Farm Management Information Systems

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Abstract. The fast changing environment, including difficult market conditions and a high exposure to financial risks are major reasons for changing production policy. Farm Management Information Systems (FMIS) appear to be a powerful tool to deal with the new conditions. However, farmers still rely more on their intuition than on proper management tools, when it comes to running a farm business. Many farmers do not use FMISs for various reasons, like lack of knowledge and the complexity of many available FMISs. In particular for small to medium-sized farms and for multifunctional farms appropriate FMISs hardly exist. The objective of this paper is to give a brief overview why modeling has not had its breakthrough in the farming sector so far.

Keywords: Farm Management Information System, Modeling, Management

1 Introduction

The skillful and accurate management of farms (Mishra et al. 1999; Muhammad et al. 2004) is one of the most important success factors for their effective functioning, their sustainable development and survival in today's fast changing environment (Forster, 2002).

The reasons why a sophisticated farm management is such an important and challenging task are certainly diverse, however, three major factors have been identified in the ongoing academic discourse (Inderhees 2006; Sørensen, Bochtis 2010):

1. A complex environment
2. Complex farm structures
3. The introduction of modern technologies to the agricultural sector (Glauben et al. 2006; Inderhees 2006; Sørensen, Bochtis 2010)

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Farms are involved in an environment, which has become more and more complex over the past decades. Once was enough to supply a society with cheap and sufficient food products, wheras today much more is expected from the agricultural sector (Rohwer 2010). The expectations incorporate compliance with regulations to be entitled for EU subsidies (Morgan et al. 2012; Sørensen, Bochtis 2010), new and stricter guidelines for the use of agrochemicals (Villaverde et al. 2014), food safety (Magnuson et al. 2013) and animal welfare requirements and environmental concerns (Malcolm 2004; BMELV 2004). In fact, the farming business has shifted to a multifunctional service sector (Schöpe 2005).

The second reason why farm management became more and more difficult, lays within the farms themselves. In Germany the total number of farms has decreased since the 1970s whereas the cultivated area did not change substantially (© Statistisches Bundesamt 2012) . Consequently, the remaining farms have become larger to benefit from economies of scale (Nause 2003) but they also became more difficult to manage (Glauben et al. 2006).

The third reason is the introduction of modern technology has contributed to the challenge of sophisticated farm management. In this context modern technology incorporates in particular the usage of PCs coupled with the application of the corresponding software of the financial statements of farms, planning tasks for land cultivation husbandry etc. Additionally, many farmer introduced GPS added tractors and "smart" machinery, GIS-supported landscape modeling and other state of the art technology, making special knowledge indispensable (Linseisen et al. 2000; Zeddies 2001). All these technologies can be combined under the expression "Wired Farm" or "Precision Farming" (Sigrimis et al. 1999).

A major outcome of the three developments described is the generation of large data volumes. To handle and to benefit from these enormous data volumes farmers have to be capable of performing the following tasks:

1. Collection of Data
2. Processing of Data
3. Providing Data
4. Using Data

To deal with these four tasks, farmers have to introduce an integrated Information System (IS) sometimes also called Decision Support Systems (DSS).

Today, most IS or DSS have a special focus. "Dairy Comp 305" for instance, is an IS especially for the herd management of milking cows (Cerosaletti et al. 2004, 2004; Enevoldsen et al. 1995), whereas MicroLEIS (Meyer et al. 2013) and DSSAT (Sonam, Sawhney 2014) are developed as very useful tools for land cultivation. AFFOREST sDSS is especially developed for silviculturist (Orshoven et al. 2007) and StocKeeper for herd management of bulls (Grubb 2010).

2 Objectives and Methods

The objective of this paper is to give first a brief overview why modeling still has not had it is breakthrough in the farming sector. The paper is aiming on the development of a FMIS that depicts all production processes and their internal interconnections of a farm accurately. The first objective deals with the question, why FMISs' pervasion performance in today's farming sector is still poor. The second one aims on identifying the most successful FMIS approaches currently applied.

The development of the FMIS model is based on a system approach that observes the farm as an open system, with productional, technological, economic and social subsystems. Firstly, a system analysis of the farm has been conducted, aiming on the identification and analysis of all the material and information flows, production processes and their interconnections. This procedure is imperative to describe the farm's production systems accurately. The procedure incorporates the data collection by conducting visual inspections (fields, animal facilities, machinery etc.), interviews with the farmer and his laborer and a thorough analysis of the farm's financial data, including balance sheets and profit and loss statements, the operating plan including spraying and fertilizing dates and crop rotation scenarios. On the basis of the collected information a farm fact book has been completed, dealing with basic external and internal conditions.

Consequently the FMIS model has been designed, based on the system analysis and the individual information requirements of the farmer. The FMIS design comprised a listing of all production processes, focusing particularly on the internal exchange of goods. Lastly, the gained information was transferred into a marginal cost model. This approach does not take fix costs into account. Therefore, all fixed assets (plant and equipment) are considered immutable. In other words, the model does not consider future investment or disinvestment decisions and has therefore solely a short term character.

3 Results and Discussion

As mentioned earlier the reasons why farmers hesitate to apply modeling to their farm are various. In the last 20 years scholars brought up several explanations. Figure 1 facilitates the understanding of their argumentation.

Complexity is one of the major impediments for the application of modeling. And this complexity occurs very different ways. First, one has to acknowledge the complexity of the farms organization itself. Various, partially very different production processes (land cultivation, husbandry etc.) have to be tuned properly. Additionally, farmer deal with biological system which can never be fully controlled.

Market risk (change of prices), financial risk further increase the number of uncontrollable factors. These two sources of complexity, namely the farm and its environment lead to complex models. But complex models are expensive, difficult to understand and to use. These are unfavorable premises for an easy and swift adaptation. The huge number of uncontrollable factors and their significant influence on the farm's profitability have another negative side effect.

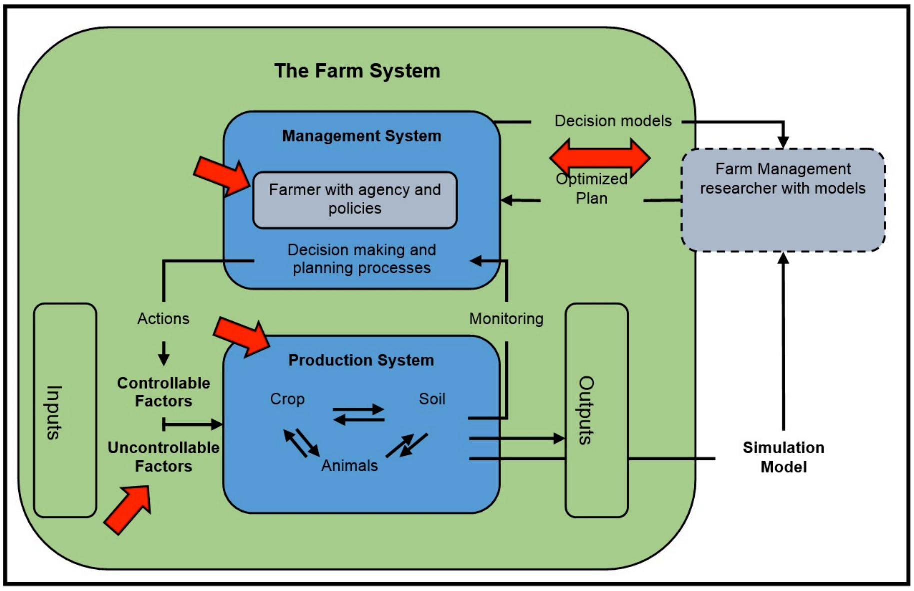

Fig. 1. The Farm System after (Sorensen & Kristensen, 1992)

When it comes to modeling of farms the first outcome of the farm analysis is a comprehensive "Farm Fact Book" which consists of the following elements: "Basic information", "Natural conditions", "Machinery", "Human resources", "Buildings", "Farm details" and "Infrastructure".

In a second step we analyzed general FMIS models. Most FMIS models in literature have quite simple structure. The structure of the general FMIS incorporates two technologies, namely plant production and livestock production. When all activities and their input respectively output factors are evaluated with prices, then an accurate calculation can be conducted. In terms of livestock production the "Herd Organization Structure" has to be considered additionally. From the calculations of the plant production the services and the livestock production one receives the coefficients necessary for the linear programming program (LP-Program). This program also considers market limitations (e.g. max. quantity salable) and production limitations (e.g. the max. available agricultural land).

The analyzed case study farm is a good example of a complex farm structure. The case study farm as displayed in Figure 2 has three major braches, namely "Plant Production", "Services" and "Livestock Production". The branch "Plant Production" has four subunits. The first subunit, called "Arable Farming" displays the three main crops, which the farmer cultivates. These crops follow the common regional scheme of crop rotation: winter wheat, winter barely, winter canola. Grain maize is only occasionally cultivated as a surrogate crop in the case that the three main crops can't be cultivated. "Feed Crops" incorporates grassland for the hay production and grain maize, which is sold to food suppliers who meliorate and resell it as pig feed to the farmer. The pasture is exclusively used for the horses during the summer.

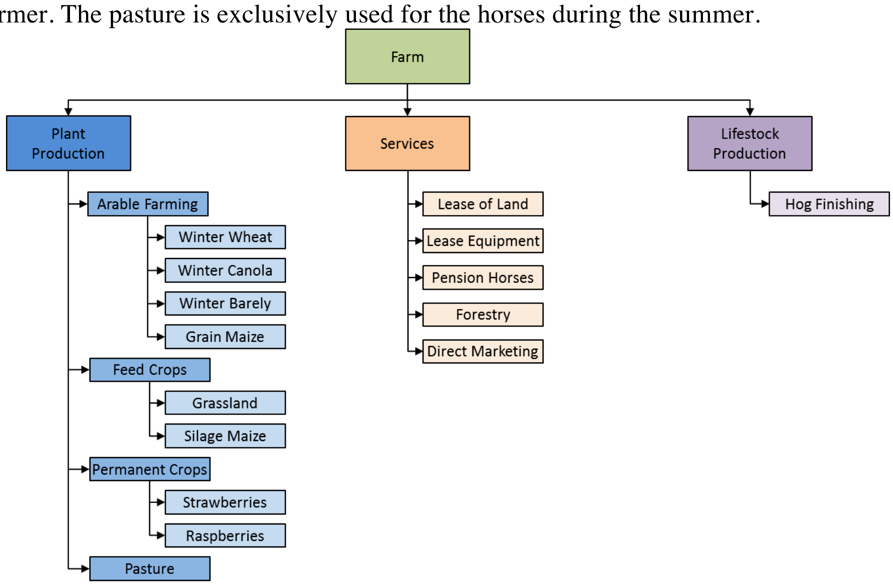

Fig. 2. The Farm Structure

The branch "Livestock Production" solitarily deals with "Hog Finishing". The 700 place of the pig stall are the biggest source of income of the case study farm, which is totally independent of the season (Figure 3).

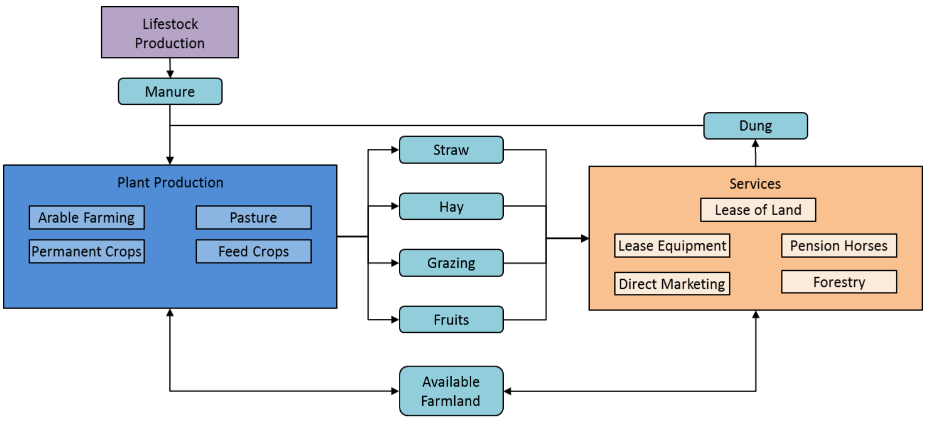

Fig. 3. Internal Material Flows of the Case Study Farm

4 Conclusion

The findings of this paper have pointed out that well balanced and carefully considered management decisions are more important for the surviving of farms. Reasons are the grown external and internal complexity of the farming business and its higher exposure to financial risks. It is likely that these factors will become even more significant in the future making a professional decision making support system indispensable. A sophisticated FMIS can be an important contribution to attain better management decisions. It has to allow farmers to easily access all information which are crucial for the farms profitability.

The minimum requirements for such a FMIS are:

1. Monitoring/Data collection
2. Planning/Scenario analysis
3. Controlling/Target-actual comparisons
4. Identification of optimization potentials /Profit maximization

However, one has to consider the enormous effort connected with a proper setup of a FMIS. Co-products, internal exchange of good or non-marketable products (e.g. crop-rotation) and a thorough cost accounting as a basis are just some factors, which have to be considered. Moreover, when it comes to optimizations (profit maximization), an allocation optimum for the entire farm is difficult to identify, since the scare resources differ from production process to productions process (arable land, feeding places, machine hours etc.). Nevertheless, the benefits of a FMIS are paying off for farmers on the long run, because a well-developed FMIS can support a decisions making process which is based on facts and not on gut instinct.

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