THE USE OF EXPERT SYSTEMS IN AGRICULTURAL INSURANCE. NECESSITY VS. REALITY

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The topic was chosen due to the fact that, although agricultural insurance is particularly needed in agriculture to achieve performance, its achievements are still modest. The importance of this research is in that it tackles a very important sector of the economy, agriculture, and puts forward an immediate viable solution that meets the current needs of farmers. The contribution of the authors is their innovative solution, namely the proposition to implement expert systems in agricultural insurance, as a means of promoting insurance products which, although they are not currently granted the due importance, have started to be acknowledged increasingly in recent times. The interest in this type of insurance is due to the recent climate changes whose effects are extremely damaging, and to the need to improve agricultural competitiveness on the common market as a result of trade liberalization in agricultural products.
The scientific literature in the field of expert systems highlights the benefits of implementing systems in all areas of economic and social activity, including insurance and agriculture, but it does not deal separately with the issue of agricultural insurance, despite its importance in the development of agriculture. This confirms the topicality of the study. Regarding the scientific methodology, in order to easily understand how expert systems work also by those who are not familiar with the field, we opted to present the stages of preparation of the system, namely: (a) preparing the knowledge database, (2) preparing the charts and (3) system encoding and assessment.
The research results, at the conceptual level, confirm the need for agricultural insurance expert systems because of the benefits it would create (ease of use, informing farmers about the existence and importance of agricultural insurance, increasing demand for such type of insurance, which would also lead to the development of agriculture, to the creation of insurance products tailored to farmers' needs) and refers to the authorities that should be appointed to implement these systems.

Keywords: agricultural insurance, expert systems, agriculture

JEL Classification: C80, C88, G22, Q14.

I. Introduction

Since 2007, following Romania's EU integration, Romanian agriculture has been put to heavy trials as it had to meet the challenges imposed by the Common Agricultural Policy. Although, in comparison with European countries, Romania ranks ninth as agricultural area, seventh as arable land, eighth according to the area occupied by pastures and meadows, fourth according to the population engaged in agriculture (Crecană 2002, 23), the impediments that are currently hindering the development of agricultural insurance (e.g. lack of awareness and confidence in insurance, lack of financial means of farmers), entail modest results, despite the significant potential and its importance in the development of agriculture. Thus, due to the fact that modern agriculture can be developed only in the presence of an agricultural insurance system, there is an urgent need to find solutions to promote agricultural insurance products, as both farmers and insurance companies do not show a keen interest in this type of insurance.

Therefore, the following questions arise: Why don't farmers buy insurance? What should be done to change the perception of farmers towards insurance, so as to boost demand for agricultural insurance?
The solution could be offered by artificial intelligence, especially expert systems. Their implementation in agricultural insurance would promote existing insurance products, finding alternatives to farmers' needs according to their possibilities and needs, and allowing for an ongoing improvement of the system as a result of feedback from farmers.
The objective of this paper is to collect data on specific aspects of agricultural, to prepare a knowledge database, to present conceptually a pilot version that will continuously improve based on the farmers' feedback, by showing clearly the collected data which would lead, through their processing, to the most relevant results.
(Ganesan 2006, 263) believes that agricultural production has evolved into a complex business requiring the accumulation and integration of knowledge and information from many diverse sources. Unfortunately, agricultural specialist assistance is not always available when farmer needs it. In order to alleviate this problem, expert systems were identified as a powerful tool with extensive potential in agriculture.

II. Literature Review

Expert systems have started to grow in importance lately, covering all areas of economic and social activity, with the role to collect data from human experts on various aspects in order to assist the user in the reasoning necessary to solve problems, at levels of expert performance, making available to him the acquired knowledge and experience.
The expert system is a software program that incorporates a particular knowledge database and an inference engine. The program acts as an intelligent adviser in a particular area (Frenzel 1987). It is a system that uses human knowledge captured in a computer program to solve the problems that usually require human expertise (Turban, Efraim; Aronson, Jay 2001).
The goal is to offer a solution to a given problem; the expert system must take a decision in this regard. For example - in this period, which is the insurance type that corresponds to the current features of the agricultural production and to the financial means of the farmer?
The ideal expert system first makes use of simple questions and rules to infer more complex knowledge. The system would be self-defensive if, instead of asking simple questions at first, would ask questions that require specialized expertise (Russel and others 1988).
(Trencher 1998, 7) consider that today, a growing number of insurers are using expert systems as a way to improve the quality of human processes - to perform tasks faster, more consistently and with fewer errors.
The main benefits of expert systems are (Turban, Sharda and Delen 2011, 569, 570):
- *Increased output and productivity.* Expert Systems can work faster than humans can.
- *Decreased decision-making time.* This property is important in supporting frontline decision makers who must make quick decisions while interacting with customers.
- *Elimination of the need for expensive equipment.* Often, a human must rely on expensive instruments for monitoring and control. Expert Systems can perform the same tasks with lower-cost instruments because of their ability to investigate the information provided more thoroughly and quickly.
- *Ability to work with incomplete or uncertain information.* Expert Systems can, like human experts, work with incomplete, imprecise, and uncertain data, information, or knowledge. The user can respond with "don't know" or "not sure" to one or more of the system's questions during a consultation, and the Expert Systems can produce an answer, although it may not be a certain one.

- *Provision of training*. Expert Systems can provide training. The explanation facility can also seive as a teaching device.
- *Improved decision quality.* Expert Systems are reliable. They do not become tired or bored. Expert Systems also consistently pay attention to all details and do not overlook relevant information and potential solutions, thereby making fewer errors. In addition, Expert Systems provide the same recommendations to repeated problems.
- *Ability to solve complex problems.*

(Gray 1987) suggested that insurers who have an automated partner generally have a higher probability to succeed in an increasingly complex environment.

While reviewing scientific literature, we found that expert systems are used increasingly more in recent years in agriculture (e.g. *Rice Crop Doctor*, the National Institute of Agricultural Extension Management (MANAGE) has developed an expert system to diagnose diseases and pests for rice crops and to suggest measures for prevention / curing, *AGREX*, *the Center for Informatics Research and Advancement*, Kerala has prepared an expert system named AGREX to help staff called on agricultural land by giving timely and accurate advice to farmers, *Punjab Agricultural University*, Ludhiana, has developed the Farm Advisory System to support agri-business management) (Kiong and others 2005), but we have not found and treated separately agricultural insurance, which would be an incentive to develop agriculture in general and in particular agricultural insurance, because in order to perform a modern agriculture, insurance plays an important role.

III. Research Methodology

The architecture of expert systems consists of 3 basic components:
- the knowledge database : it contains factual and information databases;
- the inference engine: the dynamic component of the expert system, which suggests a possible decision after analyzing the information in the knowledge database. Many expert systems are equipped with the ability to explain to the user **why**? and **how**? they have reached the chosen solutions through their reasoning;
- the user dialogue interface - the component which ensures the dialogue between the user and the computer in an exciting and comprehensible way.

Assuming the use of expert systems in agricultural insurance, we will present hereafter, in a simplified way, the steps that should be followed in building the system to generate the best option of crop insurance for one's needs.

Preparing the Knowledge Database

In order to prepare a more complex knowledge database to be included in the system, one needs to use official documents or diagrams, using specialized information from both agricultural insurance experts and experts from related fields (veterinarians, agricultural consultants, agricultural equipment suppliers, seed suppliers).

Expert systems cannot be designed without the support of a group of experts. An appropriate expert should have extensive knowledge in the field and good communication skills (Turban, Sharda and Delen 2011, 566).

Preparing Charts

Crop insurance, viewed from the perspective of expert systems, consists of multiple first-hand levels (Fig. 1). Each level is an integrated set of sublevels. For example, the "insurance risks" level includes the following sublevels: hail, frost (late spring frost, as well as early autumn frost), torrential rains, storms, hurricanes, tornadoes, landslides of cultivated land, fires caused by natural lightning (thunder, lightning), from which the farmer will choose one according to his needs.

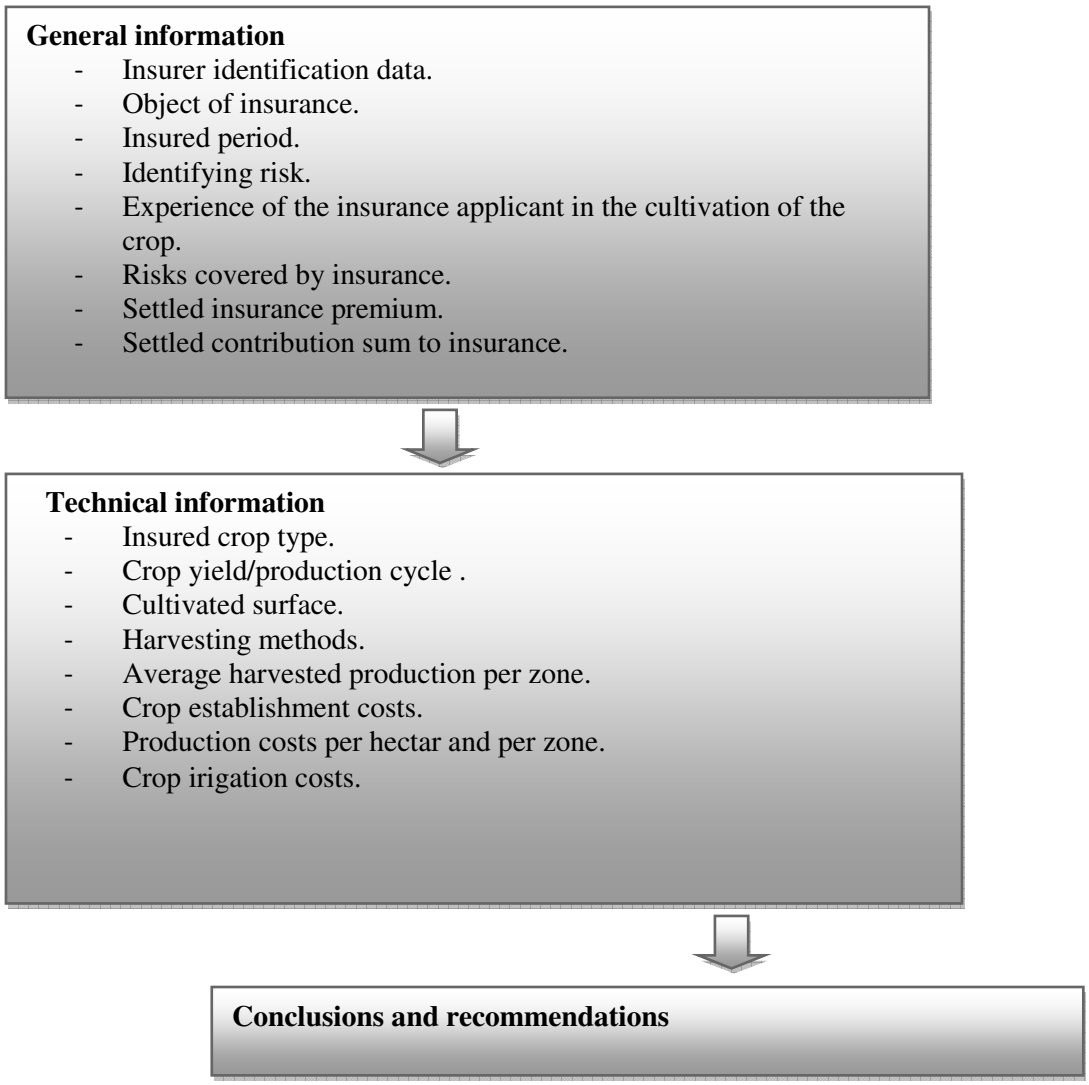

Figure 1: Agricultural insurance chart within expert systems
Source: compiled by the authors

If the reasoning is well done, it translates into the system by IF, THEN rules, which are meant to generate, at the end of the logical algorithm, the best solutions for the user (the farmer). For example: **if** there is a high probability of thunderstorms during the production cycle and **if** the required premium for the risk insured is accessible (within budget), **then** the farmer will subscribe to an insurance contract.
We opted for a simplified schematic representation (on a single level) of a possible expert system for agricultural insurance expert for a better understanding of its functioning, where the system informs the user about existing insurance conditions and provides an alternative, depending on the options chosen.

Encoding and Assessing the System

After choosing a suitable tool, (the most popular is the Corvid system), our attention turns to encoding the knowledge database. A major concern at this stage is whether the encoding process (definition of variables, building logical blocks and command blocks) is properly and effectively managed, to avoid errors. Regarding the assessment of the system, it involves both verifying (by ensuring that the knowledge database contains data acquired from experts and that there are no errors in the encoding phase) and validating the system (by confirming that the system works properly).

IV. Research Results

After observing the necessary steps followed by expert systems, one can easily notice the efficiency of implementing artificial intelligence in agricultural insurance, given that the main benefits are offering the right information to farmers, as well as high quality insurance products tailored to the farmers' needs**.**

Using expert systems in agricultural insurance would help develop the agricultural sector, bringing both immediate benefits and on the long term because they could track the farmers' behavior over time, their aversion to risk, as well as the frequency and intensity of risks in various regions, and could thus lead to the creation of improved insurance products that meet farmers' needs. These new and improved insurance products would address the different types of risks specific to agriculture, and their expansion to cover the all the farmer's assets is likely to sustain over time the development of this sector and maintain financial flow in agriculture**.**

The successful implementation of expert systems in agricultural insurance depends on properly understanding the importance of this system, on the availability and capacity of insurance companies to support this area and on the involvement of the Insurance Supervisory Commission and the Ministry of Agriculture**.**

Although it deals with the topic at a conceptual level, our research moves on to an attempt to present the necessity and importance of implementing expert systems in agricultural insurance as a solution for developing the Romanian agriculture sector because insurance plays a significant role in stimulating investments in agriculture and stabilizing farmers' income**.**

V. Conclusions

The agriculture of a country may be endangered by the weather which can not be controlled only to a limited extent and which can have major impacts on production achieved. The presence of risk in agriculture is a challenge, particularly for small farmers who are not used to insurance. (Johnson and others 1993, 35-51) showed that many farmers estimate incorrectly the probability of loss and may not correctly predict if an insurance contract is appropriate for them or not.

The implementation of expert systems in agricultural insurance would be an incentive for the development of both agriculture and agricultural insurance, because so as to perform a modern agriculture, it is necessary to maintain funding opportunities under the exact conditions required by the characteristics of the agricultural production. In this respect, the use of expert systems in insurance is a crucial tool for protecting agricultural producers and farmers. That is why the agriculture sector must be developed, especially that lately new risks have arisen as a result of climate change.

Applying expert systems technology in the agricultural insurance is as necessary as it is useful due to the fact that it provides information to farmers about the existing insurance products and it reproduces the reasoning of human experts in a comprehensible form, so that users, regardless of their level of knowledge, can decide which one best suits them at that time.

Despite the importance and necessity of expert systems as an alternative for development of agriculture and agricultural insurance, the implementation of such a system is delayed because of

the lack of involvement of insurance companies and regulatory authorities in the field (Supervisory Insurance Commission and the Ministry of Agriculture).

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