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Computers, the latest
agricultural implement
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PRODUCTION MODEL FOR MORE PRODUCTIVE AGRICULTURE

Background

Finland is a northern country, which is self-supporting in its most important farm products. Even successful cultivation of wheat is possible in the southern parts of the country since the growing time for grain is only approximately 100 days. As concerns livestock products, we produce more than is domesticly consumed. The climate and the small-holding structure of our agriculture are best suited for milk production.

Finland has an approximate number of 120,000 actively cultivated farms. The average size is 11 hectares. The proportion of people obtaining their living from agriculture and forestry is at present about 10 per cent of the country's population. The whole population of Finland is 4.8 million.

The farmers' own co-operatives play a very important role in the development of agricultural production. Especially the co-operatives that are responsible for marketing milk, beef, and eggs have established a dominating position on the market. Over 90 per cent of the farmers are members in their own national trade organization, which attends to the interests of farmers, for instance, in connection with the yearly farm income resolutions.

Agricultural basic reseach in Finland is mainly financed by the State. Research work is carried on at the Agricultural Research Centre, at the University, and also at some specialized institutes. An agricultural advisory organization financed by the State is responsible for basic advisory services extended to the farms.

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Hankkija

I am myself working in a co-operative enterprise called Hankkija that carries on trade in farm requisites, machinery and grain. Farmers established Hankkija for 77 years ago and defined its main objectives that are still in force. Hankkija's turnover last year was 5,700 million marks, i.e. somewhat over 1,000 million dollars. The turnover of the whole Hankkija Group was 7,800 million marks or approximately 1,400 million dollars.

The activities at Hankkija's Head Office have been organized under four commercial divisions. The Agricultural and Machinery Divisions each account for about 40 per cent of the turnover, whereas the Technical and Dairy Divisions jointly cover about 20 per cent. The field organization structure has been divided into five regional branches, and the regional branches further into a total number of 28 district branches. The sales work is carried out by 600 travelling field salesmen. Hankkija has also permanent sales outlets at 250 localities. Hankkija owns five feed factories and 3 seed plants. The total number of employees is almost 9,000. The membership of Hankkija's local agricultural co-operatives consists at the moment of some 66,000 farms.

Hankkija occupies 30 - 40 per cent of the total market in farm produce and requisites as well as grain. This shows that we have not yet been able to reach as good a market position in the requisites and grain trade as have, for instance, the milk and beef co-operatives. Hankkija's competitors consist of other central organizations, including both private organizations and consumer-owned co-operatives.

TuMa production service

In the circumstances described above and on the basis of the principles of Hankkija's business operations, a marketing strategy called TuMa was built up. It is an abbreviation of the Finnish words meaning "production model for more productive agriculture". The first part of the TuMa programme, TuMa for crop husbandry, was launched at the beginning of 1980. In the next year came the Crop Service and last year, the Expert's TuMa for livestock

husbandry. In four years time we have now crystallized a unified four-phase basic structure for the whole programme. According to the TuMa strategy, the measures directed to farms are now always constructed of four basic elements:

1. Survey of the prevailing circumstances on the farm
2. Data service
3. Deliveries and purchase of grain
4. Follow-up

At this stage, the TuMa programme comprises the marketing to farms of all products sold by the Agricultural Division as well as the grain purchase.

The TuMa idea follows the process thinking of modern data technics. In creating and testing the marketing strategy, we used the information and experiences obtained from a few hundreds of farms, and this enabled us in a concrete way to determine the correctness and logic of the ideas we had in mind. We wanted to develop a way of marketing that would be suited for an agricultural structure that is dominated by small holdings and family farms.

When surveying the circumstances, we aim at registering the production conditions that are most important in view of the final result on each individual farm. Hankkija does not by any means endeavour to develop a whole information system for the farm; we only do the part that belongs to our basic task and that cannot be obtained ready from the advisory organization. Such typical surveys of the conditions include soil testing, the measuring of conditions in cattle houses, the analysis of domestic straw feed and grain, and so on.

We offer TuMa data services in many different ways. For this we have good opportunities since most of our sales take place through personal contacts with farmers. The modern data technics offer new possibilities to use data services in the marketing. We have now in 4 to 5 years' time made use of data services run by our central computer. One example of this is the variety test, i.e. a programme for choosing the right grain variety.

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The variety test is a programme developed by the Hankkija Plant Breeding Institute, and it is based on the information available on the farm's cultivation conditions, the grain varieties used before, and the crops obtained with them. The data bank consists of official grain variety test results obtained over 12 years. The programme also gives lime spreading recommendations and registers the risk factors, i.e. too long a growing time and laid corn. In the near future, the programme will also include fertilizing recommendations for individual plants. One third of the member farms and over half of the grain farms have already made use of this form of service.

For about a year, we have also tested the programme for optimizing the use of feed on the farms. The programme writes out the required commercial feeds and amounts. During the sowing and threshing seasons, we have been running a weather and falling number service, which means that the farmer obtains tape-recorded information by calling a special telephone number. During the busiest days we received over 200 calls to one number.

As far as I understand, Hankkija plans to continue and improve its central-computer-based marketing services. Video systems are being taken into use in Finland. Hankkija has preliminary tests in progress in the national telephone network. I believe that videotex and similar systems are well suited for transmitting daily marketing data.

This spring we entered a new field with personal computers. We plan to market IBM personal computers even beyond the agricultural sector, for instance to the food industry, to research institutes and to schools. Since the size of Finnish farms is small, I do not believe that personal computers will very soon become generally used. Sooner or later it will, however, be necessary to have the opportunity to contact central computers by means of personal computers. Data services applied to personal computers can be used in local shops where farmers make purchases.

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Data services in all different forms are an essential part of Hankkija's marketing strategy. Its members can receive our data services free of charge. The costs incurred in producing data services consists almost

exclusively of programme and know-how expenses; expenses for technics and running constitute a markedly smaller share. In our opinion, know-how in this branch is normal work related to increasing the company's competitiveness.

The introduction of data services has, of course, required profound training of our own personnel. According to my estimates, our salesmen have altogether gone through two months' special training.

In deliveries of goods and in grain purchases we make use of the internal business information systems. During this year and the next, we are going to move over from a centralized information system to visual display units placed in the various district branches. At this first stage each district branch has a direct line connection to the central computers. The computer centre main frames are two IBM 4341 systems, and every district branch has its local IBM S/34-36. The teleprocessing network is based on 14 communication lines. At the second stage, in the years 1985 - 86, the computer network will be extended to the sales outlets. The equipment alternatives are an S/34 remote terminal or a microcomputer. This change results in quicker order handling, shorter delivery times, and up-to-date warehouse data, which, in short, means better service. At the same time, we have technical facilities for data service as near the customers as possible.

Our main objective is also to check what effect the measures taken have on the final economic result of the farm. Since the advisory organization is responsible for the overall economic calculations of the farm, Hankkija's task as the supplier of inputs is to follow the resulting production increase. This is most easily seen, for instance, as larger grain crop volume, higher milk output, and better growth of pigs.

Hankkija has now been carrying on TuMa work for 3 to 4 years. The building-up of a marketing strategy has only got a good start. Our competitors continue product marketing along traditional lines. Our marketing strength has grown together with increased know-how. It shows in both bigger market shares and improved productivity.

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A pioneer's work is, of course, exposed to severe criticism and counterblows. This we must be prepared to put up with. The TuMa way of operating also offers new possibilities to co-operate with suppliers and the company's close interest groups.

TuMa means closer contacts and better co-operation between the company and customers. To describe this co-operation, we have designed an emblem that symbolizes close and confidental relationship between the farmer and Hankkija's representative.

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THE TuMa PROGRAMME FOR CROP HUSBANDRY

The first 6 steps of Hankkija's TuMa for crop husbandry are being concentrated into three stages:

1. The basic condition of the soil, and the farmer's experience
2. Hankkija's information service, comprising
   - liming recommendation
   - choice of seed
   - fertilizing recommendation
   - plant protection recommendation
3. Purchasing of requisites, comprising
   - choice of purchasing date
   - arranging of financing
   - choice of delivery mode

As a business enterprise owned by the farmers Hankkija is the first one in Finland to have started developing service systems, by means of which it is possible to purchase requisites on the basis of better information than before, and thus to improve the profitability of cultivation.

Due to automatic data processing, the most recent results of the research and experimental activity can quickly be brought to those in need of the information.

The first application of this kind at Hankkija was the variety test which was taken into general use in autumn, 1980. After this the programme has been gradually expanded in such a way as to allow us to have a complete computer-made cultivation plan ready for each individual farm in the near future.

Next we will present the basis of this programme, the input data needed, and the output possibilities.

1. Basis

The cultivation plan is based on the following test results available in Finland:

- the official variety tests at the experiment stations
- liming and fertilizing tests at the experiment stations
- cost and result estimates of farms keeping crop yield records

2. Data needed from the farm

- customer data
- per plot:
  - data of the plot (area etc.)
  - data of soil and nutrient
  - preceding crop and its fertilizing
  - cultivation experiences (crop level etc.)
  - planned plant level and desired crop level
  - use of farmyard manure and earlier liming
- desired output alternatives

3. Output

The basic idea of the programme is that it compares these data of each individual plot, collected from the farm, with those test results in its storage, where the circumstances (geographical location, nutrient data etc.) are as similar as possible.

After this comparison the programme will write out a complete cultivation plan which includes:

- the chosen kind and variety
- the liming recommendation
- the fertilizing recommendation (fertilizer kind and quantity)
- the plant protection recommendation

The programme also gives the cost estimates per hectare and plot.

The different output alternatives are as follows:

- mere variety test (choice of plant variety)
- variety test and cultivation plan for the chosen variety
- mere cultivation plan for the variety chosen by the customer

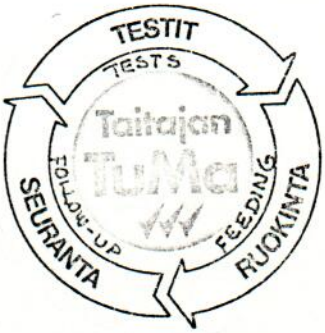
The technique used for the time being implies that the computer runs are carried out as a centralized batch at the head office once a week. Later on, however, it will be possible to carry out the runs as online runs by the data terminal at the local offices.

This information service is intended primarily for Hankkija's own members. So far we do not have any wider experiences of this service form in dealings on a practical plane, since these delivery routines are only now given their final shape. According to our first experiences, however, we believe that this information service will be well received by our customers and that we will be able to apply it to the practical sales work.

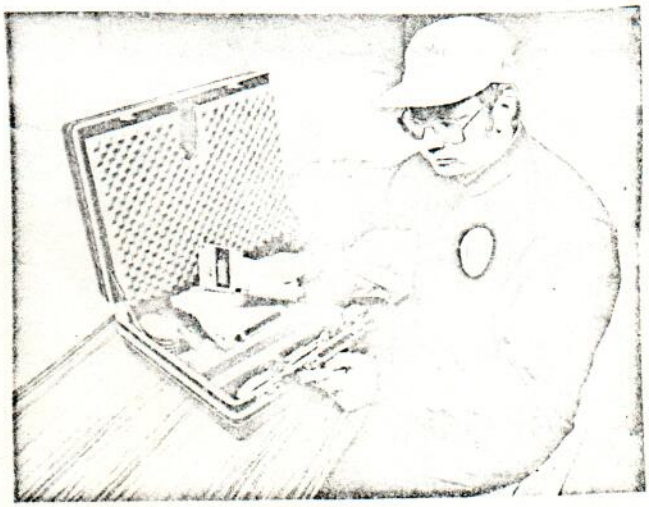
"THE EXPERT'S TUMA", PRODUCTION MODELS
FOR MORE PRODUCTIVE AGRICULTURE

The aim of the Expert's TuMa programmes is to improve the profitability of individual farms. The programme is an entirety, which is composed of the testing of production conditions, i.e. of tests, feeding, and follow-up (see emblem).

The starting point is that each domestic animal species has its own typical environmental requirements which ensure thriving and best possible feed efficiency. It has been observed that these factors are far from always ideal. In order that the prevailing conditions could be improved, it is necessary to find out what the present situation is, and that is done by means of tests.



Hankkija's feed salesman carries with him a meter case, which contains a thermometer, a moisture meter, a draft and flow meter, a gas suction pump, an illuminometer, and a dust meter (see picture).



The feed salesman visits the farm and measures these environmental factors. It should be noted that the measurements are carried out near the animals (see picture).

In addition, the measurements have to be representative in order to obtain average environmental figures. The results of the measurements are marked in a so-called environmental circle.

The environmental conditions are remedied on the basis of the test results.

Only after the environmental conditions are right, can it be assumed that the best efficiency is gained. The next step in the Expert's TuMa is proper and accurate feeding. In the right environmental conditions, a proper feed gives the best result. The last step in the Expert's TuMa is follow-up. By means of methods and appliances developed by Hankkija, it is possible, for instance, to follow the economic yield. The basic elements of the Expert's TuMa are the same for all domestic animal species. It is only the choice and weighting of various factors that differ. In the following, we are going to more carefully study the TuMa programmes for pig, poultry and dairy farming.

1 The Expert's TuMa for Pig Farming

Tests

It has been observed at Hankkija that the environmental conditions that are essential in the raising of fattening pigs are:

- Temperature (^{o}C)
- Relative humidity of the air (%)
- Size of pig bed (m^2/pig)
- Max. ventilation (m^3/pig/h)
- Air circulation speed (= draft) (m/s)
- Ammonia and hydrogen sulphide concentration (ppm)

Deviations from optimum values have an effect, among other things, on feed efficiency and the final result.

The effect of temperature on the pigs can be seen as variations in feed consumption. Both heat and cold reduce feed efficiency, and this shows in reduced growth. The optimum temperature for fattening pigs is +15 to +19^{o}C.

The relative humidity of the air tends to increase because of the water vapour that is released when the pigs expire. Too moist air causes chilliness and makes the environment unhealthier. Dryness, in turn, makes the detrimental effect of dust even worse. Diseases of the respiratory organs as well as catarrhs that increase along with unsuitable air humidity partly also hamper production. The suitable air humidity in a pig fattening house is between 60 and 80 %.

Air circulation speed (draft)

The regulation of air temperature and humidity brings along the need for ventilation. Ventilation causes circulation of the air. If the air circulation speed is high, the pig feels it as draft. The suitable air circulation speed is between 0.2 and 0.4 m/s. The detrimental effect of draft is

emphasised if the environment is cold and humid. Abrupt and quick changes are more detrimental than a somewhat unfavourable but even environment.

Detrimental gases

Pig secretion releases gases to the pig house, part of which are very detrimental. The worst is hydrogen sulphide (H_2S). Besides animals, hydrogen sulphide has also caused death to human beings. The origin of hydrogen sulphide must always be found out. Carbon dioxide (CO_2) is released to the air when the pigs expire and ammonia (NH_3) from urea. Carbon dioxide has a choky effect, whereas ammonia irritates the mucous membranes of the eyes, mouth, and respiratory organs.

Maximum ventilation

The ventilation of a pig house has to be arranged in such a way that it is possible even in hot summer weather to keep the air in the pig house comfortable. The maximum ventilation requirements are dependent on the size of the pig house. If the maximum effect of the ventilation is 80 to 100 m^3 per pig in an hour, it is in most cases sufficient to keep the pig house air tolerable even in hot summer weather.

Pig beds

As the pig grows, it needs more pen space. In final raising, the recommended space is 0.8 m^2 per pig. Crammed conditions make the pigs feel uncomfortable and behave abnormally. They may, for instance, fight or bite each other's tails.

Feeding

When the environmental conditions in the pig house are in order, the feed efficiency will be the best possible. Hankkija's own feed production offers solutions for feeding with both complete feeds and grain concentrates. On the basis of thorough product development and practical experience, Hankkija has developed the high-quality NASU feeds that correspond to the food requirements of pigs. Accurate proportioning is the basis for

successful growth results regardless of whether feeding takes place with complete feeds or concentrated grain feed. Proportioning according to feeding norms means apparent saving in feed consumption and feed costs. This is a fact that is emphasised in the Expert's TuMa. In order to facilitate correct and accurate feeding, Hankkija has made up ready-printed feeding tables for the farmers.

Follow-up

The last but not least part of the Expert's TuMa is follow-up. Follow-up gives required information of both raising results and profitability. Follow-up shows exactly how successful the raising of fattening pigs has been. Negative deviations are a sign of mistakes that have to be found and corrected. For follow-up purposes, Hankkija has developed for the farmer a follow-up form, by means of which it is possible to make a NASU analysis (see Appendix).

Results of measurements carried out

The Expert's TuMa for pig farming has been well received by the users. On the basis of the test measurements carried out, it may be noted that, in view of pig comfort, the situation in the pig houses is fairly good. The biggest deviations from optimum values were in the temperature, the relative humidity of the air and the pig beds.

The results of the measurements are presented in a concise form in the following table.

Environmental factor	% of tested pig houses		
	under	optimum	over
Temperature	4	83	13
Humidity	16	73	11
Draft	-	96	4
Bed	30	70	-
Ammonia concentration	-	80	20

2 The Expert's TuMa for Egg Production

From the producer's point of view it is essential that the hen lays eggs at a very low cost. The hen, in turn, makes demands on feed and the environment of the poultry house. Otherwise it does not lay eggs as well as its genotype presupposes. It has been observed at Hankkija that even if the poultry feed is as good as only is possible with present raw materials and know-how, the hens nevertheless do not always give the economic result that they should be capable of. In such a case the fault may be in the production conditions.

Tests

The hen is very sensitive to its environment. As essential factors affecting production, the Expert's TuMa for poultry farming includes:

- Temperature (^{o}C)
- Relative humidity of the air (%)
- Light intensity (lx)
- Length of day (h)
- Max. ventilation (m^3/h/animal)
- Draft (m/s)
- Ammonia concentration

Each of these factors has its own optimum value, and a deviation from it causes disturbances in production and consequently a poorer result. The environmental factors are measured in egg production in the same way as in pork production above. The recommended optimum values for poultry are the following:

- Temperature, 18 to 20^{o}C
- Relative humidity of the air, 60 to 80 %
- Light intensity during egg-laying period, 5 to 25 lx
- Length of day, 13 to 17 h
- Good-quality water available, 2.5 dl/animal/day
- Draft may not exceed 0.2 m/s
- Maximum ventilation, 8 to 10 m^3
- Ammonia, 10 to 20 ppm

Feeding

The daily yield of the hen remains very even during the whole egg-laying period. The size of the eggs increases, although the egg-laying frequency is reduced. Therefore, the food requirement also remains more or less the same. On this basis, Hankkija has developed a so-called TÄYS-TIPU one-feed programme, in which the feed is not changed during the egg-laying period. In view of the requirements of poultry, the Tipu feeds have the right energy/protein ratio.

Follow-up

The Expert's TuMa helps to make follow-up more effective. A follow-up form has been made up to facilitate the recording of results and calculation (see Appendix).

Results of measurements

The number of observations that have been made on the basis of the results is so far rather small so the figures can only be regarded as indicative. In summary it may be said that although there are grounds for remedy hens are, however, living in fairly good conditions. The results of the measurements carried out are presented in the table below.

Environmental factor	% of tested poultry houses		
	under	optimum	over
Max. ventilation	35	63	2
Air circulation speed		95	5
Length of day	7	92	1
Light intensity	21	75	4
Ammonia concentration		78	22
Temperature	56	40	4
Humidity	32	64	4

3 The Expert's TuMa for Broiler Breeders

A relatively recent newcomer in the series of TuMa programmes is the Broiler TuMa, which was taken into use last August.

Tests

With broilers, there are environmental factors that keep the same during the whole breeding period and factors that change with age. The standard factors and their optimum values for broilers are the following:

- Ammonia concentration, optimum = 0 ppm
- Animal density, 25 kg/m^2
- Relative humidity of air, 50 to 70 %
- Feeding space, min. 2 cm/animal
- Air circulation speed, max. 0.2 m/s

The environmental factors that change with age and their recommended values are the following:

- Lighting, at the beginning, 25 to 30 lx; at the end, 2 to 3 lx
- Water consumption, 2 x amount of feed
- Temperature at the beginning, 32 to 35°C; at the end, 20°C

Ventilation, at the beginning, natural ventilation; at the end, with fans

Feeding

The broilers are being fed exclusively with complete feed. Hankkija has developed the STARTTI-TIPU and LIHOTUS-TIPU feeds that meet the requirements of broilers. The former is used in initial breeding and the latter for fattening. Attention has to be paid to the right amount of feed.

Follow-up

Hankkija has made up a follow-up form, by means of which the producer may calculate the net profit for each breeding lot.

4 The Expert's TuMa for Milk Production

The latest newcomer in Hankkija's Expert's TuMa series is the production model for milk production. Its basic structure is the same as for other TuMa programmes: tests, feeding, and follow-up. Along with the TuMa programme for milk production, Hankkija is also introducing the computer into the planning of feeding.

Tests

In cattle house conditions the most important environmental factors that influence production are temperature and humidity. The farmer himself measures these factors on the farm. For that purpose Hankkija has developed a meter package, which is sold to the farmer at a favourable price. The meter set includes a max./min. thermometer and a hygrometer. In addition, the package includes a diary, into which the farmer enters the temperature and humidity every morning and evening (see picture). Other environmental measurements are, when necessary, carried out by Hankkija's feed salesman by means of the Expert's Test meters.

Feeding

The so-called feed optimisation is an essential part of the Expert's TuMa for milk production. It is a computer programme developed by Hankkija, which chooses for each cattle the most advantageous and productive feed combination, taking into consideration the environmental conditions, the production level and the resources on the farm. The starting point is the data received by cattle control, the analytical data on the feed produced on the farm, and the feed prices. This information is collected on a so-called farm data form, from which it can be keyed direct to the computer.

On the basis of the initial data, the computer output gives the following information:

- The most advantageous possible feed combination for two different annual yield levels
- The most advantageous feed ration according to feeding categories (kg/day)

- A profit calculation according to feeding categories (marks/head/day)
- The feed amounts and money flow per month
- The need of feeds during the period for which the plans have been made

The farmer can use feed optimisation as a means of planning. He can, for instance, prejudge feed purchases and thus save costs. The programme also tells which one of Hankkija's feeds and how much is needed to complement feed obtained from the farm. For cattle, Hankkija has developed the high-quality TUOTOS feeds. Feed optimisation is based on feeding according to each production phase.

Follow-up

In the Expert's TuMa for milk production, the follow-up is based on cattle control. That makes it possible to follow the development of milk production and also the feed consumption and economic result. Hankkija as also made up a follow-up form, which helps the farmer to monthly calculate the difference between the milk income and feed expenditure of his farm and to compare it with the result given by feed optimisation.

Summary

The Expert's TuMa programmes of Hankkija cover all the largest domestic animal groups and related services. The basic construction in all the programmes is the same: tests, feeding, and follow-up.

The TuMa programmes are a living and dynamic entirety. As soon as new reliable information is gained, Hankkija takes it into use.

CROP SERVICE

More information about the seventh step of the TuMa programme which is called Hankkija's Crop Service:

This step is constituted of Hankkija's solutions, which help the farmer in the handling and marketing of his crop. Hankkija's solutions comprise a ten-stage mode of action.

The first stage is the choice of plant species and variety. The farmer can choose the species and variety best suited for his field by means of Hankkija's variety test.

The second stage is the marketing of the crop. The farmer gets a written crop marketing guarantee when joining the Crop Service and marketing his crop by a contract.

The third stage is the decision when to start harvesting. The farmer can at any time call the Weather and Falling Number Service. That is how the farmer gets a forecast of the local weather, falling numbers and moisture of grain. This stage also includes articles concerning actual farming subjects as for eaxmple "What is the right time to harvest".

The fourth stage is the drying of grain. The farmer can use his own drier or he can use the possibility of drying grain at Hankkija's grain terminal or at Hankkija's contract drier.

The fifth stage is the storing of grain at a farm. The farmer can store grain for example in Patruuna-grain silos, which are sold by Hankkija.

The sixth stage is the solution of the value of the grain. The farmer can analyze his grain with grain analysis. It tells him the weight of volume, the protein content and the moisture of grain.

The seventh stage is removing such grain out of the farm at harvesting time, for which there is no room. Hankkija has a great storing capacity and reception capacity of grain and 135 offices all over Finland, which receive grain.

The eighth stage is the selling of the grain. The farmer can contract to store and to sell his grain to Hankkija.

The ninth stage is removing grain out of the farm. The most advisable way is that the farmer brings the smaller amounts to Hankkija's grain receptions, and the bigger amounts Hankkija removes by full loads straight from the farm to the users of the grain or to the State Granarys.

The tenth stage is to give an account of the farmer's grain. There are eight different ways for the farmer to get his money.

During the first year about 5000 farmers have joined the Crop Service, and the amount of selling contracts is increasing at a good rate.