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Precision Farming as an Ecological Approach to Production?

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A precizi3s gazd3lk3d3s, mint a termel3s egyfajta 3kol3giai megk3zelit3se

Az 3kol3gia gyakran h3tt3rbe ker3l a termel3ssel szemben, mert azt hihetj3k, hogy a gazdas3gi szempontok a fontosabbak. A t3rsadalom 3lemez3sbiztons3gi 3s 3lelmiszerbiztons3gi sz3ks3gleteinek b3v3l3s3vel a k3vethet3s3g 3g3nye is n3vekszik, a trendek a hagyom3nyos technol3gi3k fel3 ir3nyulnak. Az 3kol3giai megk3zelit3s sor3n mindig jelent3s hozamveszt3ssel szembes3l3nk, ami akad3lyozza a sz3lesk3r3 alkalmaz3st. A precizi3s gazd3lk3d3s egy lehet3s3g arra, hogyan lehet a hozamot magasan tartan, mik3zben a bemenet cs3kken. A szerz3k primer 3s szekunder forr3sok alapj3n elemzik a precizi3s gazd3lk3d3st, 3sszehasonlitva a hagyom3nyos 3kol3giai gazd3lk3d3ssal, m3rlegelve a k3l3nb3z3 technol3gi3k 3l3nyeit 3s h3tr3nyait.

Kulcsszavak: *precizi3s gazd3lk3d3s, helyspecifikus gazd3lk3d3s, menedzsmnt, fenntarthat3s3g, versenyk3pess3g*

ABSTRACT

Ecology is often suppressed compared to productivity, which makes us believe that economy is more important than ecology. With the growth of social need for traceability, food safety and food security, the trend is to turn away from conventional technologies. The ecological approaches all must cope with significant loss of yield, which hinders their wide application. Precision farming can be an option for the management to keep the high yield levels and decrease inputs at the same time. The authors analyse, according to primary and secondary sources, precision farming compared to conventional and ecological farming to see the advantages and drawbacks of the different technologies.

Keywords: precision farming, site-specific farming, management, sustainability, competitiveness

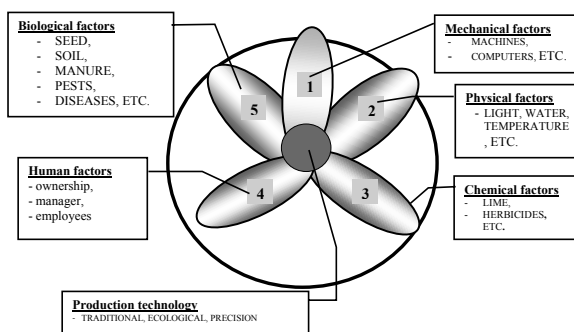
INTRODUCTION

There are many alternatives, when somebody starts with his/her own agricultural business.

A number of selections have to be made in order to identify the different asset and technological background for the optimal farm size. The started business is a system, which depends on the environment around it (legislation, market, economic, ecological, etc.). It is widely known that any system consists of defined elements, and it is only functional, if the elements are in interaction with each other. The agricultural business is a value creating/ production process that can be defined as a system and is "a set of resources, which is responsible for converting inputs into products, or services in the framework of a given technology." (Veszelka et. al 2013 p. 356) If we consider the definition of production, and formulate our opinion as generally as possible, then the production process factors are the following: technical factors, physical factors, chemical factors, biological factors and human factors. The relationships and interactions are signalized on Figure 1.

The factors, as elements of the system will be the inputs of the process, and are being transformed through the value creation,

Figure 1: The 5 factors of production and their common point



Source: Based on Pupos (in Veszelka 2013 p. 363)

built in the product or service. However, this requires that the elements interact with each other. It is acceptable that this is ensured by one of the key components of this system, the human factor. The output can therefore only be obtained if man, as an essential element of the system, provides the interaction. In this interaction lies the output (product/ service) quality and the environmental impact of the production process, too. This interaction is none other than the product/ service production technology. The technology - based system on the system approach – is non-other than the execution mode, procedure what provides the linking - based on predetermined algorithms - of the required production factors (elements) to carry out the process. The inputs needed are determined by the output. These can be different and distinct in size, even if the output is the same. This means the difference in the technological trees, and the basis of our analysis.

The first decisions, when starting an agricultural business, light up a path towards successful operation, but these first decisions will also define the ecological and economic side of the agricultural company. In this paper the authors analyse the different production process alternatives, such as ecological, traditional/conventional and precision farming. This analysis is based on the effect

of elements of production in the large food (material) crop production. These are then differentiated by the main principles of competitiveness and sustainability.

The connecting strategies and the two main principles

The duality of the desire to conserve natural resources and the lure of profit obtained by transforming it, largely determines present day's economy. Because our environment is subject to constant destruction

and the process seems irreversible, it can be assumed that the society prefers the maximum profit wealth accumulating activity. L3szl3 Csete summarizes this philosophical problem and its solution are in the following, assuming the success of the grassroots movements to alleviate the global crisis "The wrangling surrounding the sustainable development, sometimes even smokescreen, well-intentioned statements obscure the fundamental dilemma that lies between the individual short-term profit-maximizing interest and the long-term interest of society, community, for they are mutually exclusive. (...). The aim of local-level implementation of sustainability is the achievement of social well-being without damaging the natural resources" (Csete, 2011, pp. 149-150). The expected characteristics of the sustainable activities and agricultural systems are in the author's formulation summarized as follows. (Csete, 2011, p. 159)

- Recreates natural resources.
- Water-saving.
- Energy saving.
- Economical in chemical usage.
- Input-efficient.
- Produces quality.
- Harmonises with the environment.
- Skill-intensive.
- Knowledge-intensive.

There are multiple sustainable development approaches, for further please revise Mészáros & Hajduné, 2012. The main idea of being sustainable is – in my opinion – not fully turning away from conventional farming, because it would harm the food safety and security issues, but to reach and legally force on farmers a development course that could preserve nature. Because of this, the legal and administrative side of sustainability and competitiveness will be under review to see the future trajectories.

Competitiveness on the other hand is an issue that is difficult to define. According to Pupos, “It refers to the ability to compete on a market which is displayed in the acquisition of a market position and permanent endurance. This status / progress of the situation is indicated, measured basically by the extent of market share, enhancement of profitability, and business success. The competitiveness cannot be generally construed.” It can only be delimited by the conceptualization of the following:

- “The Dimension of Competitiveness.
- The Factors of Competitiveness.
- The Indicators of Competitiveness.” (Pupos & Demeter, 2011 p. 31)

Pupos also highlights the importance of a complex system and that the analysis of effect on competitiveness must be done on the level of single elements; similarly like we did before. The legal and grant system has an important effect on competitiveness and sustainability, which I would signalize here in a more detailed way. As a next step let us consider the legal side of these two defined concepts.

The new politics aims at agro economy and rural areas with a more complex rural development, putting these on a sustainable development lane. Services connecting to environment protection and climate change will be treated as a priority. The framework of

the linking challenges has been drafted for us in documents like “The Common Agricultural Policy after 2013” and the “National rural strategy”, etc. The directions can be formulated as following:

- to raise the economic and ecological competitiveness,
- strengthen innovation,
- reduce the effects of climate change,
- raise employment and economy in the rural areas,
- preserve food security and food safety.

AGRICULTURAL PRODUCTION PROCESSES AND DIFFERENTIATION BETWEEN THE ALTERNATIVES

Following the previous thought, the management strategies connecting to agriculture cannot be independent of the environment. The primary stages for environment-conscious farming are the production processes. The management must realize strategies that are incorporated in the environment and follow a system based approach. The connecting sectorial characteristics only modify, but not overwrite general interrelations, algorithms. Such interrelations are the seasonality, biological elements and timeliness that is superior to all techniques. For example, the vegetation period for a crop cannot be shortened and limitlessly lengthened. The deviation from the crops biological characteristics means a considerable loss in yield. The factors above are general to all technological alternatives, so these do not differentiate among them. The living soil is a requirement for all technological applications and must be taken as an aptness, as granted. The changes in the plants’ genome affects all alternatives at the same time. We must not forget that the agriculture is in interrelation with nature and takes a huge role in its conservation and degradation at the same time. As a conclusion we could state that

biology is a common factor for all alternatives. The difference is only to what amount can we reach the biological limits of the plants (yield, resistance, tolerance).

All other factors are not taken for granted and may be excluded and changed. These will mean the difference between technological assessments. These factors are available for all companies, be it precise, conventional or ecological. The question is how they build up their production processes. This is a huge difference in competitiveness and sustainability, as the elements used will predetermine cost levels and yields.

The primary stages of environmental management are production processes. However, in agriculture production processes feature a number of special characteristics (as mentioned before) which greatly affect the related management functions, and their space. One aspect of agricultural production processes, as product manufacturing systems is the animal or plant as a biological system. Basically, these are the elements that are causing the differences. However, it should be recognized that agricultural systems have all the features which characterize the systems in general, for example, it is possible to identify within the agricultural systems the management system that regulates and controls the real processes. By doing this, the management system will give a framework to the production. The management defines the invested asset and current asset need, together with the capital and working capital need, as the inputs appear in the production process in these forms. The management employs the human labour as the force that puts these inputs into the production process. The production process is therefore nothing but the circulation on current assets through the transformation process made by human and mechanical labour.

Once the management created a working system, intervention might causes dysfunction, as a whole system is more than the building elements. These elements are (biological) systems in themselves and therefore the careless doing is to be avoided. This is a major reason why we cannot change the elements within a working system. This could cause unforeseen consequences. Let us take the example of manure. Manure is a biological factor and has a very good effect on the organic life of the soil, but it also carries herb seeds, which causes the soil to be weeded. In a precise structure, such as precision farming, this effect is undesirable. In a system, which is favoured for its low chemical use (organic and precision farming) this effect excludes manure from the choices. While it could be a good option for animal husbandry farming, where the dispense of this material is a need and provides active substance instead of lime. In an environmentally friendly approach, the system bears the following characteristics:

- There is juxtaposition or parity between the elements.
- The elements can only be assessed realistically in the whole system.
- The defined structural ordering is a condition for the elements to interact with each other; and that new properties, the characteristics of the system come up.
- Some elements of the system - the biological factors - are of key importance for the functioning of the system.
- The impact is multiple in the operation of systems at targeted intervention, etc.

There is also a need for the knowledge of the connecting main characteristics of companies, as economic systems, besides the previously mentioned basics of production processes. Among them, the following is important for us:

- The subsystems (elements) of the company as an economic system are themselves systems,
- The various relationships cannot be accurately described,
- The system works in a stochastic way,
- The operation cannot be determined precisely in forward,
- The risk must be accounted,
- It is an open unit is not isolated from its surroundings, being in close interaction with them,
- It operates dynamically, the company conducts simultaneously real and nominal processes are present parallel, inextricably from one another.

We must turn to the three technologies in title to analyse them in view of the statement above. It is important that we described the production processes in general, in order to isolate the production processes from one another. There are huge differences in the processes, although this might not be visible on the end product.

THE CHARACTERISTICS OF THE THREE PRODUCTION TECHNOLOGIES

The three approaches are conventional, precision and ecological farming, which will show significant differences in their way of production. In Table 2, we summarized the differences in the three production technologies. After this we try to evaluate the methods according to their economic (competitiveness) and ecological (sustainability) usefulness in the life of companies and society. Through this we can characterize the processes and isolate the three approaches from each other. In the table we used a 1-5 Likert-type scale for evaluation, but is only for informing us, it has nothing to do with competing of the processes. I would like to highlight the short definition of the processes together with the common points.

Conventional farming: It is a highly mechanized, intensive agricultural production form that uses concentrated fields and high input materials. The main idea of competitiveness is the low cost, but instead uses high cost level. Competitiveness is in the central focus of the management.

Precision farming: It implements innovation in accordance with and subordinated to the corporate strategy in a way that the production system's inputs and management functions are chosen based on the (site-specific) agro-ecopotential of the farm sites. Optimization and cost decrease stand together with yield increase and risk management.

Ecological farming: "It ensures healthy farming and healthy food for today and tomorrow, by protecting soil, water and climate, promotes biodiversity, and does not contaminate the environment with chemical inputs or genetic engineering." (Greenpeace International 2009) Though many new studies vision that ecological farming can be economic and produce high yields, (Badgley 2007) but we are still doubtful and under Hungarian condition the large application of the approach is questionable. In the table the competitive point of view will determine the scores, but in the explanation part, the sustainability issues are presented, too.

As we can see, the technologies are fairly different, they are easily separable from one another. A few comments on the evaluation are required:

Automation level: Considering competitiveness, automation is a good way for risk management and concentrated work. It is certain tough that from the viewpoint of (environmental and regional) sustainability automation is a less desired option, being a driving force of industrialization.

Human labour: It is the reciprocal of automation, taken into consideration that monthly wages have a competitiveness

Table 1: The characteristics of different technologies from the competitive point of view

Denomination	Conventional farming	Precision farming	Ecological farming
Automation level	4	5	2
Human labour	4	5	2
Fixed costs	3	1	4
Depreciation	3	5	2
Variable costs	4	3	2
Computer expertise	4	2	4
Grant system	3	4	5
Application of innovations	2	5	4
Level of sustainability	2	4	5
Yield	3	4	2
Risk management	2	4	1
Sum	34	42	33
Treatment zones	Agricultural field as a whole	Within field units, the plants themselves	
Applicable on large farms	Yes	Yes	No

Source: Authors own compilation

decreasing effect. This may change with the CAP and the national politics, but in the present, Hungarian companies are keen on lessening their workforce. The human labour is not part of the property, while non-current assets are. Purchasing machines therefore immediately raise the company's own capital.

Fixed costs and depreciation: These two factors go hand in hand with automation level. The high level of fixed costs requires high capital, which is uncompetitive, but it also raises the level of depreciation, which is favourable because it decreases the tax base.

Variable costs: These include all current assets that are used for the production process. The ranking indicates the cost requirement, which will also indirectly influence the capital need through working capital increase.

Computer expertise: This is a specialty of the precision farming, as a limited knowledge of

computation is needed for the calibration of the machines.

This is frightening for some of the farmers according to secondary literature. It means a cost increase in training cost or hiring employees with expertise.

Grant system: Taking the EU and national grants into consideration, there is one difference between the technologies that is the Agri-environmental program. This is available for all that fulfil the requirements. It is easier for ecological and precision farming companies. In the future this will force companies to apply for greener farming.

Application of innovation: Innovation as a key factor of competitiveness is very

important for companies. It has many forms of appearances, with the help of its new techniques, cost decrease and efficiency increase can be achieved. Conventional farming is slower to react to newer technologies, than the other two.

Level of sustainability: Sustainability is – in our opinion – also part of competitiveness. Given the social trends, all companies must consider being as sustainable as possible. It has a marketing value, which is a part of every competitive strategy.

Yield: There is not much between the yields of the three approaches, but the scores show real differences.

Risk management: Together with automation (decreasing human mistakes) and using all inputs to the optimal amount, precision farming has the highest risk decrease value. Being short on inputs and not able to prevent all harmful

effects in a large, open field, ecological farming is the most risky of the three approaches.

Sum: The addition of points give a non-improving score of the three technologies. According to our point of view, precision farming is the most competitive of the three. Ecological and conventional farming ended up on second place, scoring almost the same amount of points. It is certain that if we took the sustainability principle as a deciding factor, the end score would have been different. We must not forget that the most important principle nowadays for companies is competitiveness, everything else is suppressed by it.

SUMMARY

According to the results we can conclude three major points. The first one is that precision

farming is more compatible with competitive farming than the other two. Therefore it is more appropriate for large farm application, than ecological and conventional. This may change in time with innovation and legal grant system, the result depicts the present situation. The second point is that ecological farming is more appropriate for family businesses, than conventional and precision. This is proven by the lower capital, higher labour need, which is a characteristic of Hungarian family farms. The third point is that the three approaches are different, which is shown by the distribution of scores, and the end result. This is important as every agricultural business has the option to find the appropriate production processes suitable for the immediate economic and ecological environment.

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