

## **Assumptions for collecting information for a module concerning a machinery park of ecological farms in GEKKO programme<sup>1</sup>**

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**Summary.** The work presents an analysis of the machinery park equipment in the group of 100 ecological farms. It was one of the starting points to undertake an attempt of working out a module, in a computer programme concerning a machinery park in ecological farms. Works on the module have been carried out also based on consultations with ecological agriculture experts. The obtained research results and the authors' experience gained at the study on the programme allow for the conclusion that the worked out module can be used in practice and can facilitate the work of advisers, inspectors and representatives of other units which supervise and cooperate with the producers with ecological food. Moreover, it will indirectly influence the growth of efficiency of the carried out agricultural production.

**Key words:** computer program, machinery park, ecological farms.

### INTRODUCTION

Ecological farming means “the system of farming, which activates natural environment production mechanisms through application of natural, technologically non-processed means, and at the same time ensures durable soil fertility and animal health as well as high biological quality of agricultural products” [7]. The Polish market of ecological products is characterised by slow but systematic increase of the number of farms producing food in this system and at the same time the increase of the offer scale. Poland has very good natural and social conditions for ecological farming development. A superior participation of family agricultural farms, usually of multi-directional production, which easily transform into farms producing healthy food are a very significant factor of this development. Moreover, factors such as low environmental pollution, big surface area of the protected

terrains, low level of chemical crop boosting substances use, multi-directional character of production of agricultural farms and high resources of free and considerably cheap work force in agriculture, positively influence the development of ecological production in Poland.

Present and future development of agricultural farming is strictly connected with its competitiveness towards other agricultural systems. Streamlining of activities in agriculture, consisting in, inter alia, the best use of the equipment used in agricultural production, also requires the knowledge on the shaping factors of the machinery and the tractors exploitation process in a farm, which according to Kocira and Parafiniuk [4] significantly influences efficiency of farming. Proper organisation of transport has a significant meaning from the plant production point of view through the optimal selection of transport means [5, 6]. Many authors indicate legitimacy of using modern information technologies supporting efficient agricultural production [1, 2, 3, 9]. The research they have carried out shows the need for implementation of computer systems in different fields of activity concerning agricultural production, inter alia, for managing of a widely understood agricultural information, optimisation of agricultural production and achieving required quality indexes of food products. The required reporting which accompanies ecological agricultural production is a basic condition for obtaining the available union subsidies in this scope [8]. At the same time, agriculture is also an area where implementation of IT systems may activate agricultural environment to use modern tools supporting management. Therefore, it is significant to know the problems of ecological farms functioning, monitor their activity and indicate the activities which would allow for an increase of their competitiveness.

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## OBJECTIVE AND THE SCOPE

In the age of information it is hard to imagine a well operating system of food production without using an electronic calculation technique, which would determine the assumptions, rules of operation as well as complex and fast evaluation of the economic activity of agricultural units producing ecological food in an organised way.

Presently, ecological farm owners meet considerable difficulties at keeping detailed production documentation as a statutory requirement. GEKKO programme is dedicated to support reporting with the use of a computer. Considering farmers' needs, an attempt was taken up to form the assumptions which will be used to form a module collecting information on a machinery park of ecological farms. The module, upon being designed and included in the programme, will allow for the support of rational machinery park management.

## RESEARCH AND INITIAL ANALYSIS RESULTS

Many authors consider ecological farms as extensive, weakly equipped and using low-advanced production technologies. Providing that an extensive character can be explained by conditions resulting from ecological production rules, technical equipment frequently does not differ from conventional farms operating in comparable conditions (natural conditions, surface area of a farm, region of activity). As a result, production technologies are not less advanced than in conventional farms. Necessity of limiting the use of chemical substances may cause necessity of frequent agrotechnical operations, *inter alia*, mechanical weed destruction. This, in turn influences the need to purchase modern machines. Table 1 presents machinery park equipment of ecological farms covered by the research within grant NO 12 016510. The data included in the table concern the results obtained in the initial research on 100 ecological farms on the territory of south Poland. These facilities were divided into 8 area groups. The analysed objects involved on average 1.58 tractors per one farm, and this value was not lower than one in any of these groups. From among the listed group of machines, cultivating machines were the most numerous - in each area group more than 2 units per farm. The machines for green forage harvesting were also numerous. High level of machinery park equipment at the investigated farms with green forage harvesting machines results directly from the structure of use of this facilities, where extensive production based on meadows and pastures was carried out many times. Among the studied farms, there was also a group of 20 farms designed for milk production, where green forage and hay are the basic fodder. Moreover, they have to apply to ecological farming rules *i.e.* cattle grazing. In the evaluated population, fertilization, protection and plant care machines constituted a substantial group. It results from the fact that guidelines concerning the rules of using those

machines in ecological farms disable the use of machines from these groups in ecological and conventional farms at the same time. Therefore, farmers, whose use of services is limited (using equipment in conventional farms), are forced to purchase this type of a machine (Table 1).

In the case of the remaining listed group of functional machines, their number is satisfactory. Although, the quantity analysis indicates considerably good technical equipment, one should remember that in majority these are old and worn out machines of parameters far too different from modern standards. It is caused by goods production of ecological farms which is lower than in conventional farms and at the same time by lower incomes, which influence their low investment potential even upon considering a fund. As a consequence, majority of ecological farms can not afford to purchase modern machines. It concerns mainly farms of a small surface area. Therefore, considering the necessity of applying modern technologies connected with a low investment potential of farms, proper machinery work organisation and the rational use of the possessed machines gets a new meaning. Specialistic computer programmes can play a significant role in rational management of a machinery park.

Farmers obliged to keep reports of the production, which they carry out in the ecological system, may use presently GEKKO programme. Originally, this programme includes statutory guidelines and requirements of supervising units concerning agricultural machines and mechanisation. Developing this programme with a module that collects information on the machinery park, will allow support of the rational machinery park management. As a result, a farmer using a reporting programme will gain additional tool informing him on a present state and indicating directions of organisation activities which allow obtaining indexes characterising effective use of the machinery park.

GEKKO programme in its basic application is designed to simplify keeping the reports in ecological farms, which is required by the supervising institutions. However, application of the programme for this purpose, does not exclude its other applications, *inter alia*, calculations concerning efficiency of the used mechanisation. In this situation, widening the functionality of application with a module concerning agricultural engineering is well grounded.

Preparing guidelines, which may serve for working out a module collecting data concerning a machinery park in GEKKO programme, was carried out in four stages:

### 1. THE ANALYSIS OF INFORMATION REQUIRED BY INSTITUTIONS, LISTED WITH INFORMATION RECOMMENDED BY EXPERTS.

The scope of data required by binding law and supervising institutions, concentrates as a rule on areas which are not connected with mechanisation. In principle, the required documentation does not include any information concerning machines which farmers possess. Only in the registry of agrotechnical activities, a farmer should list field works technologies which are used in a farm.

**Table 1.** Description of the investigated farms

Specification	Parameter	Area groups										Total
		up to 3 ha	3.01 to 5 ha	5.01 to 7 ha	7.01 to 10 ha	10.01 to 15 ha	15.01 to 20 ha	20.01 to 40 ha	surface area 40 ha	Average		
		Average	Average	Average	Average	Average	Average	Average	Average			
Number of tractors	unit-farm <sup>-1</sup>	1.29	1.43	1.44	1.13	1.86	2.13	1.78	2.67	1.58		
Trucks and delivery trucks	unit-ha <sup>-1</sup> AL	0.69	0.39	0.26	0.14	0.15	0.12	0.07	0.05	0.27		
	unit-farm <sup>-1</sup>	0.12	0.07	0.06	0.19	-	0.13	-	0.5	0.11		
Remaining transport means	unit-ha <sup>-1</sup> AL	0.09	0.02	0.01	0.02	-	0.01	-	0.01	0.03		
	unit-farm <sup>-1</sup>	0.88	1.07	1.13	0.94	1.29	1.38	1.33	2	1.16		
Loading and unloading devices and machines	unit-ha <sup>-1</sup> AL	0.45	0.29	0.2	0.11	0.1	0.08	0.06	0.04	0.2		
	unit-farm <sup>-1</sup>	0.18	-	0.06	-	-	-	-	0.17	0.05		
Cultivating machines	unit-ha <sup>-1</sup> AL	0.07	-	0.01	-	-	-	-	0.003	0.01		
	unit-farm <sup>-1</sup>	2.88	3.5	3.88	2.81	2.64	3.13	2.78	4.33	3.18		
Fertilization, protection and plant care machines	unit-ha <sup>-1</sup> AL	1.41	0.92	0.69	0.33	0.21	0.17	0.11	0.08	0.59		
	unit-farm <sup>-1</sup>	2.06	2.14	3.06	1.31	2.57	3.63	2.44	2.67	2.38		
Sowing and planting machines	unit-ha <sup>-1</sup> AL	1.03	0.57	0.53	0.16	0.2	0.2	0.09	0.05	0.42		
	unit-farm <sup>-1</sup>	0.76	1.29	1.38	0.81	1.57	1.13	1.11	1	1.13		
Green forage harvesting machines	unit-ha <sup>-1</sup> AL	0.34	0.34	0.24	0.1	0.13	0.07	0.04	0.02	0.19		
	unit-farm <sup>-1</sup>	2.18	1.79	2.13	1.63	3.5	3.25	3	3.33	2.44		
Grains and root crop harvesting machines	unit-ha <sup>-1</sup> AL	1.11	0.51	0.37	0.2	0.27	0.18	0.12	0.06	0.42		
	unit-farm <sup>-1</sup>	0.65	0.86	0.81	0.75	0.71	0.63	0.89	1	0.77		
Animal production machines	unit-ha <sup>-1</sup> AL	0.31	0.25	0.14	0.09	0.06	0.04	0.04	0.02	0.14		
	unit-farm <sup>-1</sup>	0.59	1.07	0.69	0.63	1.93	2	1.56	1	1.09		
Seeds cleaning and sorting machines	unit-ha <sup>-1</sup> AL	0.24	0.31	0.11	0.08	0.15	0.11	0.06	0.02	0.15		
	unit-farm <sup>-1</sup>	0.41	0.86	0.56	0.44	-	0.38	0.22	-	0.4		
	unit-ha <sup>-1</sup> AL	0.18	0.21	0.1	0.05	-	0.02	0.01	-	0.09		

[Source: Author's own research]

However, there is no information in the forms concerning the machines which have been used, and in original forms their use may be listed in additional notices. This system causes that farmers do not enter information which is not required (including machines) and additionally list only activities and agrotechnical operations, which in their opinion may be essential from the point of view of ecology rules (basically they confirm, that the applied technologies are ecological).

Consultations concerning functionality of GEKKO application were carried out many times with experts, i.e. farmers, advisers, inspectors supervising ecological farms, employees of licensing units and scientists. During consultation, introduction of a larger number of the collected data on the machinery park was suggested. At the beginning the method of using these data was not specified. However, it was soon determined that these data may be used inter alia in the process of preparing subsidy applications (not necessarily connected directly with ecological production) and for obtaining information on using and operational costs of the possessed equipment. Although, in the initial stage, it was assumed that because of the programme use simplification, it will collect only a minimal scope of data, the authors found it purposeful that a developed version of application for experts should be designed. A module concerning mechanisation will be one of these modules.

## 2. DETERMINATION OF THE SCOPE OF INFORMATION CONCERNING MECHANISATION AND TECHNICAL MEANS OF PRODUCTION COLLECTED IN GEKKO PROGRAMME IN THE PRESENT VERSION.

Although, a current documentation of ecological farms operation does not require information concerning a machinery park, information on agricultural machinery and their use in technologies has been already anticipated in the basic version of GEKKO programme. Fig. 1 presents a fragment of a data base of this programme concerning the machinery park and Fig. 2 presents an exemplary screen shot.

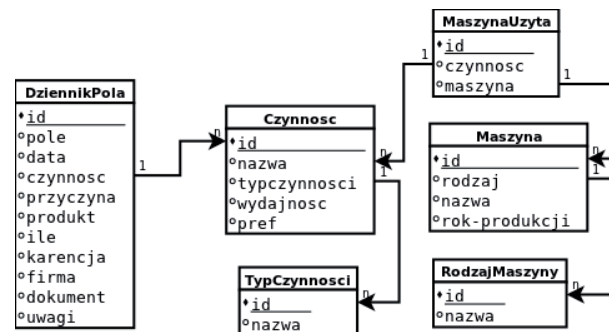


Fig. 1. A fragment of a GEKKO programme data base concerning the machinery park (relation scheme, basic version)

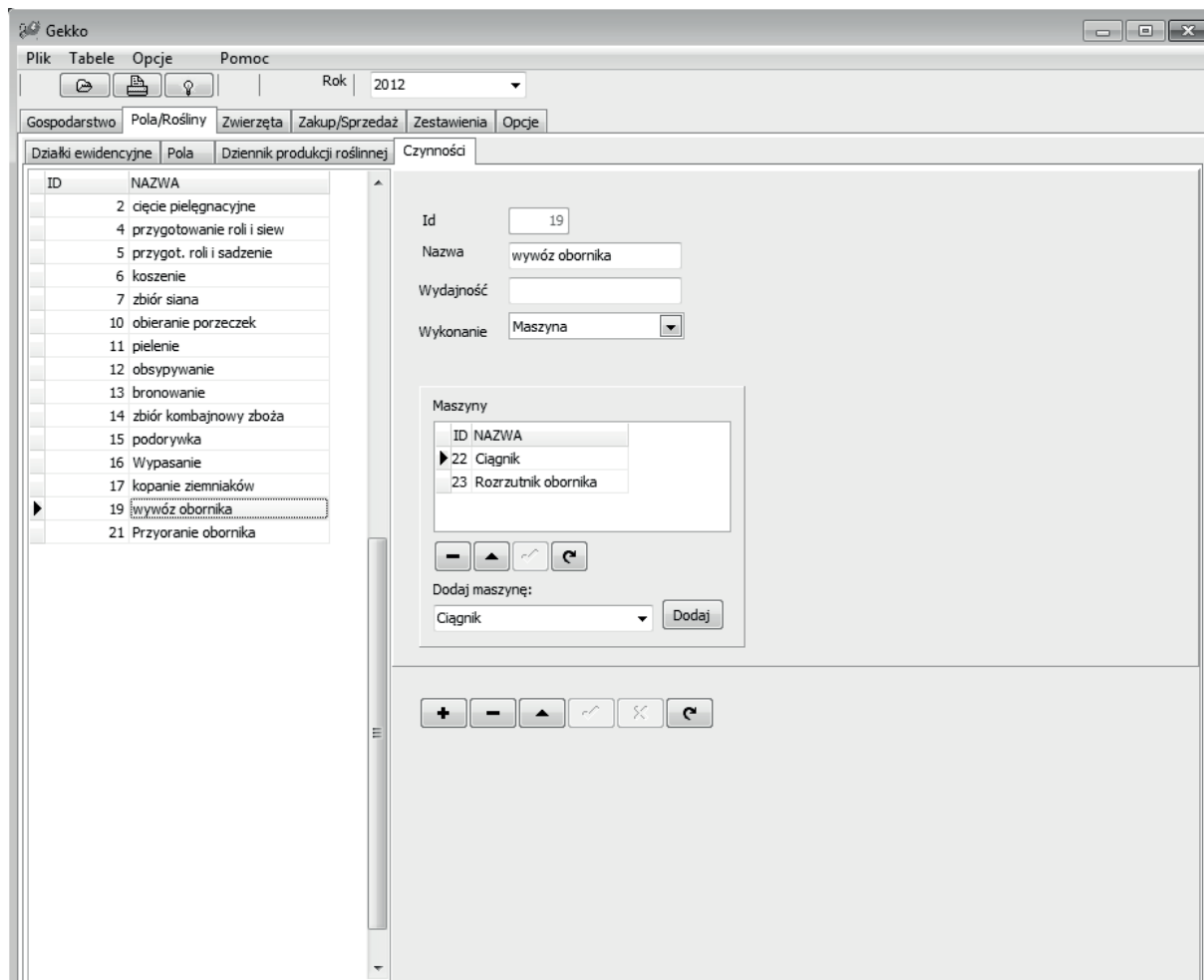


Fig. 2. An exemplary screen shot of GEKKO programme (actions module)

This information includes the name of the machine, type and the year of production. Additionally, in the table of activities, efficiency of a particular activity may be entered and in table 2 under the "Use Machine" key word, all applied machines and tractors can be listed. As a result of entering data concerning the machine and information included in the "Field Register" table, which constitutes an equivalent of the record of agrotechnical activities, one may obtain information on:

- farm equipment with tractors and agricultural machines,
- age of the owned equipment,
- machines used in particular technologies.

Additionally, the following may be calculated:

- number of machines and tractors of particular types,
- their real use,
- dates on which they operate.

An exemplary screen shot of GEKKO programme was presented in Fig. 2.

### 3. DETERMINATION OF THE SCOPE OF INFORMATION INDICATED FOR BEING INCLUDED IN THE MODULE WHICH IS BEING DESIGNED.

This part of analysis is designed to concern the scope of the introduced data. However, their scope has to be subordinated to a final effect. Taking the above into consideration firstly, a minimal scope of information, which has to be obtained at the programme output, should be determined.

As a result of consultation, it was assumed, that the programme, which concerns the use of the machine should give an opportunity to list their:

- use,
- dates, when they are used,
- exploitation period,
- operation costs,
- replacement and current value (upon deducting appreciation charge),
- exploitation period,
- replacement value of a machinery park.

A part of the above mentioned indexes may be calculated as soon as after entering complex data in the standard version. The remaining has to be included in the designed module. Whereas, the scope of additional data may be divided into two parts:

- the one concerning a specific machine (which basically has to be entered by a farmer) and
- the typical one for the group of machines (which may be downloaded from a built-in data base).

This division is crucial from the point of view of ergonomics of the programme use, since it enables the decrease of amount of data entered by the programme user. This effect is obtained through placing these data in the built-in data base or downloading from outer sources. However, it should be mentioned that, although there are indexes typical for the group of machines, in special cases they have to be treated separately for particular machines. Therefore, the programme has to enable en-

tering a particular index for a single machine, although the index for a group has a different value.

As a consequence, it has been determined, that entering the following data to the programme is necessary:

- machine price (or its replacement value),
- maximum exploitation period,
- operation potential (the amount of work, which the machine can use in the exploitation period),
- surface area taken by a machine,
- efficiency,
- power or power demand,
- type and unit fuel consumption,
- cumulated coefficient of repairs and technical service,
- annual insurance costs,
- type and unit consumption of additional materials,
- number of personnel,
- energy mean cooperating with a machine,
- others - e.g. load capacity, mass, volume, etc. or other data which are specific for a particular group of machines. Diversity of parameters causes that it is difficult to predict all possibilities on the stage of the programme design.

The above data, entered to the system, upon application of suitable algorithms, will allow calculation of the assumed indexes.

### 4. THE METHOD OF IMPLEMENTATION OF ADDITIONAL INFORMATION IN THE PROGRAMME - INSTRUCTIONS FOR MODULE CONSTRUCTION.

The method of implementation in the programme has to concern, first of all, two areas, which has to be considered by programmers at working out a module. Data, which have to be collected in order to enable further calculations, constitute the first area, whereas algorithms and methods of indexes calculations which result from the module operation are the other area. In the study herein, the authors concentrated on the first area. It is justified by the fact, that collection of proper data may enable calculation of further indexes in the future, even these, which can not be predicted on this stage. Additionally, it has to be mentioned that the data collected today may enable future calculations. Whereas, lack of proper input information may effectively disable even basic calculations. Fig. 3 presents a fragment of a data base of GEKKO programme concerning a machinery park in the version extended with additional elements.

When analysing data placed in the scheme (Fig. 3) one may notice that as a result of the suggested modifications only two tables will be modified: "Machines" (including data of machines in a farm) and "Machine type" (concerning machine types - universal data). Such a small integration in a developed structure of a full data base of the programme, including few dozens of tables (53 composing tables in the 0.45 version of the programme) is advantageous. However, it may happen that the scope of changes will be bigger in the final version.

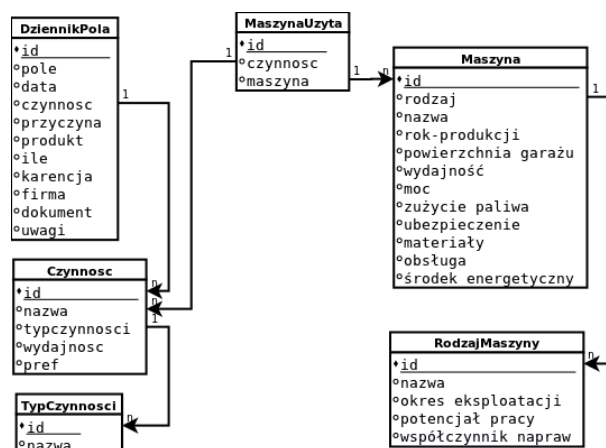


Fig. 3. A fragment of a GEKKO programme data base concerning a machinery park (relation scheme, extended version)

A correct design of a data base will result in a possibility of entering new procedures of calculations in the programme using existing data.

#### SUMMARY

Ecological farming, despite differences from conventional farming does not diverge from the accepted standards within the scope of the machinery park. Since, also in this case, a proper mechanisation of both plant and animal production conditions effective farming. The initial research, which was carried out within the research project, proved that quantity equipment of the machinery park in the researched farms is on the satisfactory level and allows mechanising particular agro-technical operations. However, frequently the only fact of possessing machines gives no bases for effective use. Thus, only the rational and planned use is a condition of profitability of their exploitation. In this aspect, the problem of planning and recording activities concerning the scope of the machinery park use appears. In the case of ecological farming, farmers meet the necessity of keeping reports in the moment of starting their agricultural activity in the system of healthy food production. Upon getting acquainted with the required reporting and consultations with experts on ecological farming, the authors attempted to prepare a module for registration of activities concerning a machinery park while working out a computer programme. Expanding the programme with this module is a result of cooperation with agricultural advisers, who indicated "the usefulness" of operating the data concerning agricultural machines. They frequently make use of this information while preparing applications e.g. concerning purchase of agricultural machines within particular operations of the Development of Country and Rural Areas Programme. In these operations, to justify a specific purchase, a state of the present equipment of the machinery park and inter alia possibilities of using a machine, the purchase of which is intended must be listed.

In the case of ecological farming, farmers who keep a record of activities using the worked-out computer programme will be able to assign the used machines and tools to the activity, apart from the recording of the activity. In effect, the designed module will become a perfect tool, which will influence the evaluation of the technical base use. As a consequence, it will influence the increase of efficiency of the farm management process.

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ZAŁOŻENIA DLA ZBIERANIA INFORMACJI DO MODUŁU  
DOTYCZĄCEGO PARKU MASZYNOWEGO GOSPODARSTW  
EKOLOGICZNYCH W PROGRAMIE GEKKO

Streszczenie. W pracy przedstawiono analizę wyposażenia parku maszynowego w grupie 100 gospodarstw ekologicznych. Był to jeden z punktów wyjścia do podjęcia próby

wypracowania modułu w programie komputerowym dotyczącego parku maszynowego w gospodarstwach ekologicznych. Prace nad modułem zostały przeprowadzone również w oparciu o konsultacje z ekspertami rolnictwa ekologicznego. Uzyskane wyniki badań i doświadczenia autorów zdobyte w pracy nad programem pozwalają na wniosek, że opracowany moduł może być stosowany w praktyce i może ułatwić pracę porad-

ców, inspektorów i przedstawicieli innych jednostek, które nadzorują i współpracują z producentami żywności ekologicznej. Ponadto, wpłynie to pośrednio na wzrost wydajności produkcji rolnej.

Słowa kluczowe: program komputerowy, park maszynowy, gospodarstwa ekologiczne