Enikő Lencsés

Szent István University, Gödöllő, Hungary

POTENTIAL ADAPTATION OF PRECISION FARMING TECHNOLOGY IN THE FUTURE

MOŻLIWOŚCI ZASTOSOWANIA TECHNOLOGII ROLNICTWA PRECYZYJNEGO W PRZYSZŁOŚCI

Key words: motivation, structural interview
Słowa kluczowe: motywacje, wywiad strukturalny

Abstract. The aim of this paper to define the future adaptation of precision farming technology in the group of farmers who used the technology and the group of farmers who not used it base don the structural interview. This paper examine that which factors influence the adaptation of the precsion farming

Introduction

The birth place of the precision farming technology is the USA, where the media media attention of the research of precision farming in the 1990s was huge. At the begining of the GPS combined yield-mapping methods, tools were appeared. The site specific yiledmapping was used in 3% of the american farmer sin 1992 [Lowenberg-DeBoer 1999], in 1998 any kind of precision farming elements were used only in 5% of the american famers [McBride, Daberkow 2003].

Precision soil-sampling and the varriable rate fertilization systems were quickly spread among the farmers. In America the GPS-based soil-sampling was applied 29% in 1996, 33% in 1997, 43% in 1999 of farmers. While precision fertilization combined with guideline tool was occurred only 13% of farmers, but utill 1999 this number is grown to 37% [Akridge, Whipker 1997]. In Denmark the number of farms with precision farming technology is about 400 Enterprise (> 1%), usually the average area is more than 200 hectares. But only 10 who uses more than one element of precision [Pedersen et al. 2004]. These numbers prove that the precison farming technology is in the early adopter section in the innovation curve, despite of its age (the technology is more than 20 years old). Althoug the precision farming technology was exit of the innovator section, technology is developed constantly nowadays. So the R&D activities are still work about the precison farming technology.

The aim of this paper to define how the farmers see the future of the precison farmiong technology in their farms.

Materials and methods

In the scientific literature of precision farming technology mostly the adoptation and the knowledge of the technolgoy was written and did not make resarech works about the future appliaciotion or add-aptation of the technology. From the summer of 2010 to springt 2011 I made an own data collection in order to define the future adaptation of the precison farming technology in Hungary. The source of the data collecion was structured interviews. The data collection was made personal, and in the end of data collection 72 farmers answered. Thanks to the personal interviews nobody was excluded from the examination becasue of missing data. The availabele samlpe database (n=72) was divided into two sub-sample database. The first sub-sample includ the farmers who use precision farming technlogy (n=31). The second sub-sample include the farmers who not use precision farming technology (n=41).

The diference between the future imagine by precision farming technlogy in the group of user and in the group of non user was on the focus of my resaerch. The other aim of research was to define the motivation factors of future adaptation or expansion of precision farming technology.

Variety of statistical methods were used to accurate and effiecent processing of the collected. One- or two-variable statistical analyses have been applied. The crosstab analysis was applied to explore the relationship between the notmetric variables. In the crosstab analysis the value of the chi-squared (c^2), Cramer V and the Goodman and Kruskal tau and as well as the significance levels were helped to explore

the relations. The varraince analysis was applied to explore the non metric independent variables effects to the metrical dependent variables. The validation of the crosstab and the variance analysis was 5% level of significance. In the case of both relationship testing the null hypotheis was the lack of relationship between the two variables. If the signmificance level is lower than 5% it means that there is a significance relationship between the two variables [Sajtos, Mitev 2007].

Results and discussion

Some interviewees were used the precision farming technology for ages, some interviewees plan the adoptation of this technlogy and some interviewees heard about the technology but not plan the adopotation. All interviewees has crop production in their farms. There were no territorail demarcation under the interviews in Hungary.

The average age of the interviewees was 48 years. In the sample the youngest farmer was 25 years old, and the olds was 75 years old. The rate of farmers who are younger than 35year is 28%, which is higher than the national average (7%) in 2010 [Valkó et al. 2011]. In my data collection the reason of the high rate of young farmers come from the method of data collection. The interviews mostly made on agroshows where usually the younger ages represented. In the sample the rate of older farmers (older thank 65 years) was 11%.

The aspects of demographic analysis there were an important issue was the highest educational level of farmers. In the test sample the university education reach the highest proportion, it was followed by the elementary education, college degree, and secondary education. The proportion of high school graduates and vocational training did not reach 10% of the sample. Half of the interviewees have a superior qualification.

There were no significant connection between the age and the highest educational level of farmers based on the crosstab analysis (Pearson(χ)^2 value).

The most commonly used indicator to characterize the farm is the economy size. During the structured interviews the following tree standpoint were used for determint the economy size:

– cultivated land[1],
– European Size Unit[2],
– number of employees[3].

The proportion of large farms in the sample was 44%, of medium-sized farms was 38% and the of the smal was only 18% based on cultivated land. Based on the European Size Unit the rate of very small farms (below 4 ESU) is 25%, of small farms (between 4 to 8 ESU) is 13%. Based on the European Size Unit the small farms (below 8 ESU) together are twice the share as the small farms based on cultivated land. In the total sample the rate of medium-sized catageroy according to ESU (8 to 16 ESU)) is 33%, this rate is almost the same like the rate of medium-sized farms based on cultivated land. The rate of big sized farms was 30% based on ESU. Most of the farms (49%) employed less than 10 persons.

As the size economy size of farms are different based on the three points of view. For example, the number of employees on the basis of the test is a small-sized holdings to 49%, the ESU on the basis has only 38% of the small ones are very small and, at the same time together is being worked by the holding under the area of the small farms of 18%. These differences justify to m ake crosstab analysis between the different aspects.

There were no significant relation between the size-category based on cultivated area the size-category based on number of employees. So the size of cultivated land do not influence the number of employees in the test sample. But number of full employees than the part time employees were growed in direct proportion with the size of cultivated land. Summary there were no relation between number of employees, the income of farms, and the cultivated land.

Usage of precision farming technology

During the interviews the 43% of the farmers used any elements of the precision farming technology, and the rate of non user farmers were 57%. In my opinion the reason of the high percentage of precision farms is that mainly the interviews made on agroshows where the farmers usually more opened for new technology than the average.

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1 Cultivated land: small (<30 hectare), medium (31-300 hectare), big (>300 hectare)

2 ESU: very small (<4 ESU), small (4-8 ESU), lower-middle (8-16 ESU), upper-middle (16-40 ESU), big (40100 ESU), very big (>100 ESU)

3 Number of employees: no employees (0 capita), small (1-10 capita), small medium (11-49 capita), medium (50249 capita), big (250-499 capita), very big (>500 capita)

Table 1. Relation between the adaptation of precision farming technology and some important farm information based on crosstab analysis
Tabela 1. Zależność pomiędzy adaptacją technologii rolnictwa precyzyjnego a ważnymi dla gospodarstwa informacjami podstawie analizy krzyżowej

Name of independent variables/*Zmienne niezalezne*	Pearson χ^2 /test *Pearsona* χ^2		Goodman and Kruskal tau/*Test Goodman i Kruskal tau*		Cramer V/*test Cramer V*		Stength and direction of relation/*Siła i kierunek zależności*
	value/ *wartość*	*α*	value/ *wartość*	value/ *wartość*	value/ *wartość*	*α*	
Economy size of farms based of ESU/*Wielkość ekonomiczna gospodarstwa*	8.96	0.11	0.13	0.11	0.36	0.11	no/*nie*
Size of farms based on cultivated land/*Powierzchnia użytków rolnych*	8.64	0.01*	0.12	0.01*	0.36	0.01*	+ moderate/ + *umiarkowana*
Ranking of income of technologies/*Ranking przychodów i technologii*	2.00	0.37	0.03	0.37	0.17	0.37	no/*nie*
Age of farmers/ *Wiek rolnika*	7.09	0.03*	0.09	0.03*	0.31	0.03*	+ moderate/ + *umiarkowana*
Education of farmers/ *Wykształcenie rolnika*	1.72	0.88	0.02	0.88	0.12	0.88	no/*nie*

* level of significance less than 5%/*poziom istotności <5%*
Source: own study based on structural interviews
Źródło: opracowanie własne na podstawie wywiadów

There was significant correlation between the size of cultivated land and the adaptation of precision farming technology. There is a moderate correlation between these two variables based on the value of Craber V (Cramer V =0,36 a=0,01). There is a moderate correlation between the age of farmers and the adaptation of precision farming technology (Cramer V=0,31 a=0,03). The farmers who used precision farming technology mostly are in his middle ages (40-64 years old), and nobody used the precision farming technology in the older group of farmers (older thank 65 years). There were no significant correlation between the income of farms, the highest education of farmers and the adaptation of precision farming technology (Tab. 1).

Examined the frequency of application of certain items of precision farming technology on the first place there were the line control, 35% of the precision farmers used this element. On the second place were the netbased soil sampling, 22% of the precision farmers used this element. Close on the third place is the precision fertilization (19% of users) and precision plant protection (15% of users).

There were no significant relation between the cultivated land and the choice of elements of precision farming technology based on the crosstab analysis. So the size of cultivated land dose not influence the selection of elements of precision farming technology.

Examined the relation between the size of ESU and the choice of element of precision farming technology there were no significant correlation based on crosstab analysis. So the selections of elements of precision farming technology dose not depend from the size of ESU. Although in the group of lower and upper medium sized farms the precision fertilization nobody used. The adaptation of precision plant protection appeared only in the very small, small and big sized farms based on ESU.

Only 25% of the farmers who used precision farming technology used more than one elements of precision farming technology. The 75% of these farms install first the soil sampling. Both farmers who used three of four elements of precision farming technology (13% of users of precision farming technology) adopt the elements at once. In this group of farmers the most spread elements were the precision fertilization and the precision plant production and it followed by the precision tillage and precision sowing.

Future plans of precision farming technology

The 55% of the farmers who used precision farming technology planed adapt more elements of precision farming technology. The 15% of the farmers who did not used the precision farming technology in the time of interviews planed adapt some elements of precision farming technology. In the interviews there were a list of elements of precision farming technology and the farmers should select that which elements want to adopt in the future and which year.

The most farmers who planed adopt an element of precision farming technology though about adopt the precision fertilization or precision plant protection. The farmers wanted to adopt the precision plant protection in the next 2 or 5 year.

The farmers who not used precision farming technology in the future want to adopt precision plant protection on the first place, precision fertilization on the second place, and the precision sowing ere only on the third place. These farmers not though about adopt the precision sowing, precision weed management or precision tillage in the next 2 year. These farmers though to adapt the line guard, yield mapping, precision sampling in the next 5 year (Fig. 1).

The 17% of the farmers who used precision farming technology in the future want to adopt precision fertilization. On the second place there were precision sowing, the yield mapping and the precision plant protection (7-7% of the farmers who used precision farming technology). On the end of the rank were the line grad, because the 35% of the users still adopt this (Fig. 2).

The relation between the used elements and the planed elements of precision farming technology in the group of farmers who still used the technology were examined. In the time of interviews the 74% of user of precision farming technology farmers used only one element of the technology and 52% of these farmers planed to adopt the new element. The most frequently planed expansion of elements were the precision fertilization, the lined guard and the yield mapping. The 50% of the farmers who use two kind of elements of precision farming technology not planed expansion of technology and the other 50% planed the adaptation of precision fertilization. Nobody planed the expansion in the future in the group of farmers who used more than two elements of precision farming technology.

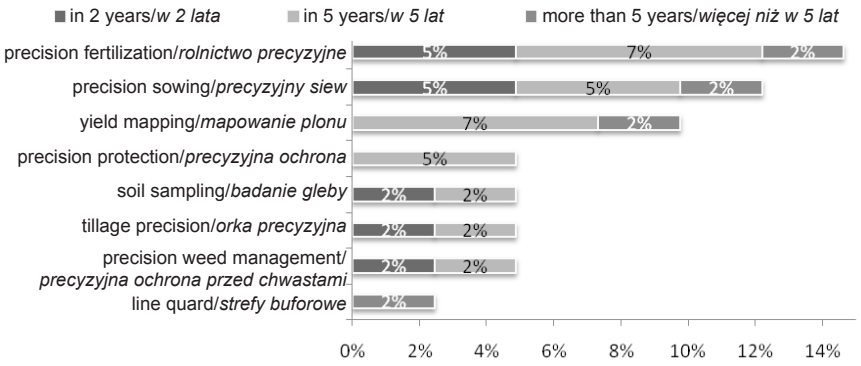

Figure 2. Plan of adaptation of precision farming technology in the non-user of precision farming technology (n=41)
Rysunek 2. Plan wdrożenia technologii rolnictwa precyzyjnego dla rolników niewdrażających tę technologię (n=41)
Source: own study based on structural interviews
Źródło: opracowanie własne na podstawie wywiadów

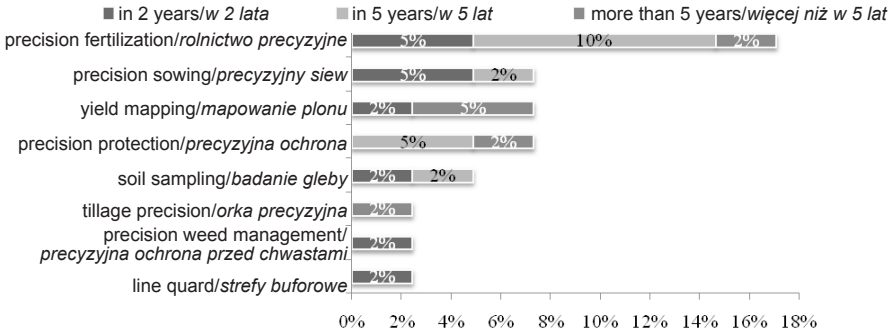

Figure 3. Plan of adaptation of precision farming technology in the user of precision farming technology (n=31)
Rysunek 3. Plan wdrożenia technologii rolnictwa precyzyjnego dla rolnikowi wdrążających tę technologię (n=31)
Source: own study based on structural interviews
Źródło: opracowanie własne na podstawie wywiadów

There were moderation significant correlation between the adaptation of yield mapping and planning of precision fertilization and the adaptation of line guard and planning of precision tillage. There were no significant correlation between the other adapted elements and the other planning elements.

The 27% of the non-users of precision farming technology though that if they adopt the technology it is only possible with own equipments and only 2% said that some elements would use in service.

Conclusion

The size of cultivated land of farms is significant correlate with the adaptation of precision farming technology. Mostly the middle aged farmers used precision farming technology. The income of farm not correlated with the adaptation of precision farming technology. The size of cultivated land dose not correlate with the selection of elements of precision farming technology.

Based on the frequency of application of elements of precision farming technology the rank of community is the following: line guard, precision soil sampling, precision fertilization and precision plant protection.

The community of the planning of adaptation in the future is the following in the group of farmers who not used precision farming technology still: precision plant protection, precision fertilization, precision sowing.

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Streszczenie

Celem artykułu było określenie możliwości adaptacji technologii rolnictwa precyzyjnego w grupie rolników, którzy korzystali z tej technologii i w grupie rolników, którzy jej nie wykorzystywali. Zidentyfikowano czynniki, które wpływają na adaptację technologii rolnictwa precyzyjnego.

Correspondence address:

Enikő Lencsés, lecturer
Szent István University
Faculty of Economics and Social Sciences
Institute of Business & Organizational Management
Páter Károly u. 1.
H-2100 Gödöllő, Hungary
e-mail: lencses.eniko@gtk.szie.hu