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# A four nation survey of farm information management and advanced farming systems: A descriptive analysis of survey responses

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The aim of this paper is to present the descriptive results of the survey responses that explore the perception of advanced information systems among four European countries: i.e. Denmark, Finland, Germany and Greece. The study evaluates the potential time savings associated with office tasks for information management and the likely adoption of advanced farming systems and precision farming practices. The survey results suggest that there are differences in weekly hours allocated to office tasks and its distribution across countries. However, there seems to be a potential benefit for introducing labour saving farm information management systems in relation to budgeting procedures, field planning and paperwork to deal with subsidy applications and public authorities. More than 40% of the respondent farms from Germany, Denmark and Finland seem to be unsure about usefulness of computers in dealing with official institutions and consumers. The extent to which the finding is linked to the budgeted time allocated to office tasks is worth pursuing.



## 1. Introduction

In recent years, the development of automated systems in agriculture has gained an increased interest, which has led many researchers to start exploring the possibilities to develop more rational and adaptable systems based on a behavioural approach (e.g. Sørensen et al., 2010b). A combined application of new communication technology, sensor systems, more powerful computing power, positioning systems (GPS) and geographical information systems (GIS) have enabled the development of new systems for cultivating and harvesting crops (e.g. Slaughter et al., 2008) and to improve indoor animal feeding management and milking systems (e.g. Wathes et al., 2008; Meijering et al., 2004).

Research into autonomous vehicles in agriculture started in the early 1960's by mainly developing automatic steering systems (Wilson, 2000). Robotic applications in agriculture, forestry and horticulture have been developed for various applications (Kondo and Ting, 1998; Hollingum, 1999). In terms of fully autonomous vehicles in agriculture, a limited number of applications like the automated harvesting system Demeter (Pilarski et al., 2002) as well as in semiautonomous tractors (Freyberger and Jahns, 2000; Billingsley, 2000) have been developed. There are a number of field operations that can be executed by autonomous vehicles and being more profitable than conventional machines (Sørensen et al., 2005; Pedersen et al., 2007). In recent years the development of autonomous vehicles in agriculture has experienced an increased interest. There are a number of prototypes that have been reported in horticultural crops, such as oranges (Hannan and Burks, 2004), strawberries (Kondo et al., 2005) and tomatoes (Chi and Ling, 2004). For field crops there are also a number of prototypes, such as the autonomous Christmas tree weeder (Have et al., 2002), the API platform for patch spraying (Bak and Jakobsen, 2003) and the hortibot vehicle for high-tech plant nursing (Jørgensen et al., 2006). A study by Reinemann (1998) indicate that there was about 5 milking robotic systems in Denmark in 1998, 50 systems in Germany

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and about 150 systems in the Netherlands back in 1998. Currently, this number has doubled several times (Meijering et al., 2004). Parallel to this development, there is a development of automated feeding systems and biosensors that can register the quality of milk, disease level among animals and gather other information to improve the productivity and quality at the farm.

Precision farming has been practised mostly in Northern Europe, USA, Australia and Latin America for about 20 years. The early adopters started with yield monitoring and mapping and continued with variable rate application of mainly lime and nitrogen-fertilizers. Technical enthusiasts were the first to adopt PF practices and by the year 2000 about 400 Danish farmers (about 9% of the cereal acreage) have adopted some site-specific and GPS related technologies on their farms (Pedersen et al., 2004). Although these practices has been of increasing interest among farmers, the economic benefits from variable rate nitrogen application and patch spraying, has not been fully demonstrated yet (Pedersen et al., 2009 and Swinton and Lowenberg-DeBoer, 1998). Time requirement and high cost of data handling were cited as the main problems of practicing precision farming in a survey carried out in Denmark and in Cornbelt, USA (Fountas et al., 2004).

Farmers who gather data based on site-specific tools (GPS, yield sensors, etc.) have a limited number of agronomic models and decision support systems available to evaluate this comprehensive amount of data and thereby to adapt their decisions on a sub-field level. Therefore, attempts have been made to structure the farm information flow to better handle all this information in an efficient way (see Fountas et al. (2006) and Sørensen et al. (2010a)). Due to the complexity of decision making and the relatively high investment costs, farmers have been reluctant to invest in these systems. So far, there have been conducted a number of surveys on the adoption and perception of precision farming systems in Europe and North America (see Pedersen et al. (2001, 2004)). Meijering et al. (2004) reported studies on milking systems conducted in Europe and US.

However, little emphasis has been put on analyzing the potential use of farm management information systems seen in a broader context like the potential time savings that are related to improved management of information systems and the likely adoption of precision farming in a multinational context. In an attempt to fill this gap, a survey was conducted in the autumn of 2009 among four EU-member countries Germany, Denmark, Finland and Greece with a first objective to generate a database for subsequent assessment of farmers' perception of farm information management systems and subsequent estimation of the time farmers allocate to inside office administrative tasks and outside office farm related tasks. Next, a second objective would be to investigate the possible link between farm legal/official and business information systems and the use of advanced automated systems. This study was part of an on-going EU research project FutureFarm. FutureFarm has defined aims at meeting the challenges of the farm of tomorrow by integrating farm management information systems (FMIS) to support real-time management decisions and compliance to standards.

The aim of this paper is to present the descriptive results of the survey responses. Thus the paper first presents the descriptive results of the surveyed population demography, farm structure, production characteristics and main cultivated crops in rotation. The second part focuses on time budgets for administrative work and office related tasks. The third section gives an overview of the farmers' use of precision farming technology and other automated farming systems. In addition, the analyses of country differences as well as the associations/correlations between farm structures and the use of advanced automated systems are commented. Finally, the discussion of the descriptive results, summary remarks and perspectives are presented.

## 2. Methodology and data

### 2.1. The survey

In Denmark, 400 questionnaires were posted and distributed among Danish farmers. Farms in Denmark are registered by land-use and livestock production. The four main farm types are arable, dairy, pig, and horticulture farming systems. Proportional to this distribution the questionnaires (Q) were sent out, though leaving out the horticultural farms, as the group statistically would become too small.

In Finland, 700 questionnaires were posted to Finnish farmers combined with the possibility to upload answers on a web-site. There are around 70,000 active farms in Finland, and the questionnaires were sent to 1% of randomly selected active farmers in each region. In Germany, 1000 questionnaires were posted to farmers across the country, ensuring that each of the 10 notable regions had 100 questionnaires. The German farms receiving the questionnaire were among those receiving over 40,000 EURO in farm supports from the EU. In Greece, farmers were mostly approached with personal interviews in the region of Thessaly, Central Greece. Thessaly is the main agricultural region in Greece with larger farms in comparison to the rest of the country, predominantly cultivating cotton and cereals and to a lesser extent vegetables and trees. The farmers were randomly selected.

The survey was coordinated by University of Copenhagen, Institute of Food and Resource Economics and consisted of 31 questions. The questions were the same in all countries with adjustments in each country to reflect language differences. The results, where relevant are presented allowing for across country comparisons. In Greece, questions related to precision farming were left out because the systems were not available.

The survey was designed to collect information on demography, farm and production characteristics, inside-office and outside-office time budget, the level of adoption of advanced automated systems and the perception of farmer towards the use of arable precision farming practices.

Demography and farm characteristics include the age of the farmer, the level of education, the size of the farm land measured in hectares, the texture of the soil, the production activities on the farm, where the latter also reflects the sources of individual farm income as well as the first ranked main crops cultivated on the farm. The production characteristics of the farm cover labor requirements, the use of external help as well as the costs of production per hectare farm land and external services. The inside-office and outside-office time budgets were designed to provide information on documentation needed to fulfill the requirements of legal/official and business information systems for successful management of the farm business. The information on advance automated systems included the use of livestock feeding, robotic milking systems as well as field auto guidance and crop management (grain drying) systems, the use of precision farming practices and farmers' perception of precision farming.

### 2.2. Data analysis

The descriptive summaries are provided as percentage distributions for level variables and as averages for ratio variables. The country differences as well as the tests for association/correlations were conducted using chi-square ($\chi^2$) tests in cases of level responses and the analysis of variance in the case of ratio variables, where *F*-tests and multiple *t*-tests are used to inferred on significant relationships. Significant tests of associations or correlations were conducted by relating farm characteristic variables to the advanced automated systems and time budgets as well as between the time budgets and the use of advanced automated systems.