized under good feeding and management systems.

Under the present and future situation with shortage of concentrate and protein supplements, the development into better use of available grass and legume feed resources is a necessity. Such a development program shall be given the highest priority. This is covered in paper (17), where so called non traditional feeds also are included.

In this respect the legume *Gallega orientalis* (see paper 79) is investigated with regard to its nutritive content and feeding value.

The Department has a well equipped laboratory for conventional feed analysis. It is used both for routine analysis of feed samples from the farms as well as for the development work.

The scientific staff includes both experienced and younger scientists. They have international contacts, a.o. with the Nordic countries.

The Department has over the years published many papers dealing with applied aspects of cattle feeding. It plays an important role for the development work and extension activity in Estonia. Cooperation with the Department of Animal Nutrition and the Estonian Agricultural University has also been demonstrated (see paper 47). Such cooperation should be promoted with regard to better use of available resources to be used for teaching, basic and applied research.

18. Meat Production resources of Estonian Cattle breeds

Project leader: A. Suurmaa, Cand. Agr. Sci.

Practically all beef in Estonia is produced by dairy cattle. Therefore it is considered important to find ways and means to increase total meat production and meat quality from within the existing cattle population without negatively influencing milk productions.

The project spans over a rather wide area.

- progeny test of bulls for their sons meat production and quality
- in vive estimations of body composition
- the influence of feeding intensity on beef quality
- the effect of crossbreeding with Holstein Friesian cattle on beef production in Estonian Black and White cattle
- field recording of Hereford cattle.

The topics selected for study are all relevant for the development of cattle production in Estonia. Most of the studies use standard methods and the results, although rather straight forward, will be of practical value in the livestock industry. The studies of in vivo estimation of body composition in cattle involve methodological development and appear to be of general scientific interest.

The group which in addition to the project leader, comprises 3 persons with Cand. degrees and one junior researcher has established contacts with scientists in Finland, Iceland, Norway and Sweden.

The Cattle Breeding Centre (general conclusions)

Projects no. 1, 10-12, 16-18

The scientists in the Cattle Breeding Centre have been very active. It is obvious that the Centre is involved not only in research but also in developmental work and in giving advice to the practical production sector. The name "Breeding Centre" is perhaps a misnomer, as "breeding" in the normal English usage means "selection and reproduction for genetic improvement". A more appropriate term in English would be the Cattle Production Centre. The Centre has evidently responsibilities for general cattle production involving both breeding, feeding and husbandry. The Centre is also undertaking activities which in Western countries often or generally are executed by private cooperatives (e.g. progeny testing of bulls) or by private or governmental organizations (e.g. advice on practical cattle production, the organization of milk recording or execution of milk analyses).

The research in the Centre is generally very practically oriented and should perhaps best be seen as a part of a directed developmental process. This developmental research has undoubtedly - under the existing economic system - been of great importance for cattle production in the country.

The staff at the Centre has over the years had close contacts with researchers at EPU and the Institute of Experimental Biology. The participation in the teaching of undergraduate students seems however to have been very limited, which is regrettable as the Centre staff as a collective has much to offer in knowledge and experience.

2. The breeding and selection of eggs and meat type hens in Kurtna Poultry Breeding Experimental Station.

Department of Poultry Breeding.

Project leader: Axel Turp, Cand.Agr.Sci.

The poultry research is carried out at the Kurtna Poultry Breeding Experimental Station and covers breeding, feeding, management and veterinary matters. The staff comprises, in addition to the project leader, two persons with Cand. degrees and one technician. There is floor space for raising 75.000 chicks, keeping 12.000 breeding hens under individual control and 45.000 parent stock hens. The station appears to work more or less as a commercial breeding centre for the development of breeding material to be used in the national poultry industry. Their selection work appears to have been relatively successful.

The station receives students from EPU for practical training. One Cand. degree thesis was presented in 1987 on leaf protein concentrated and rapeseeds in poultry rations.

3. Improvement in diagnostics and prophylaxis of bovine metabolic disorders

Background

This project can be divided in to three parts: (a) application of established and well-known international methods (kits) to analyse enzymes in serum and to use bromsulphthalein retention test as aids in diagnosis of liver disorders in cattle, (b) to set up methods for measurements of the levels of various minerals, trace elements and vitamin D, and (c) determine the teratogenic effects of ochratoxin A, a mycotoxin that can induce disease in farm animals such as pigs and chickens. This part has been, at least temporarily, interrupted. There is not a sufficient amount of information on this latter part of the project for an evaluation.

Comments

Ad (a). The methods have been applied on sera from Estonian cattle of various ages and breeds. The studies appear to be well performed. In future, the group's aim is to use blood profiles as an aid to detect metabolic disorders.

Ad (b). The methods used are up to date. The research has revealed deficiencies of some trace elements and vitamin D in Estonian cattle. One young scientist is planning to go to Sweden and establish contacts in this field.

Ad (a) and (b). The laboratory is rather well equipped but suffers from lack of spare parts and chemicals. The group is research-minded and wants international contacts. There is also a need for access to international literature. Certain coordination within this research area can probably be arranged between this research group and researchers at the Faculty of Veterinary Medicine and at the Agriculture Biotechnology Centre.

Recommendations

Continuation of this project is recommended. However, blood profiles and its possible applicability has been called in question and, therefore, a thorough study of modern literature is recommended before further studies in this area are performed.

7. Improvement in the ways of utilization of land and cultivated grasslands etc.

Department of Economics.

Sector of Grassland Husbandry.

Project leader: Mr Jaan Liiv, Cand. of Sci.(Agric)

The section was founded in 1984. It is involved in research and development work in three main areas: 1. Production of forage, 2. Utilization of forage in milk production, and 3. Grazing on cultivated and natural pastures. The activities are of very applied nature and they expressed their future responsibility within

- Scientific research work on forage crop production, at present in cooperation with the departments of Grassland Husbandry and Botany at Est.Agric. Univ. and coordinated by Dr. H.OLDER (see nr 91)
- Advice on forage production to the ten ELVI experimental farms.
- Extension work to other farms in Estonia.

The submitted paper (nr 7) clearly shows that the section has very actively worked with development and extension activities within their field of responsibility. Development studies on their use of e.g. red-clover is of great value for the Estonian forage production.

It is, however, recommended to have closer cooperation with experienced animal scientists when it comes to the analysis and evaluation of forage crops and research in that field. Use of gross energy content of forage, as mentioned in the paper, is only of very limited value for feed evaluation. Bearing in mind the vast experience and knowledge in this research area, it is suggested that future research work should be directed more towards principles concerning relationships between forage/pasture, feed intake, rumen metabolism and animal performance.

The section has four scientists, two with Dr.-degree and two post-graduate students.

13. Evaluation of rams according to their performance

Department of Sheep Breeding.

General information

The department is located at the Puka Experiment Farms some 30 km south of Tartu. The staff comprises 2 scientists and technicians. The sheep station has a winter flock of about 800 sheep, of which 1/3 are of the Estonian White Faced breed and 2/3 of the Estonian Dark Faced breed. Techniques for feeding and husbandry of sheep and pasture management applicable in Estonia are worked out. At the station performance testing is made in a flock of about 60 young rams.

The project

Since 1986 the best ram lambs descending from the best rams are collected from all over Estonia and performance tested on uniform conditions during one year for traits such as growth and body conformation, wool production and quality. The project summarizes the results of the evaluation of 263 young rams in the period of 1987-91. The activity, although not research in the true sense, is important as a part of the national effort of improving sheep production, which is of particular significance to the small private sector.

14. Feeding, feeding technology and keeping systems of pigs

Department of Pig Breeding, feeding, feeding technology and keeping systems of pigs.

Program leader: Leo Nigul, Cand. Agric. Sci.

The report includes a summary of the passed research and development activities regarding pig feeds and feeding, and management systems for pigs. The shortage of protein and protein feeds has influenced the programs and several studies have focused on the potential of unconventional feeds as substitutes for conventional feed stuffs.

With respect to the situation in the country the choice of research problems seems to have been relevant. Great efforts have been put into the area of minimizing dairy products for piglet feeding and in the use of feed additives, such as growth promoters. The use of domestically produced protein sources in pig production has been another important area. Most of the results of this applied research seems also to be in agreement with results reported in the international literature. Some unusual ideas have been evaluated, such as the use of lake mud and microbial mass propagated on peat. These ideas have been shown to be inapplicable in practice.

As to the experimental methods, evaluation of growth performance in production experiments has been used. As far as I am aware only one level of substitution has been used in most of the experiments. The use of a stepwise increase in the level of inclusion of the ingredients under test (with at least two levels over the zero level) is a much more informative way of evaluation than just one level. Sometimes the results could be biased by using just one level. Certainly, as an experimenter one has to balance between the resources available and the problem to be solved. However, it seems necessary also to consider the quality and reliability of information produced. This is a general comment, since it is difficult from the overviews given, to decide if it is applicable to the research under evaluation.

A further comment is to use more advanced statistical methods in the process of evaluation of experimental data; so from a statistical point of view e.g. the effects of sires, dams and time of the year could be of importance to consider in order to increase precision.

Production experiments are expensive. Hence, the research strategy should also consider other means of evaluating feedstuffs prior to a big experiment, such as the use of metabolic experiments. However, it should be emphasized that production experiments are essential as a final step and as a basis for practical recommendations and economical decisions. The scientific basis could become much firmer by the combination of more basically oriented and applied experiments.

The research activity at the time of our visit was low, which was explained by the present shortage of funds. The staff within the pig feeding research sector includes 2 scientists. The laboratory for feed analysis included some basic instruments. It seemed to face similar problems as other laboratories of this kind in Estonia: lack of some equipments and spare-parts.

No regular contact with the Animal Nutrition or Animal Husbandry Department existed at present. They did not have any students doing their diploma work on the station. The only sign of cooperation with the Agriculture University was the textbook (in press) regarding pig nutrition and feeding, which was due to be published jointly by prof. Oll (Anim. Nutr.) and Dr. Nigul.

15. Improvement of the swine breeding system

Department of Pig Breeding, feeding, feeding technology and keeping systems of pigs.

Project leader: Kalju Eilart, Cand.Agr. Sci.

In the project report a description is made of the national improvement program for pig production. The pig research station at Kehtna has facilities for progeny testing 110-120 boars per years, a pork research laboratory for meat studies, a feed laboratory and facilities for feeding trials. Equipment has been developed for phenotype testing of live pigs for degree of fatness. A traditional system for progeny testing of boars for growth rate and meat quality on test groups of four pigs is being used. Crossbreeding experiments have been carried out in which different cross-combinations between the Estonian Bacon breed, the Large White and Duroc have been obtained. Heterosis of the same magnitude as in similar experiments in many other countries have been obtained.

Studies of meat quality have revealed a high proportion of the quality defects PSE and DFD.

The scientific staff involved in the project comprises in addition to the project leader 4 persons with Cand. degree. One of the staff members defended his Cand. thesis in 1990. A large number of papers have been published in Estonian and Russian.

In the near future a data base and computer programs will be developed for the studies of genetic parameters and the calculations of selection indices to be used in the national breeding program. The decision to move the immunogenetics laboratory to Tartu is sensible as this will facilitate cooperation with the immunogenetics laboratory for cattle.

Comments and conclusion

The activities at the Swine Research Station have undoubtedly been of great value for the development of the Estonian pig production. However, as the country is entering into a market economy and the pig meat quality is low (high frequency of PSE and DFD and high carcass fat content) increased attention to improvement of meat quality seems warranted in the immediate future. Cooperation between the Swine Research Station and the Meat and Milk Laboratory, EPU, should be strengthened. Cooperation should also be strengthened with the small animal husbandry and nutrition departments at EPU.

19. Elaboration and application of bovine embryo transfer technology etc

Department of Reproduction Biology

Leader: Dr.Vet.Sc. Ilmar Muursepp

Principal Activities

The Department has been responsible for the development of cattle A.T. in Estonia. Three A.I. stations are being supervised by the Department and it is also responsible for education of technical personnel for A.I. work in the field. The Department's research program is mainly aimed to introduce new technology suitable under Estonian conditions but part of the research program is a combination of basic and applied research. During the past 5 years the following projects have been carried out: (1) research aimed to improve the fertility in dairy cattle by program for prophylaxis and therapy of uterine infections, (2) improvement of techniques in artificial insemination, (3) introduction of embryo transfer. Scientific work in embryo transfer was started in 1982. Several subprojects to the embryo transfer project have been successfully completed or are currently going on at the Department. As examples can be mentioned influence of the donor's uterine environment on the number, quality and viability of embryos, embryonic mortality of transferred embryos, development of a practical method for determination of progesterone in milk by using monoclonal antibodies. The scientific work is carried out in the laboratories of the Department in cooperation with the experimental farms. The current project to develop a RIA for estimation of progesterone is done in cooperation with Tartu University (Institute of General and Molecular Pathology) and Estonian Agriculture University (Department of Surgery and Obstetrics).

International contacts: Experts from the Norwegian Red Cattle Association performed 1991 an embryo transfer experiment together with the Department (the results are to be published at ICAR, The Hague, this Summer). Dr. P. Bredbacka from the Agricultural Research Centre of Finland introduced 1990 clinique for microsurgical bisection of bovine embryos. The scientific results are under publication in the American Journal Theriogenology. Dr. U. Jaakma at the Department has received a scholarship from SI (Swedish Institute) for a 3 months study leave to the Department of Obstetrics and Gynaecology, SLU, Uppsala, September-December 1992.

Scientific staff: One Dr.Vet.Sc., 4 cand.Sc., 2 scientists.

Instruments, equipment: Relatively modern equipment especially for embryo technology.

Evaluation

The scientific work is mostly of applied nature, but of good quality, and of great importance for Estonian agriculture. The laboratory equipment is relative modern. During the last 2-3 years contacts have been created with especially the Nordic countries. The young staff members understand and speak rather good English.

Recommendations

Closer research contacts should be established with the Agricultural University in Tartu (especially with the Faculty of Veterinary Science). The cooperation with Tartu University should continue. Continued support to the research programs at the Department is strongly recommended. Further possibilities for the young staff members to spend shorter periods in laboratories in Western Europe are recommended.

20. Development of fish farming

Background

Aquaculture is a relatively small industry in Estonia. The present main objects for fish farming are common carp and rainbow trout, amounting to a production of about 800 tons per year of each species, concentrated into more than 30 farms. Only farming for consumption purposes is considered in the report from Estonia. In the following, some information on aquaculture activities to support the fisheries will also be considered by the evaluator. Aquaculture research on consumption fish is largely concentrated to the Department of fish farming, at the Estonian Institute of Animal Breeding and Veterinary Science in Tartu.

Present objectives of research

The present objectives of the Department of fish farming (DFF) is focused on carp breeding, addressing questions on strain performance, selective breeding, technology development, and disease control. A few activities are related to rainbow trout farming, especially on artificial propagation of the species. In addition, DFF acts also as the reproduction centre for quality stocking material (common carp) and for gene pool protection purposes.

Research activities

a) Staff and competence

The present staff consists of two full-time and two half-time post-graduate researchers, three graduate research associates and one research assistant. The competence within the group is at large oriented towards fish genetics and carp breeding. From a general standpoint there seems to be a good to very good competence within the DFF regarding fish population genetics (Paaver) and on carp biometrics and production (Puhk, Gross, Thovet). There appears to be a fair to good competence in fish (carp) disease identification and treatment, especially regarding ectoparasites (Kasesalu, Laius), and a qualitatively fair but quantitatively limited competence in salmonid (rainbow trout) rearing and reproduction (Post). There is only limited competence within the DFF at present to provide expertise and advice for the development and application of rearing technology, nutrition, and production alternatives (i.e. intensive v. s. extensive aquaculture) in a wider spectra of species.

b) Facilities

The practical and experimental work by DFF is carried out mainly at Ilmatsalu Carp Farming Experimental Station, ECFES (carp) and the commercial Aravuse Trout Farm, ATF (rainbow trout). The present and future potential for activities at ICFES is severely limited by poor quality and small amounts of water. At ATF, research activities are limited mainly by the goodwill of the management of the farm, i.e. the willingness of the farm management to carry the major part of research costs and to allow limitations in production plans by research. At present there is no alternative research facility nor are there funds available to match commercial losses due to constraints on fish production at the farm because of the research projects.

Prospects for aquaculture in Estonia

a) Natural conditions

The conditions for fish farming in Estonia appears to be comparable to the ones prevailing in Sweden and Finland. Estonia has a number of fresh water bodies, dominated by a large part of the Peipse Järv lake. Some of these could possibly be used to a larger extent than at present both for intensive (i.e. cage-rearing, pond-rearing, tank-rearing) and extensive (i.e. ranching) aquaculture of suitable species. However, the topographic and environmental conditions will have to be considered carefully before more detailed recommendations on production capacity and so on can be made. A number of Estonian rivers flow into the Baltic Sea both towards the Gulf of Finland in the north, and towards the big island's archipelago and the Gulf of Riga in the west and south. These circumstances might provide excellent conditions for a whole series of supply of aquaculture to the fisheries by producing juvenile fish (i.e. salmon, trout, whitefish, pikeperch and so on) for stocking and ranching purposes. However, the actual pollution state of the rivers as well as the state of the fisheries in the area, are not known in any detail by the evaluator.

Tentatively, the conditions for more large-scale fish farming on the coast appear favourable, especially in the large island's archipelago. Also applications of the delayed release technique for salmon and trout should be of interest to consider. The conditions on the big islands (Saaremaa and Hiiumaa) are important to consider further, as they might be of great interest for some specialized aquaculture activities, i.e. crayfish farming and ranching. Thus, as a whole, Estonia appears to have very good natural conditions for aquaculture. There is also an apparent vicinity to a potentially very large market for farmed products in the former republics of the Soviet Union.

b) Utilized and potential species for aquaculture in Estonia

At present, aquaculture research as well as industrial activities in Estonia are focused mainly on common carp.

Conclusions and recommendations

According to my analysis, natural conditions for fish farming, and the prospects for applying fish farming technologies to support the inland and sea fisheries are very good in Estonia. Compared to the potential of the industry, research efforts are at present limited.

There is some qualitatively good, but quantitatively narrow, ongoing research at DFF, focusing mainly on carp. I recommend a coordination in the future between research for fish farming on one hand, and research for fish stocking and ranching on the other. Research at DFF devoted especially to biological quality and technology of juvenile fish production will be beneficial to both fish farmers and fisheries managers. Increased research efforts should therefore focus on juvenile production of species, possessing features for use in fish farms as well as in the Estonian fisheries. I would especially consider rainbow trout, Baltic salmon, brown trout, pikeperch, sturgeon and crayfish. In order to be successful, research will have to have access to suitable facilities and equipment for genetic and technical research.

I have the following detailed suggestions:

DFF should be authorized to maintain a small research group on carp farming (1 scientist each on genetics, production technology, and disease control). The Estonian carp farming industry should be evaluated from a market perspective.

The rest of the present DFF should be stimulated to redirect their research towards salmonid research, focusing on population and quantitative genetics, and biology and technology of juvenile salmonid production. First priority should be put on scientific exchange and on transfer of methods for selective breeding of rainbow trout, then on salmon and brown trout smolt rearing research and technologies. I recommend this group to be reinforced by three research positions; one on (salmonid) fish disease problems, one on fish nutrition, and one on salmon smolt biology.

Research on potentially interesting freshwater species for intensive and extensive aquaculture (i.e. pike-perch, sturgeon and crayfish) should be supported.

Present research facilities are very poor and insufficient to meet requirements for research. Also, research equipment will have to be improved. I strongly suggest that Estonian authorities give high priority to finding means to supply the research and industry with two carefully localized facilities; one for salmonid research and one suitable for combined research on species like carp, pike-perch and crayfish. The latter would replace the present at ICFES. The new facilities will have to be manned by competent technical staff. These facilities are key resources to support aquaculture in Estonia.

I recommend Estonian authorities to try to find support from Sweden, within the unilateral support program, for the following objects:

- a) Construction and building of the salmonid research facility, including equipment.
- b) Research equipment.
- c) Technology transfer and research exchange, especially regarding scientific selective breeding (rainbow trout), nutrition, smolt production and smolt quality control, and sea-ranching.

I recommend joint research projects between Sweden and Estonia regarding delayed release techniques, crayfish and sturgeon farming, and farming economics.

I recommend Swedish authorities to support Estonian request for the mentioned topics above. The range of support needed can be estimated as follows:

Salmodid research facility	10-15 mi Skr
Research equipment	2-3 mi Skr
Tech.and Research exchange	1-2 mi Skr
Research projects.....	2-3 mi Skr

IV.8 Estonian Agrobiocentre

75. Non toxic-insecticide and know-how on the base of this preparation to prolong the period of biological control of plant vermins.

This project is run by the Estonian Agrobiocentre in collaboration with a Swedish company. It started in 1991 and involves testing of non-toxic insecticides in new modifications.

Comments

It is difficult to draw any conclusions yet. The project needs follow up. The preparations are not registred as pesticides. They are basically gelatines blocking the respiration paths of insects at contact and thus considered as plant care preparations. No data or references were presented indicating that this is a research project in its true sense.

68. Elaboration of ELISA-diagnostics and vaccine against infectious bovine rhinotracheitis virus

Background

Infections with bovine infectious rhinotracheitis virus (IBRV) are world-wide spread and have been recognized in Estonia. The IBRV is an important pathogen of cattle. This project deals with the development of an ELISA-test for detection of antibodies to IBRV in cattle sera and the development of a vaccine to this virus.

Comments

Vaccines to IBRV and ELISA test for detection of antibodies to IBRV are available on the international market. However, the project is clearly of importance to Estonia. The Agrobiocentre is rather well equipped, the researchers are young and enthusiastic and have both national and international scientific contacts. However, there is no, or little, contact with other researchers dealing with animal viruses in the Estonian Research Institute of Animal Breeding and Veterinary sciences. There is also a tendency of the Agrobiocentre to be too commercialized, which may have a negative influence on science.

The ELISA is now developed. There is little information available about the vaccine project.

The research group has plans to develop ELISAs for detection of antibodies to other viruses than IBRV. They have also done some characterization of different strains of IBRV which may be of international interest.

Recommendations

The development and use of ELISAs for detection of antibodies for various viruses facilitate both diagnostics, control programs and investigations of the impact of virus infections on animal health. Continuation of the project is therefore recommended. There is not sufficient information on vaccine development and production to do any recommendations.

69. The investigation of coliinfections prophylactic methods

The institute has to develop effective methods to prevent E-coli infections in calves and piglets. In doing so they have studied the different strains to find out the antigens, thermostable and thermolabile toxins etc. and also to investigate whether strains adhere or not. A number of well defined strains have been used to produce vaccines and as far as can be seen, the effect of vaccines are controlled in a proper way.

70. Selection of Eimeria strains for avian coccidiosis vaccine

To be able to produce an active vaccine against coccidiosis in chicken the laboratory has tried to find strains of interest. Dr Parre and his group are elaborating a polyvalent vaccine and use strains of *E. tenella*, *E. acervulina* and *E. maxima*. All of them have been isolated from Estonian animals. The work is going on and the team seems to be very qualified.

71. Normalization of metabolism and digestion of domestic animals

Background

This project deals with the development of suitable remedies for metabolic disorders on cattle, deficiencies of trace elements and vitamins in cattle and pigs, and for diarrhoeas in calves.

Comments

Some preparations of this kind are needed in animal husbandry. For instance, propylene glycol is widely used in prophylaxis and treatments of ketosis in cattle and electrolytes in treatments of calves with diarrhoea. The composition of these products are well-known from literature. The development of such preparations is hardly research, merely business and therefore no recommendation is made.

72. Elaboration of probioticums for calves, piglets and chickens on the base of lactobacilli

The institute is elaborating probiotics for cows, piglets and chicken. They are based of lactobacilli. The preparations are used to improve the intestinal microflora. It should be noted, however, that the composition of the intestinal flora is very much complicated. We are dealing with a lot of unknown facts and it is difficult to demonstrate in a scientific way the microbiological effect of giving orally microorganisms supposed to constitute part of the normal intestinal flora. However, positive results have been reported from this group.

The institute is very active and there is a strong will to produce a number of preparations to be used for farm animals. The scientific methods are good and modern, the control of the products is good and the production seems to be safe.

73. The study about the perspective of producing feed protein by bio-converting the milk whey

About 100 species of micro mycetes were studied in batch cultures. Based on various production parameters, three different species have been selected. The highest biomass yield reached 23-25 g dry matter/litre with a protein content of 28-31 % in DM. The studies have been stopped due to lack of money.

It might be mentioned that similar studies were extensively performed in the 1970s and the 1980s at many places, but interrupted when they show to be economically profitable.

Estonian Agrobiocentre (general conclusions)

Among the duties given to the Estonian Agrobiocentre can be found investigations of complicated infectious diseases in animals and the prophylactic use of vaccines etc. by using modern molecular biotechnology. The equipment of the institute in the different laboratories is good, the scientific methods seem to be quite up to date and based on modern molecular biotechnology. For the production of specific vaccines in cows and piglets very modern technique is used.

IV.9 Tallinn Technical University

21. Improvement of food quality and nutritive value. Rational use of raw materials and by-products of food industry.

Department of Food Science and Technology, Food Laboratory

Food Science

The Department has about ten researchers with a Ph D degree. This should constitute the basis for a good research environment. The productivity seems to be good, judging from the publications described, the number of dissertations and diploma research work. Few of these have, however, been published in well-known Western journals.

The Department possesses the most common instruments of analysis, but they say that the instruments ought to be more modern. Advanced equipment is lacking.

They have a large variety of different projects within several areas of food science. These include utilization of raw materials and by-products, nutritional and toxicological aspects, as well as food additives and ingredients. The project mix gives a rather split picture.

It is difficult to judge if the Department has made strategically right choices to obtain the goal of supporting the Estonian food industry. It seems as if they want to meet the quality demand by working with "natural additives" rather than trying to preserve the original quality of the raw material.

They totally lack research on chemical and microbiological qualitative changes, and are not working within central areas such as aroma and structure. The meat area, which should be a central field from an Estonian point of view, is not treated.

Maybe the group should gain by giving priority to one or two areas of international importance from a basic research point of view. Besides this, they can have a relatively broad applied research within areas of applications of central importance.

22. Biotechnology, Enzyme engineering

Department of Organic and Biological Chemistry

There are four researchers with a Ph D Degree in the Department, and seven researchers with other academic degrees. This relatively limited group has achieved surprisingly much productive work. The publication rate is good, as is the number of doctors degrees achieved. They have also participated in the development of several patents and have organized international symposia. Few works have however been published in well-known international journals.

There is a big lack of financial resources, above all of hard currency. This has probably resulted in a somewhat old-fashioned equipment.

The project mix is well focused on different immobilization techniques. The Department has studied a broad range of immobilization methods, bearing materials, cathalysts and processes. The pace of development before 1985 seems to have been the same as in the rest of the world. The similarity between the problems treated is striking. After 1985 there are examples of interesting new applications within the area. A special field of research is the production and utilization of cyclodextrin-derivative.

Further, the Department has studied cinestical aspects of the produced immobilizing complexes in practical use. Examples of reactor studies also exist here. The line of research as a whole is very clear and the problems are relevant.

The research in the Department has also resulted in industrial processes, so its importance to Estonian industry is obvious. One has, however, the impression that an international contact area developed even further would be useful to the group. Maybe some duplication of work could be avoided and the effectiveness of the group be further increased.

IV.10 Institute of Zoology and Botany

NS 2 Molecular biology of potato viruses

This group has been working with determination of the antigenic structure of potato viruses, in particular potato virus X has been studied in great detail. The methods used are very up to date and the results have been published in international refereed journals. Another line of research is mechanisms of resistance to viruses. Transgenic plants expressing the coat protein of PVX have been produced.

Comments

The research carried out by this group is of high international standing. This is emphasized by the fact that prof. Mart Saarma holds a position as head of the Department of Plant Molecular Biology in Helsinki. The members possess high competence and experience in the fields of molecular biology and gene technology. International contacts have been established. Important results can be expected if the group is given the financial support needed.

NS 10. Plant nematology: taxonomy, ecology and evolution of plant parasitic nematodes including host-parasite relationship and theoretical aspects of control

Comments

In contrast to the majority of projects subjected for evaluation by our group, and which have been sizeable and possible to give a fair evaluation, this report covers a lifetime achievement of very high international standard in the field of plant nematology. It is not possible with the limited time we have had (the project was not included in our visiting program) to give a correct and full covering statement.

We can only recommend the Estonian authorities to carefully examine the need of plant nematology in the sector of agricultural research. The present research group headed by Dr. Eino Krall is well known among nematologists. It would be of great disadvantage to the country if the competence and high reputation terminates with Dr. Krall's retirement.

IV.11 Tallinn Botanic Garden

NS 39. Introduction and acclimatization of ornamental plants (evaluation of the report only, no visit).

The Tallinn Botanic Garden is one institution under the Estonian Academy of Sciences. It was founded about 30 years ago. In 1990 its collections included 6.890 taxa. Since the start the main research has been centred on introduction of plants. Valuable, rare or promising taxa have been the main objects. Previously, six collection expeditions to different areas of the former Soviet Union were made. A yearly "Index seminum" is available as basis for seed exchange.

This Garden includes an arboretum with many taxa of conifers and deciduous trees, a dendrarium, a rose collection, a collection of woody ornamentals, a special collection of Cymbidium orchids etc.

The list of publications (69 references, mostly in Estonian) covers recent work. Disease resistance and plant protection are frequent aspects on several taxa. The report indicates scarcity of funding and staff.

Comments

It seems now motivated to review the research objectives to concentrate more on Estonian conditions and needs, but also to find ways to select and maintain existing, unique collections. It seems advisable to organize a Technical advisory committee with representation of all Estonian botanical, agricultural and environmental (in a wide sense) sectors to make such a review and to plan for the future development of the Garden and related research.

Important plant material existing in Estonia should be further explored such as old ornamental plants which still may be found around old farm-houses, old landraces of cultivated species, stress-tolerant plants, plants which have had cultural-historical importance, plants for potential use in the future, threatened plants etc. Estonian experts would know best what the future direction should be in "a more Estonian Botanic Garden".

Among the Nordic countries there are several Botanic Gardens and related genetic researchers. Further contacts would be of mutual value.

**PROGRAMME FOR THE EVALUATION OF ESTONIAN RESEARCH IN AGRICULTURE AND FORESTRY
(June 25 - July 1 1992)**

Thursday, June 25

- 09.00 Arrival in Tallinn
- 11.30 Meeting with representatives from the Estonian Research Council and from the Ministry of Agriculture: background to the evaluation etc
- 12.00 General review on the Estonian Research Institute of Agriculture and Land Improvement (EVIKA).
- 12.30 Lunch
- 13.30 Visit to departments, laboratories etc of EVIKA.
- 18.15 General discussion

Friday, June 26

- 09.00 Group I-III: travel to Harku to visit the Institute of Experimental Biology of the Estonian Academy of Sciences
- Group IV: travel to Kloostrimetsa to visit the International Plant and Pollution Research Laboratory
- 12.30 Lunch
- 13.30 Departure to Tartu
- 16.30 Visit to Tartu University
- 18.00 Visit to the rectorate of the Estonian Agricultural University: general review

Saturday, June 27

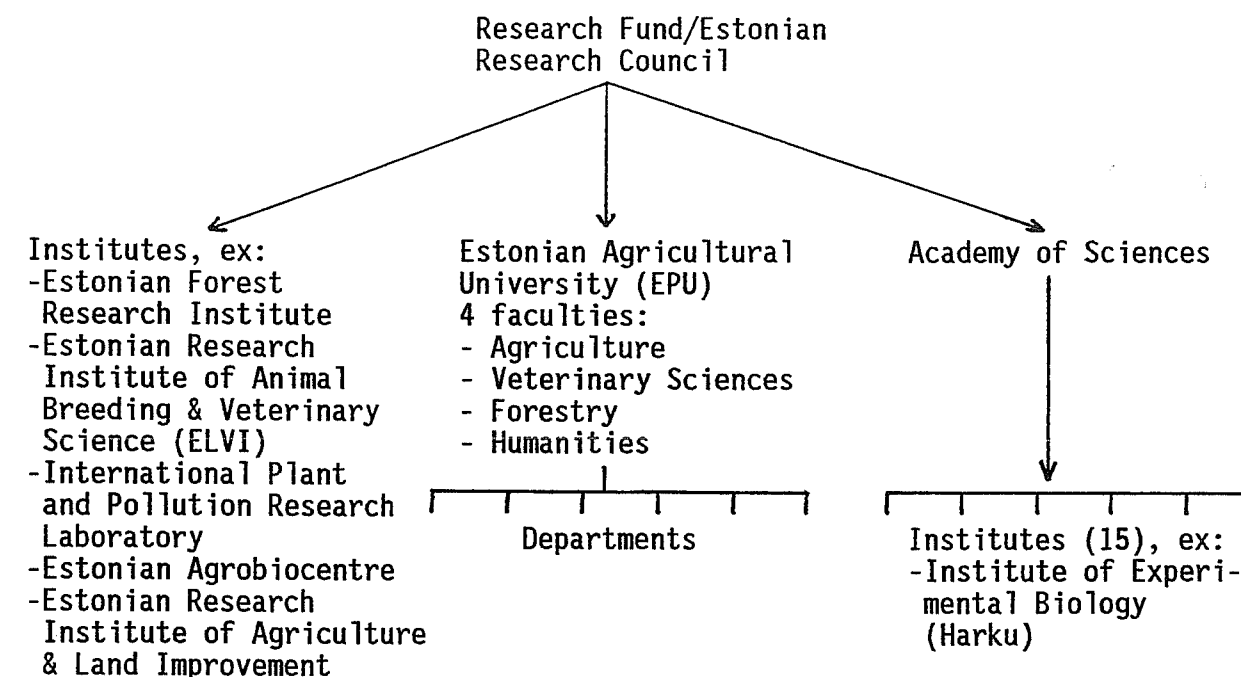
- 09.00 Group I-III: visits to the departments, laboratories etc of the Estonian Agricultural University (cont. in the afternoon)
- Group IV: visit to the Estonian Forest Research Institute
- 12.30 Lunch
- 13.30 Group IV: visit to Järvselja forest area
- 18.15 Total discussion

Sunday, June 28

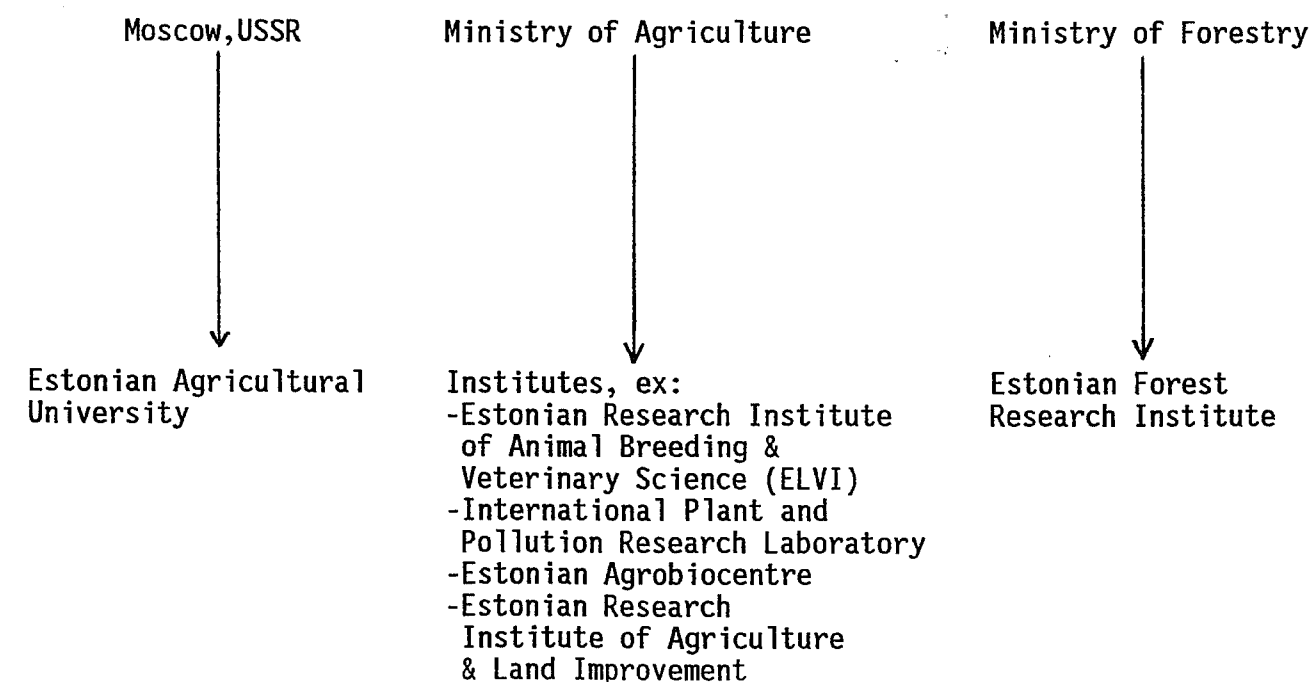
- 09.00 Group I: excursion to Olustvere and Polli
- Group II-III: excursion to Otepää, Laatre and Puka
- Group IV: excursion to Kohtla-Järve to visit forest recultivation areas

ORGANIZATIONAL SCHEME

(Financing from 1991)



(Financing until 1990)

Monday, June 29

- 09.00 Group I : travel to Jõgeva Plant Breeding Station
- Group II-III: visit to the Estonian Research Institute of Animal Breeding and Veterinary Sciences
- Group IV: visit to the Estonian Agricultural University
- 12.30 Lunch
- 13.30 Group I: cont. at Jõgeva with general discussion and visit to the department of Natural Geography of Tartu University and to Estonian Agrobiocentre
- Group II: cont. in Estonian Research Institute of Animal Breeding and veterinary Sciences. Visit to Märja and Ilmatsalu and to the Estonian Agrobiocentre.
- Group IV: cont. in the Forest Research Institute
- 18.30 Total discussion

Tuesday, June 30

- 08.00 Travel to Tallinn through Kehtna, Kuusiku, Varbola (Kurtna)
- 10.30 Group II-III: visit to Kehtna Experimental Station of the Estonian Research Institute of Animal Breeding and Veterinary Sciences
- Group I, IV: visit to Kuusiku Experimental Station of the Estonian Research Institute of Agriculture
- 12.30 Lunch
- 13.30 Group I-IV: visit to Varbola stronghold and alvar forests on the route to Tallinn
- Group II: (Animal Sc) visit to Kurtna Experimental Station of Estonian Research Institute of Animal Breeding
- 16.30 Short meeting with representatives from Estonian Research Council and Ministry of Agriculture

Wednesday, July 1

- 09.00 Work in private
- 12.30 Lunch
- 17.30 Return to Stockholm