KNOWLEDGE SYSTEM SUPPORTING TECHNOLOGY DESIGN FOR AGRICULTURAL PRODUCTION.

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ABSTRACT

The paper presents an attempt to conceptualise the system supporting the technology of agriculture farm production design resulting with printed documentation. The presented conceptualisation is implementable as network information services technology.

Key Word: Knowledge System, Agricultural Technology Production

INTRODUCTION

Production processes in agriculture, as opposite to an industrial production, are generally carried out without precise specification and documentation. Well documented, personalised production technology taking into account the needs, possibilities and external constraints of particular farmer are necessary for production process being predictable, controllable and repeatable. The design of technology for agricultural production process using traditional methods is very cumbersome. Thus it is desirable to apply computer aided design resulting with complete documentation of production process technology. That documentation is particularly required when introducing new approach for quality control of agriculture products. The well documented production technology in agriculture is necessary for introduction the ISO 9000 standards series into the food production. Food producing companies are interested to have predictable and controllable base of agricultural farm products. It implies that agricultural production must respect the precise procedures during the all stages of production process like sowing, fertilisation, cultivation, plants protection, harvesting, storage and transportation. Those partial processes have impact on final product quality. Food producers being interested in specified quality of agriculture products have to support the farmer with knowledge and information. Farmers can be incorporated into food quality management chains. Farm production based on precisely specified production technology is necessary factor to establish contracts with food producers.

It is expected that users of presented system for computer aiding design of agriculture production technology could be food producers and extension service. Such a system would function as information service for farmers.

STRUCTURAL ASSUMPTIONS

There is assumed that the system supporting the technology design for agricultural production is organised according to the following principles:

1. In the system environment exists and is available specific information and knowledge located in external databases.
2. Those external informational recourses are located in the places where information is created, maintained and offered outside.
3. The system involves a proper mechanisms for automatic linking to external recourses, acquiring processing and storage of needed information.
4. The farm model is implemented as complex informational object possessing proper attributes and methods. The model identification as equivalent to giving the attributes specific values.
5. The printed form of the farm model is equivalent to documentation of designed production technology for the farm.

CONCEPTUALISATION OF THE SYSTEM

The project of production process technology for a given farm is conceptualised as a production model of that farm. The farm model involves three submodels: actual farm model, operational model and conceptual target model. The actual farm model describes the current state of the farm. The operational model involves the knowledge and instructions for transfer from actual to target model. The target farm model is created as result of analysis of farmer's needs, possibilities and external constraints.

The specific knowledge necessary for building the target farm model is assumed to be located in various external sources. For example, the knowledge about particular machinery, fertilises, herbicides etc., has to be located at and supplied by their producers.

The system is conceptualised like a complex information organiser and processor. The structure of system inputs and outputs is shown on Fig.1.

The design of technology can be seen as two parallel process:

- identification and diagnosis of farmer's needs and possibilities,
- synthesises and specification of production technology.

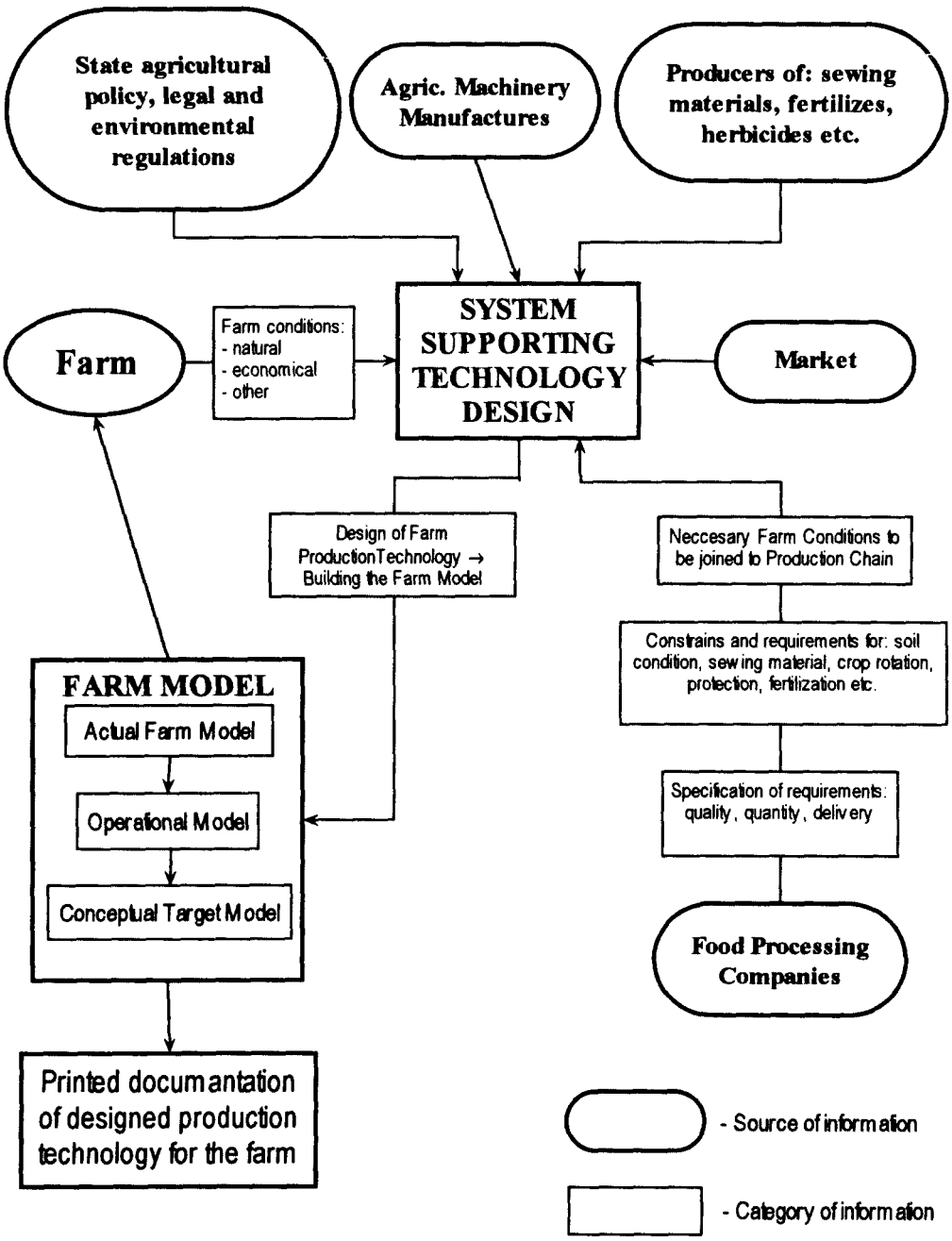

Fig.1. Structure of informational environment for agricultural production technology design.

The identification of what a farmer needs and what he can, goes parallel with synthesis of technological project. There are involved requirements and necessary conditions for the process to be started, continued, finished and repeated in subsequent production cycles. The process of identification and synthesis is carried out in various aspects: agro-biological, social, psychological, technical, operational and economical. The distinction of the two above stages enables independence of the system utilisation from alternating sources of input data (market prices etc.).

The production technology design seen as a building the farm model is implemented as a top down process (Fig.2). On the first stage there is identified the farm model category. There are assumed three basic categories "Kusz and Marciniak (1996 a)".

Model I concerns highly productive farms producing input materials for food processing companies. The farms classified to that category are permanently incorporated into food production and quality management chains. Those farms strictly fulfil the requirements resulting from quality management strategy of food producers. The objective of the farm is not to maximise the production but to produce contracted quantity of the product of required quality.

Model II concerns smaller farms which have a little chance to be fully supported by food industry. Important feature of those farms should be their elasticity in adapting production profile to varying market conditions. A part of those farm can participate in the market typical for the first farm category by creation the "producers groups". Such a group can be equally attractive for food companies as large, highly productive farms but under condition that legal status of that group will be clear enough.

Model III concerns farms producing for own purposes where the substantial incomes are from complementary activities in various services, food pre-processing, storage and other family business.

The classification to one of the basic categories is performed as special diagnostic process. The criteria used for diagnosis are structuralized hierarchically from general to specific.

The initial step of diagnostic process determines natural possibilities of the farm using the criteria involving soil, climate, infrastructure, development potential etc. On this stage there is used the rule that the agriculture production should be located in the places where natural factors are favourable. Additionally, there is taken into account the infrastructure in farm location area like roads, water supply, telecommunication, etc. The important factors could be the social ones like the age of the farmer, his education etc. "Kusz and Marciniak (1996 b)."

The next stage of the farm identification is a building of the production model of the farm. In this stage it should be determined what to produce (production profile) and what is an optimal farm specialisation. Diagnose on this stage is equivalent to a choice of the particular food production chain.

There is taken a methodological assumption that food production company which is managing his production chain determines the farm model, both on

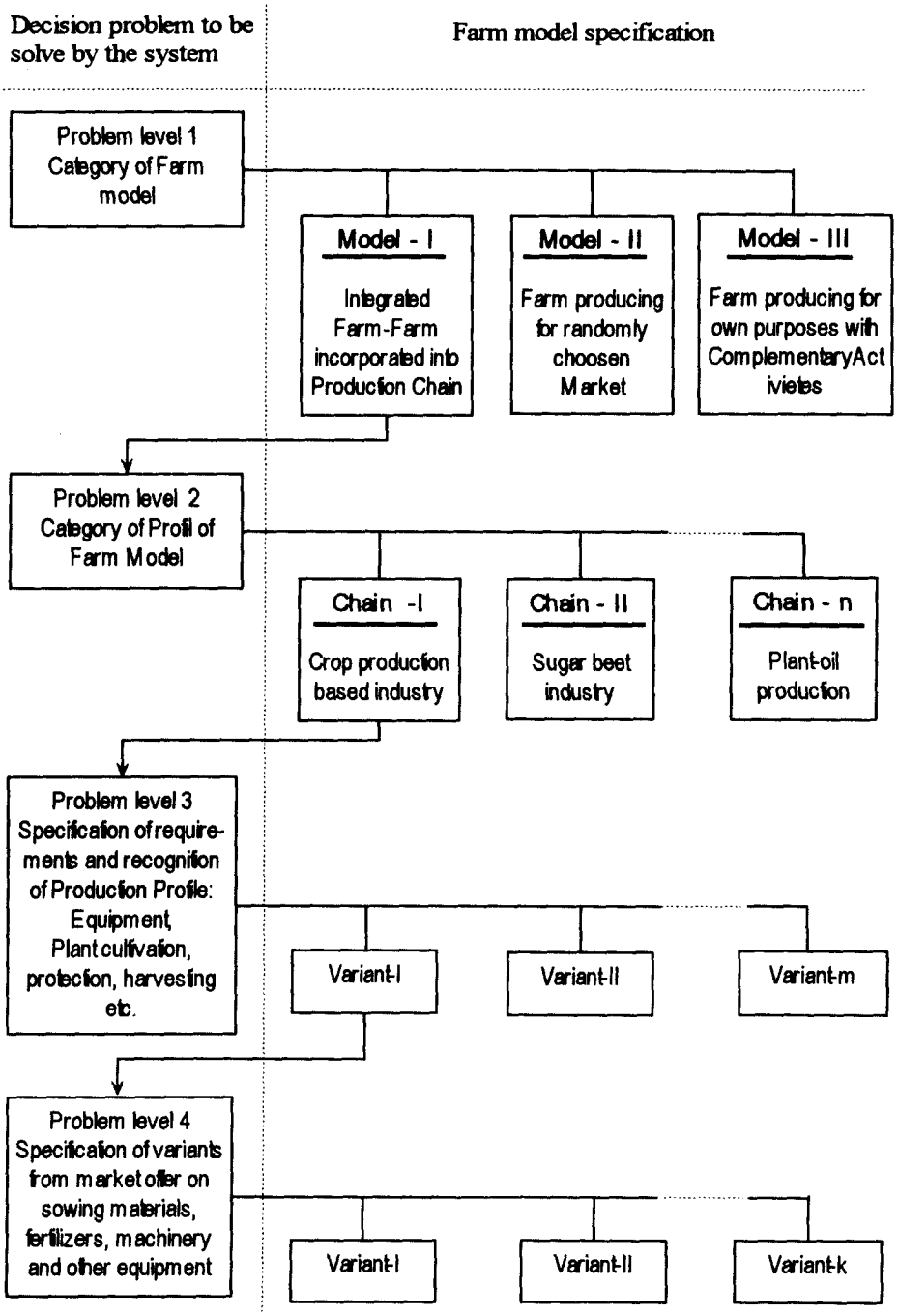

Fig. 2. Phases of Farm Model identification.

strategic level (farm output) and operational level (how required output is achieved). So the next stage of farm identification (after choosing the production chain) is controlled by the food production company requirements. The basic set of requirement are: minimal production of a main crop, the final quality of the crop, economical regulations and organisational requirements. Next the above requirements are translated on the more specific decision concern: supplementary crops, crops for rotation, sewing material, fertilisation, plant protection. For example in the case of sewing material, the food production company can formulate selection criteria or even specify particular variety. Then the system utilises information supplied by producers of sewing materials and select their offer according to previous specified criteria. The final result takes into account the requirements of food producers and farm conditions.

Further there are specified the necessary sort and capacity of machinery The criteria for machinery selection result mainly from quantitative requirements of food production company. Additionally there are taken into account requirements on production process predictability and reliability resulting in an increase of theoretically required capacity of machinery. Predictability is understood as ability of farm to minimise an impact of bad atmospheric conditions.

The above stage allows for making decision what particular sewing material, fertilisers, herbicides, machinery should be selected from a given market offer taking into account the economical factors. The resulting farm model is called a target model.

CONCLUSIONS

The presented conceptualisation is implementable as network information services technology. The most important feature of the presented system conceptualisation is that the system doesn't contain all information and knowledge needed for technology design but relies on external information recourses. Its function is reduced to organising the design process, supporting the farm condition diagnosis and synthesis the adequate production technology for the farm. This feature make the system to be affordable to extension service and food processing companies. Farmers are assumed to be clients of the system.

REFERENCES

1. Kusz, A. and A. W. Marciniak. 1996 (a). Information needs and computer based decision support of local agriculture state agencies of Lublin Region. Paper presented during EUNITA workshop, 21 - 25 May, Keszthely, Hungary.
2. Kusz, A. and A. W. Marciniak. 1996 (b). A model of an individualised expertise for farms undergoing market-oriented transformation. Paper presented during EUNITA workshop, 21 - 25 May, Keszthely, Hungary.