PRECISION AGRICULTURE IN HUNGARIAN LEGAL ENVIRONMENT

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Abstract

The regulation of precision agriculture is still in its infancy; as the general agricultural law, tax law, environmental law regulations are applied to this new form of agriculture that can be characterized by modern techniques, the Internet of Things, and the consideration of place of production conditions. There are precision agriculture farmers in Hungary who have gathered in an interest protection organization, and according to the Hungarian Minister of Agriculture, precision farming is one of the preconditions for the competitiveness of Hungarian agriculture. At the same time, several circumstances obstruct the spread of precision farming. These include the high cost of machinery and other equipments, the lack of professional knowledge of farmers, the unfavorable structure of agriculture (e.g. fragmentation of arable lands, aging of farm population), the general lack of trust and the excessive complexity and the frequent changes in agricultural legislation. This study examines some relevant elements of Hungarian legislation, also with special respect to the views of farmers. It highlights the shortcomings and contradictions of Hungarian law that, as it is already been known, may hinder the spread of the new, innovative solutions in practice.

Keywords: *precision agriculture, Hungary, farmers" opinion and motivation related to precision farming, agricultural law problems, Common Agricultural Policy*

Researches on Precision Agriculture (PA)[1] focus primarily on the question: what advantages does precision farming offer. The answers include the lower ecological impacts, the reduction of costs, higher and more stable yields and higher profits. PA can be a likely answer to climate change and food security as well. It is often viewed as the "cultivation system of the future". Beside the ecological, agronomical, economical, technical, botanical, soil and science aspects of PA, social scientific approaches have come to the forefront recently. Is PA accessible to all types of farmers? What are the social benefits and potential negative social consequences of PA (e.g. from the perspective of employment policy, how does a farmer become redundant?)? To what extent does political and legal environment promote or hinder the spread of PA? This paper is looking for the answers to these questions, under Hungarian conditions.

As far as the narrower subject of the research – legal regulations on the PA – is concerned, there are hardly any previous Hungarian antecedents.[2] The reason for this

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[1] In this study, the terms precision agriculture and precision farming are used with the same meaning.

[2] Legal researches have been launched only recently in Szeged and Debrecen, while agricultural professionals have been publishing PAs regularly since the 1990s. Á. Bujdos PA deals with certain aspects of EU law. Á. Bujdos:

is that PA as a form of farming is relatively new, and the legal (agricultural, environmental, water law, tax law, etc.) regulations that apply to it do not contain requirements adjusted specifically to PA yet.

Issues of legal regulation appear rarely, usually scattered, fragmented in the international literature of PA. At the same time, due to the specificities of national legal systems, foreign regulatory experiences can only be adapted to a limited extent, even within the European Union with a Common Agricultural Policy (CAP).[3] This is an important factor to mention because this research topic is only partly international. CAP regulations apply in all Member States (in the field of market regulations, direct payments, protection of the environment, food safety etc.), but a significant part of agricultural situations (such as the regulation of land ownership, land leasing, taxation) constitute a national competence. At the same time the results of social science (especially agronomy and sociology) can be relied upon, so the evaluation of the existing regulations and the justification of the necessary measures and legislative changes is possible from their perspective.

This study was completed as part of an interdisciplinary research project, however, it only examines PA from a legal perspective. By studying definitions known in the professional literature, I try to describe what can be considered as PA. In the course of the research, a questionnaire survey and several interviews were conducted (both in 2018) among Hungarian farmers. Based on the answers, the study shows what farmers consider important in the legal-political context for the spread of the PA, and it examines the circumstances behind the responses of the farmers. While seeking reasons it reflects on the problems of legal regulation and application.

1. Definition of precision agriculture

The first research task is to examine what precision farming means from a legal perspective. Clarifying the meaning of concepts in legal regulations is indispensable for the determination of the material scope of law. Currently there is no Hungarian legislation or binding EU legislation that would explicitly regulate and define PA. At the same time, there is a need from the direction of agricultural policy to promote the spread of PA,[4] that cannot be imagined without legal regulation. This can be solved by the legislator either by providing a generally applicable definition and introducing specific regulations on PA, or by indirectly regulating it without a definition, by promoting its main (favorable technical,

Precision agriculture: a potential tool to tackle drought and water scarcity in the EU. *Hungarian Yearbook of International Law and European Law 2018*, 371-388. E. Farkas deals with the issue of innovation. E. Farkas Csamangó, Gazdasági és jogi kérdések a környezetjog területéről: Az öko-innovációról. [Economic and Legal Issues in the Field of Environmental Law: Eco-innovation] – In K. Gellén (ed.): *Gazdasági tendenciák és jogi kihívások a 21. században*, Szeged, Iurisperitus Kiadó, 2019, pp.39-53.

[3] To review therelevant legal regulations (on data management, food safety, climate change mitigation etc.) of the EU *See:* M. Kritikos: *Precision agriculture in Europe: Legal, social and ethical considerations: Study*. Brussels, 2017, 80. http://www.europarl.europa.eu/RegData/etudes/STUD/2017/603207/EPRS_STU(2017)603207_EN.pdf (last access: 20.05.2019).

[4] Phil Hogan, the EU Commissioner for Agriculture said at the Forum for the Future of Agriculture 2018 that: "Member States would have to (…) explore the introduction of (…) incentives for precision agriculture." After 2020 "the role of new technologies and precision agriculture will be central" in the CAP in achieving the objectives of climate protection without reducing production volumes.

https://ec.europa.eu/commission/commissioners/2014-2019/hogan/announcements/speech-commissioner-phil-hogan-forum-future-agriculture-2018_en (last access: 19.05.2019)

management, environmental etc.) features separately.[5] It can be assumed that the former solution would be more accurate, more expedient in terms of PA, while the advantage of the other solution could be the its competitiveness and technological neutrality.

The question is, therefore, whether a generally acceptable definition could be given in the light of the professional literature and other non-legal sources, and, if so, in what category the precision farming could be classified according to its definition.

There are many definitions known of PA, almost all of which emphasize the linking of state-of-the-art agricultural machinery/technology with IT equipment, and the approach to economic, environmental and social sustainability. One way to do this is to differentiate within the areas of land: "precison farming is the term given to a method of crop management by which areas of land or crop within a field are managed with different levels of input in that field."[6]

According to the late British Home Grown Cereals Authority (merged into a new entity in 2008), PA is: "management of farm practices that uses computers, satellite positioning systems and remote sensing devices to provide information on which enhanced decisions can be made."[7] The United States Department of Agriculture calls this kind of agriculture "as needed" farming and define it as "a management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture or yield, for optimum profitability, sustainability and protection of the environment."[8]

In the Hungarian literature, PA is considered to be complete if a soil analysis based on a satellite navigation supported soil sampling, a differentiated nutrient replenishment, yield mapping, precision sowing, and differentiated plant protection are implemented on the given farm.[9]

There are a few who, opposite to us, makes a distinction between PA and PF. According to this view, PA is a sustainable use of agricultural resources which can be achieved by managing agricultural systems based on information and knowledge. Compared to this, PF is the use of available technologies to tailor soil and crop management to fit the specific conditions found within an agricultural field.[10]

PA is cost-intensive due to the high cost of special machines and the appropriate IT background, but it is eased by the fact that it is not necessary to introduce all its elements at the same time, thus it is possible to switch gradually between traditional farming and a system based fully on

[5] The main differences between conventional and precision farming are summarized by J. Tamás, *Precision agriculture*. University of Debrecen AGTC, Debrecen, 2011, 2.

[6] R.J. Godwin, G.A. Wood, J.C. Taylor, S.M. Knight, J.P. Welsh: Precision Farming of Cereal Crops: a Review of a Six Year Experiment to develop Management Guidelines. *Biosystems Engineering* 2003/4, p. 376. doi:10.1016/S1537-5110(03)00031-X. Spatial thinking has a long tradition in Hungary, both in practice and in scientific research, mutat rá Tamás, ibid. 1.

[7] H. J. S. Finch, A. M. Samuel, G. P. F. Lane: *Lockhart and Wiseman"s Crop Husbandry Including Grassland.* Elsevier, Woodhead, 2014,p. 236.

[8] Ibid.

[9] K. Takácsné György: *A precíziós növénytermelés közgazdasági összefüggései. [Economic contexts of precision plant production],* Szaktudás Kiadóház, Budapest, 2011.; J. Popp, E. Erdei, J. Oláh: A precíziós gazdálkodás kilátásai Magyarországon (Outlook of precision farming in Hungary). *International Journal of Engineering and Management Sciences* 2018/1, 138.

[10] J. Vieira Rocha: Precision farming and geographic systems. In C. Bauzer, M. Medeiros (Eds.), *Advanced Geographic Information Systems (Vol. 1.).* EOLSS, Oxford, 2009, pp. 151-168 (166).

precision solutions.[11] At the same time this also means that the use of some precision machines alone does not necessarily mean precision farming.

Based on the studied literature and the wide variety of documents available on the Internet (Commission and Parliament background studies, press releases, chamber statements, association documents),[12] at the very least, there is no uniform definition that can be used in legislation. Generally speaking, it is a form of farming, the conceptual elements of which can be adapted to the specific technical, economic, scientific approaches and policy objectives.

The limitations of the creation of a definition are also burdens for the legal regulations. If precision farming fails to formulate a definition that describes its essence to the legislator to distinguish it clearly from other types of farming methods/forms, then only the conceptual elements of precision agriculture can be captured by regulation. It may be a question of further research what conceptual elements (e.g. input and output characteristics, technical, information technological, soil usage, etc.) can be highlighted. This can be followed by the examination how the characteristics of precision farming fit into the current regulatory framework and – e.g. in line with the forthcoming reform of the Common Agricultural Policy – the changing regulations. Thus, what legal institutions, regulatory methods and elements are relevant within agricultural and environmental law as far as precision agriculture is concerned.

At the same time, it can also answer the question of which solutions with similar parameters can precision farming compete with. It is not a jurisprudence / research decision, but it can be examined how regulatory priorities can develop in this respect. From the prspective of legal policy, I would emphasize two aspects. On the one hand, I believe that there is a more favorable form of farming in terms of environmental sustainability (e.g. ecological farming), that at the same time has lower productivity. In this way, PA can represent a midway between, a transition to the promotion of ecological and economical interests. On the other hand, my opinion is that the spread of PA – for both farming and nature conservation reasons – should only be allowed in landscapes that are suitable for intensive farming (e.g. areas with lower quality of land, but rich wildlife, extensive cultivation and conservation of natural values should be encouraged).

In view of the above, the EU will, in the future, certainly expect the Member States to promote its spread by appropriate measures, in parallel with the pursuit to provide more opportunities for Member States to give input on agricultural policy for promoting agricultural innovation and for providing local answers for challenges (such as climate change).[13]

[11] G. Kemény, I. Lámfalusi, A. Molnár (Eds.): *A precíziós szántóföldi növénytermesztés összehasonlító vizsgálata.* [Comparative Study on Precision Farming in Crop Production.] Agrárgazdasági Kutató Intézet, Budapest, 2017, 16.

[12] Relevant policies and legal acts of the EU reviewed by: R. Schrijver: *Precision agriculture and the future of farming in Europe: Scientific Foresight Study.* European Parliamentary Research Service, Brussels, 2016, 42. IP/G/STOA/FWC/2013-1/Lot 7/SC5.

[13] According to the EU Commissioner for Agriculture, the future CAP will be more ambitious in terms of environmental objectives, and "greener" agriculture (among others) should be provided through the wider use of precision farming methods. In several of his speeches, he explained that the increasingly complex challenges facing the CAP need to be met with increasingly simple administration and the use of modern technologies; support for agricultural innovation will be left to the Member States after 2020. https://ec.europa.eu/commission/commissioners/2014-2019/hogan/announcements/speech-commissioner-phil-hogan-opening-wageningen-university-academic-year_en; https://www.euractiv.com/section/agriculture-

2) Issues of legal regulations

The research deals not only with the actual situation of PA in Hungary, but also with its perception by farmers and its possibilities for spreading. Interviews and questionnaires were conducted in order to get to know them. The problems raised by farmers are described below.

2.1. Problem map based on the opinion of farmers

Within the framework of the project 30 in-depth interviews were conducted with farmers in the Great Hungarian Plain[14] who are affected or may become involved in precision farming. Although the interviews do not explicitly approach the obstacles of the precision agriculture, the circumstances that stimulate it and the opinions about the PA from a legal perspective, [15] the interviewees have raised a number of questions that can be answered in whole or in part by means of legal regulation. Interviews – because of the relatively low number of respondents – serve as a basis for hypotheses rather than conclusions. Although the relevant issues that have arisen cannot be weighted based on the interviews, it is worth listing them.

a) It includes, in particular in smaller private farms, the lack of appropriate expertise as a barrier. The problem affecting the sector as a whole in Hungary is that the legislation does not expect any expertise from the farmers. So, anyone can farm without proper theoretical and practical knowledge. While since 2014, if buying or renting a land (if the land area reaches 1 hectare), certain knowledge shall be proven,[16] the requirements are only formal (can be accomplished easily, with participation in a course held only at four weekends). There is a more serious requirement, e.g. for large-scale use of plant protection products. However, precision farming would require more. This is confirmed by the literature.[17]

The organization of professional agricultural training is primarily a state task and the qualification requirements are defined also by legislation. In response to today"s expectations, state-accredited precision farming training is now taking place at some Hungarian universities, but for the time being there are thousands of professionals missing from the country who have the appropriate IT and management skills, that could also be passed on to others.

b) The issue connects with the expertise whether the farmers are provided someone to address their questions. While in several countries of Western Europe it is a tradition for decades, in Hungary, many

food/interview/hogan-eu-member-states-will-decide-on-agriculture-innovation-after-2020-not-brussels/ (last access: 20.05.2019).

[14] Today, PA is mainly spread in farms engaged in field crop production. A significant part of the Hungarian arable land utilized for field crop production (about 4/5 of the total irrigated area) is located in this region. Data of the Agricultural Research Institute, 2018. http://repo.aki.gov.hu/3168/1/2017öntözés kiadvány.pdf (last access: 20.05.2019).

[15] The interviews focused on the situation of the individual farms, opinions of the farmers, and primarily detected the problems of technology, labor, information flow and profitability. The interview questions changed from case to case according to the specifics of the given economy. We have not been specifically asked about the difficulties of legal regulation and bureaucracy, so they were only discussed when the interviewees themselves considered it important.

[16] In contrast, in many countries in Western Europe (eg Denmark, France, Germany), farming is conditional on the existence of expertise, that also affects inheritance. Ch. Grimm: Von der Landwirtschaft zur Wirtschaft auf dem Lande? Gedanken zum Begriff der Landwirtschaft. *Agrarrecht*, 2001/1, 3-4.

[17] The primary barrier to the spread of PA is the human factor, that highlights the importance of information and training. Popp et al, p 141. Special training courses have already been launched in Budapest, Debrecen, Eger, Győr and Keszthely.

complain about the lack of an appropriate system. This is not a coincidence, since the use of up-to-date, knowledge-based support for all farmers is an indispensable condition for the application of new technologies, but it is not considered as a priority by the current agricultural policy (along with training).[18]

c) Many also reported shortcomings, uncertainties and inconsistencies in the subsidy system. Predictability would be important as the expensive equipments and softwares are not necessarily procured at the same time. However, if it becomes available one day but the other day the special machine purchase support is not provided (currently not available), we cannot talk about predictability. There were also general problems related to subsidies such as inconsistencies in quantitative and qualitative criteria, market distorting effects of subsidies, slowness of decision making, different effects of support in field crop production and among large and small producers.

At the same time, as the literature points out, the negative experiences of domestic farmers are partly related to the fact that they have made inconsequent improvements. However, they are still currently receiving high income support, while interest rates are low, which are worth taking advantage of.[19]

d) The issue of the suitability of croplands and the need for differentiation have been raised by the more environmentally conscious farmers. This is not a coincidence, because one of the PA"s virtues may be to keep the conditions of the production area in mind, but this is not the case if the selection of the crop is not done properly. However, in a significant part of the Hungarian agricultural lands, plants that do not meet the natural conditions and the challenges of climate change are cultivated, non-soil-friendly farming technologies are used, [20] and the size of the land parcels has also been determined inappropriately.[21] First of all, changing the form of cultivation and a general land consolidation could help, but its social support is low and the government to this day has not undertaken its implementation.

e) A modern land evaluation system is required to know the characteristics of the croplands. Farmers are also facing problems in this area, as the main elements of the Hungarian land evaluation system were introduced – for taxation purposes – at the end of the 19th century. In the meantime, however, social and ownership conditions have changed, the role of ecological aspects has increased, and many ecosystem services in the land have been ignored, so it would be justified to complete the land reform that was left undone the 1980s.[22]

[18] Popp et al. p.143.

[19] Popp et al, 144.; I. Kapronczai: A műszaki fejlesztés beruházási háttere és az agrárpolitikai hatások [Investment background of technical development and agricultural policy effects]. *Gazdálkodás*, 2017/3, pp. 187-198.

[20] In 2005, a quarter of the arable land was considered to require a change in the cultivation and land use, and with that experts suggested to withdraw 1.5 million hectares of land from intensive crop production. In contrast, in the recent period (as a result of EU subsidies), the cereal sector has grown steadily. *See:* J. Ángyán, T. Szalai, Z. Fodor, R. Lőrinczi, G. Nagy: A földhasználat alakulása. [Land use trends] In P. Stefanovits, E. Michéli (Eds.): *A talajok jelentősége a 21. században.* MTA, 2005, Budapest, pp.55-57.

[21] E. Szabó, I. Pomázi (eds.): *Magyarország környezeti mutatói 2000 [Environmental Indicators of Hungary 2000]*. Környezetvédelmi Minisztérium, Budapest, 2000, p. 132.

[22] F. Máté, G. Tóth: A földértékelés tendenciái. *[Land Evaluation Trends]* In P. Stefanovits, E. Michéli (Eds.), *A talajok jelentősége a 21. században.* MTA, 2005, Budapest, 339.; I. Szűcs: A termőföld környezeti és gazdasági értéke a 21. században [The environmental and economic value of land in the 21st century]. In P. Stefanovits, E. Michéli (Eds.), *A talajok jelentősége a 21. században.* MTA, 2005, Budapest, p. 352.

f) Some indicated problems with the state-operated Soil Protection Information and Monitoring System (TIM). The details of the interview did not reveal, however, but the statement of the Ombudsman for Future Generations points out that the financial resources of the domestic monitoring systems are uncertain and the number of measurement points in the monitoring networks is constantly decreasing. The change of soil property due to various reasons (e.g. climate change, inadequate cultivation) requires the operation of a soil information system that reliably supports decisions on soil protection interventions, food safety, water protection, climate protection and land use planning.[23]

g) Strong concentration is an important feature of the structure of land use for the spread of precision farming. Despite the significant process of land concentration in recent decades[24] also fragmentation of the land structure (overdivision, large number of relatively small farms and parcels) appears to be a major barrier. There is a lack of regulations to kep farm areas together (e.g. special inheritance rules). The current law regulates the acquisition of land, not the acquisition of agricultural holdings as economic, organizational and technical units.[25]

h) The respondents consider it important to develop a system of agricultural services (e.g. machine rental, wage labor, consulting, etc.). This is related to the issues of farmer and producer organizations and co-operatives, that also have been mentioned by many. Organizations and co-operatives could provide appropriate frameworks for the joint organization, co-ordination of services and the joint procurement of machinery. In Hungary, however, there are lags in this area, that can be explained by the bad historical memory of the kolkhoz-type cooperatives that used to be established once based on the Soviet model and the lack of trust. [26]

i) The national rules and procedures for the operation of unmanned aircraft also give grounds for complaints, that hinder the spread of the technology, as they do not take into account the specificities of agriculture.[27] For example, flying larger drones suitable for spraying should be reported 30 days in advance. On the other hand, the meaning of drone use would be to intervene at the time of detection of agricultural pests, focusing on the affected area, as soon as possible.

j) Some of the legally relevant issues are related to irrigation, licenses required for water use, and other – rather excessive – administrative burdens. Due to the climate change in Hungary, there are longer periods of lack of rainfall, which affects many farmers, increasing production costs and drought damage. The Hungarian water management is not prepared to deal with the problem, therefore in the second half of 2018 the Government approved Government

[23] Statement on Soil of Ombudsman for Future Generations, Budapest, 29. 11. 2016, 15, 19.

[24] I. Kovách: Földek és emberek. Földhasználók és földhasználati módok Magyarországon.*[Soils and people. Land users and land use modes in Hungary.]* MTA Társadalomtudományi Kutatóközpont-Debrecen University Press, Budapest, 2016, pp. 39-45.

[25] Article P (2) of the Fundamental Law of Hungary; Act CXXII of 2013 on the transfer of lands used for agriculture and forestry.

[26] G. G. Szabó, I. Bartha: A mezőgazdasági termelői szervezetek - szövetkezetek jelentőségének és helyzetének változása az EU-csatlakozás után [Changes in the importance and position of cooperatives - agricultural producer organizations after EU accession]. *Gazdálkodás*, 2014/3, pp. 263-278. It should be noted that under the current Hungarian legislation, cooperatives still do not fully comply with Western European type cooperatives.

[27] Hungarian regulation does not take into account the appearance of new technologies and their economic impact, thus making it difficult for example to access national data assets for business purposes and to use drones for production purposes. Popp et al, p. 143.

Decree No. 1426/2018. (IX. 10.) on the development of domestic water management for irrigation purposes. (For the purpose of development, the irrigation infrastructure is being assessed, the regulatory environment is changing, an irrigation agency is being set up, etc.). Unfortunately, during the planning of the measures, the possibilities of precision farming were not taken into account and therefore a regulatory environment was created in where the ecological and competitive advantages of precision farming hardly prevail.

Changes to water legislation have already been made in some areas in 2019. So, for example, water license – under certain conditions for soil protection, environmental protection, water management – can be issued for water use for irrigation for up to 20 years instead of 5, which ease the administrative burden for the farmers concerned. The so-called permanent water shortage period in which farmers do not have to pay a water resources fee after the amount of water used for irrigation (pursuant to Section 15/C of Act LVII of 1995 on Water Management) has been extended. In addition, the State may derogate from the provision on the obligation to pay water resources levy for reasons of social, environmental and economic effects and geographical and climatic features in favour of the water user.[28] A separate law has been adopted on the framework for cooperation between farmers for irrigation (e.g. establishment of irrigation communities and districts, easements).[29] The fee requirements are debatable, as the principle of recovery of the costs of water services (see EU Water Framework Directive, Art. 9) may be undermined. Farmers are exempted if water resources are limited, while regulation does not encourage sustainable and efficient water use, that could be achieved, among other things, by precision farming.

2. 2. Some highlighted factors the according to the questionnaires

In the questionnaire survey, we received responses from 604 farmers, representing about 116,000 farms using 95% of the country"s cultivated areas. 7.2% of the respondents listed themselves as precision farmers. There were four issues that were more closely related to the legislation. We were asking about that as far as the spread of the PA is concerned how important the long-term land use legislation, the PA-specific tax policy, the PA"s political environment and the long-term predictable agricultural policy are considered. We asked to evaluate the significance of each factor on a five-grade scale. The results are summarized in Table 1. below.

Table 1.

The role of the legal, political environment in the motivation of farmers relating to PA

Factors	mean	Standard Deviation	Factor Weights
Legislation that allows long-term land use safety	4,12	0,83	0,54
Fair tax rules adjusted to precision farms	3,70	0,99	0,84

[28] It should be mentioned that a special fee has been introduced for agricultural water supplies.This fee was introduced in 2015 as due to the decision no. C-525/12 sz. European Court of Justice between the Commission v Germany (11.09.2014; ECLI:EU:C:2014:2202). J. E. Szilágyi: Aktualitások a mezőgazdasági vízjog köréből: A mezőgazdasági öntözés változó jogi szabályozása [Current Issues in the Field of Agricultural Water Law: The Changing Legal Regulation of Agricultural Irrigation.]. In K. Gellén (ed): *Honori et virtuti: Ünnepi tanulmányok Bobvos Pál 65. születésnapjára.* Iurisperitus Bt., Szeged, 2017, p. 433.

[29] Act CXIII of 2019 on irrigation agronomy.

Precision farming friendly political environment	3,66	0,98	0,86
Long-term, predictable agricultural policy	4,18	0,92	0,51

Source: self-created, based on survey results.[30]

It can be seen that the grade of laws that provide a long-term land use and long-term, predictable agricultural policies are significantly higher than the grade of the answers to questions specific to precision farming. (The reason why the ranking of the answers given to each question does not match the order of the factor weights of the questions, can be examined by modeling, but in any case, it indicates that the farmers do not necessarily make their decisions based on rational aspects.) If the precision farmers and the other farmer"s responses are considered separately, it is clear that there is the greatest consensus on the importance of long-term land use regulation.

Below are the individual factors. I am trying to highlight what can be the basis of these answers.

2.2.1. Significance of legislation that provide long-term land use

In Hungary, following the change of regime in 1989, there was an agricultural land structure in which land use had two decisive titles: ownership and lease.[31] The proportion of rent is the highest in the field crop production (55%). Ownership provides a stronger position for farmers, because (unlike some Western European countries) Hungarian agricultural law hardly applies so-called tenant protection measures. Although there is a pre-lease right, which gives an advantage to the previous lessee when entering into a new contract (under certain conditions, such as being registered in the "register of farmers", expertise, local residence), at the same time, for example the right to appoint the new tenant (the former tenant is not allowed to say who will continue the farming after her/him). The minimum lease period is 1 year, that does not guarantee the return on investment, but it takes the continuity of the work due in the given marketing year into account. A minimum or a specific period of lease has not been set by the law (as opposed to French law, for example).[32] The Act CXXII on the transfer of lands (Land Act)[33] sets the maximum lease period as a rule for 20 years (in case of forest area it can be significantly more, depending on the age of the forest). Within this time frame (1-20 years), the duration of the legal relationship is determined freely by the parties (owner, lessee). However, conclusiom of contracts with a duration of more than 5 years is motivated with an exemption from tax by the lessor. [34] If the contract has expired, the owner (whether or not he has the expertise or other profession) may decide to continue to cultivate the land himself, thus not to re-

[30] For complex statistical evaluation of the results of the survey and interviews *See*: A. Bai, P. Balogh, Á. Bujdos, I. Czibere, L. Fodor, Z. Gabnai, I. Kovách: Main motivational factors of farmers adopting precision farming in Hungary. *Agronomy* (submitted for publication, 2019).

[31] The asset management rights established in the case of state-owned lands (5-20 years) (the relevant rules are laid down in Sections 19/A – 22 of the Act LXXXVII of 2010 on the National Land Fund), or the land use and usufruct established for the relatives of close relatives (for free) has less importance.

[32] In Western Europe, the lease is generally considered to be long-term with a duration of more than 10-15 years, that is beneficial for both the owner and the tenant. A. Burgerné Gimes: Földhasználat és földbirtok-politika az Európai Unió országaiban. [Land Use and Land Tenure Policy in European Union Countries] *Statisztikai Szemle* 1998/4-5, 483-489.

[33] Section 44 of the Act CXXII of 2013 on the transfer of lands used for agriculture and forestry.

[34] Point 9.4 of the Exhibit #1 of the Act CXVII of 1995 on personal income tax.

lease it. [35] In case of inheritance, keeping the farm together is not ensured. This regulation result in contracts of varying duration depending on the strength, the size and fragmentation of the land (land), the EU subsidies and the land market conditions.

It increases the significance of the issue that the ownership structure and use conditions of Hungarian agricultural production areas are still characterized by extremes. In the case of fragmented parcels – that, in many cases, although makes up a single piece but is jointly owned by several people[36] – the tenant has to enter into a lease agreement with several owners, that becomes possible often with many difficulties. At the same time, small-sized parcels are difficult to carry out self-production (it is not typical of field crop production, but for example, it is feasible in grape production).[37] Fragmentation, therefore, favors capital-intensive farmers who have sufficient resources to rent land from small owners or the state and create a large economy. At this point, it should also be noted that companies in Hungary have not been able to acquire land since 1994, which means that the lease is the main legal basis of land use. At the same time, the farms with the largest area operate as companies (e.g. as a public or a private limited company, or a private limited liability company).

There is no minimum land parcel size in Hungary, only the size of land that can be acquired by one person and the so-called land possession limit is declared by the Land Act. A person can acquire a maximum of 300 hectares of land (at the same time, if it is inherited, there is no upper limit), while the land possession maximum (that covers all areas used by the farmer) is currently 1200 ha, and in exceptional cases, 1800 hectares. (The latter applies, for example, to farmers engaged in animal husbandry.)[38] However, these rules are not suitable for characterizing the real forms of possessions or farm sizes. The latter period has been characterized by a significant concentration of property, that is not apparent in the registers (this is due to the phenomenon of company relations and cross-ownership).[39]

The importance of long-term land use rights lies first and foremost in the time needed for the return on the costs spent on developments and investments. The regulation providing long-term land use could get a high score also because the current regulation is relatively difficult to understand, it is over-bureaucratised,[40] and in addition, the regulations of land sales

[35] Some Western European countries (e.g. France) restrict the owner"s right to dispose of the property (re-leasing can be denied only in cases specified by law at the end of the lease period). Burgerné Gimes, 483.

[36] One of the negative consequences of the change of regime is that lands were given into undivided joint ownership, and because of the small size and the location they cannot be distributed physically to individual lands. Currently approx. 1 million hectares of land and 4 million people are affected, that makes it impossible to predict long-term farming. According to press reports, the Ministry of Agriculture is currently preparing a draft law for resolution (in previous years there have been several attempts to eliminate undivided joint ownership, but with limited success)

https://www.portfolio.hu/vallalatok/nagy-valtozas-jon-az-osztatlan-kozos-tulajdonnal.313535.html (last access: 28.05.2019).

[37] From a statistical point of view, the farm threshold (the minimum area) is 500 m2 for grapes and orchards and 1500 m2 for other areas.

[38] In Hungary, although Article P) (2) of the Fundamental Law requires a qualified majority law (requires two-thirds of the votes) to regulate agricultural holdings, there is currently no legislation that would define the categories of holdings (e.g. small and large farms) on the basis of their size.

[39] Kovách, 67, 80-82. I note that, between 2002 and 2014, there was a limit specifically for all the lands owned by family members.

[40] In addition to the Act CXXII of 2013 on the transfer of lands used for agriculture and forestry the Act CCXII on certain measures and transitional regulations related to the Act CXII of 2013 on the on the transfer of lands used

(acquisition, leasing)[41] have changed many times over the past decades. The fine-tuning of the land acquisition regulations introduced in 2014 has not yet been completed, and there is still a lot of uncertainty in judicial practice.[42] Several statutory provisions of the act had to be amended because of the decision no. 17/2015. (VI. 5.) AB of the Hungarian Constitutional Court, the other rules are being contested by the European Commission.[43] In the course of the operation of the National Land Fund, irregularities were also detected by courts and government control bodies.[44] Farmers, on the other hand, need to have a stable, clear regulatory environment to support their business decisions.

2.2.2. Significance of the long-term, predictable agricultural policy

Today, agricultural policy is partly a competence of the EU and partly of the Member States, so its predictability depends partly both on the governance of Member States and on the EU. The CAP has undergone several reforms since 1991. A good part of these was made before Hungary"s accession, but since the accession has brought enormous changes in the national agricultural policy (e.g. within agriculture, the emphasis has shifted from animal husbandry to crop production). Today, the new CAP is being prepared in line with the new seven-year budget cycle (2021-2027).[45] The main directions of change (diversification, decoupling, greening, etc.) have been revealed for a long time, newer and newer corrections are preceded by several years of public negotiations, so the farmers are not facing the unexpected. Now in 2019 the changes after 2020 can be expected, e.g. reduction of

for agriculture and forestry shall also be highlighted. Special requirements apply to contracts concluded with the National Land Fund, the sale of vineyards in the wine-growing settlements, etc. At present, the notaries of local governments, the local bodies of the Chamber of Agriculture and government offices are involved in the execution and approval of land transactions.

[41] For example, the number and order of the right of pre-emption and the regulation of the acquisition of foreigners has changed several times (can it be obtained by them, and under what conditions). For the maximum duration of the lease, special regulations other than the general were applicable to forests, grapes and orchards. The maximum amount of rentable area was different for natural persons and companies (the former were 300 ha, the latter could rent 2,500 ha of land) and the area leased from the National Land Fund was not taken into account. It is completely new from 2014 to require the authority approval of contracts, and to prescribe the quality of "farmer" (and hence the existence of the aforementioned expertise) for Hungarian farmers and the obligation of personal utilization. Between 2014 and 2018, the Land Act was amended 9, the Supplementary Act was amended 26 times, to a greater or a lesser extent.

[42] T. Andréka, I. Olajos: A földforgalmi jogalkotás és jogalkalmazás végrehajtása kapcsán felmerült jogi problémák elemzése. [Analyzing the legal issues emerged in land-use legislation and application]. *Magyar Jog*, 2017 /7-8, 410-424.; I. Olajos: The acquisition and the right of use of agricultural lands, in particular the developing Hungarian court practice. *Journal of Agricultural and Environmental Law*, 23/2017, 91-116.

[43] J. E. Szilágyi: European legislation and Hungarian law regime of transfer of agricultural and forestry lands. *Journal of Agricultural and Environmental Law*, 2017/23, pp.158-161.

[44]In the most well-known case -No. Pfv.VI.21.775/2015 – the Curia declared the invalidity of the land lease contract on April 12, 2016 due to a collision in legislation and goodwill. (A company got land from the From the National Land Fund that did not perform any agricultural activities).

[45] J. Martinez, J. E. Szilágyi, A. di Lauro, L. Bodiguel, R. Norer, A. Reinl, E. Gregoire, Ch. Busse, M. List, I. Olajos et al: *CAP reform: Market Organisation and Rural Areas: Legal Framework and Implementation*. Baden-Baden, Nomos, 2017. For the Hungarian aspects of the 2013 reforms *See*: T. Andréka, K. Bányai, I. Olajos: The most changes of Hungarian Agricultural Market Policy after the 2013th CAP reform. *Journal of Agricultural and Environmental Law*, 19/2015, pp. 6-18.

subsidies, further greening.[46] It should be noted, however, that in connection with the unhealthy agricultural farming structure in Hungary, the proportion areas involved in field crop production is significant.[47] The vast majority of EU agricultural subsidies have also been spent on this in Hungary, and the participants of the sector are apprehensive of the reduction in subsidies. (In recent years, only the cereals sector has been able to grow within agriculture as a result of EU subsidies, while its growing share makes the whole agricultural sector vulnerable).[48]

In Hungary, land policy has always been a priority within the (national) agricultural policy.[49] Hence, the issues of predictable agricultural policy and regulation of secured long-term land use are connected. Over the last 100 years, several radical revolutions (land reforms, nationalization, reorganization, privatization, etc.) have taken place in this area. [50] During the decades of communist dictatorship, the fundamental rights of citizens, so as their rights to property was often violated. State interventions affecting the farm structure often neglected economic-management aspects, eg. it was not considered an issue to establish viable economic units (farms) after the regime change and the liquidation of Soviet-type cooperatives; economically related lands and economic equipment and machines were not in the hands of a single owner.[51]

There are several models of farm regulation in Europe.[52] Currently, Hungary occupies a transition between these, its agricultural legislation is fragmented (incomplete) and only partially capable of

[46] The Common Agricultural Policy – instruments and reforms. Fact Sheets on the European Union, European Parliament, 2018. http://www.europarl.europa.eu/factsheets/en/sheet/107/a-kozos-agrarpolitika-kap-eszkozei-es-ezek-reformjai (last access: 05.06.2019).

[47] According to the data of the Hungarian Central Statistical Office (HCSO/KSH) in 2017, almost 60% of the country"s agricultural land was arable land.

https://www.ksh.hu/docs/hun/agrar/html/tabl1_3_1.html (last access: 20.05.2019).

[48] Gazdaságkutató Intézet: *Az „elmúlt 8 év" és a „majdnem elmúlt 8 év." A mezőgazdaság teljesítménye.* [Institute for Economic Research: The "past 8 years" and the "almost past 8 years". The performance of agriculture] Budapest, 2017. https://www.gki.hu/wp-content/uploads/2017/11/GKI-Az-elmút-8év-Mezőgazdaság.pdf (last access: 20.05.2019).

[49] Kovách, p. 83.

[50] Kovách, pp. 14-15.

[51] For the legal problems of the agricultural policy measures of the regime change *See:* L. Fodor, *Agrárjog (fejezetek a mezőgazdasági életviszonyok sajátos szabályozása köréből) [Agricultural law (chapters on the specific regulation of agricultural life)]*, Kossuth Egyetemi Kiadó, Debrecen, 2005, 78-106.

[52] The differences between the models can be captured in the following areas: restriction of the acquisition of property, regulation on the size of the land, provision of official approvals, regulations for the farmer (e.g. expertise, local residence, the obligation to operate the farm, i.e. to cultivate the land). Some countries use additional instruments to protect small lands or tenants, while there are countries that have an liberal and institutionalized land policy. K. Bányai: A magyar mezőgazdasági föld tulajdoni és használati forgalmának jogi korlátai és azok kijátszása [Legal Limitations on the Ownership and Use of Hungarian Agricultural Land and its Circumvention] (PhD thesis), Miskolc, 2016.; T. Prugberger Tamás: Szempontok az új földtörvény vitaanyagának és a parlament által elfogadott szövegének értékeléséhez a nyugat-európai megoldások tükrében, [Considerations for the Evaluation of the Debate of the New Land Act and the Text Adopted by the Parliament in the Light of Western European Solutions] *Polgári Szemle*, 2014/3-6, 162-169.; A. Burgerné Gimes: Földhasználati és földbirtok-politika az Európai Unióban és néhány csatlakozó országban, [Land Use and Land Policies in the European Union and in Some Acceding Countries] Közgazdasági Szemle, 2003 szeptember, 819-832.; M. Kurucz: *Mezőgazdasági ingatlanok agrárjogi szabályozása.* ELTE Jogi Továbbképző Intézet, Budapest, 2001; T. Prugberger, J. E. Szilágyi: *Földbirtok-politika az EU-ban. [Land policy in the EU]* In Cs. Csák (Ed.), Agrárjog, Bíbor Kiadó, Miskolc, 2004, pp. 69-83.

fulfilling its task.[53] After the change of regime, the most important question was how large the size of the land owned or used by one person could be (at the same time, it was also a question whether companies could acquire land), but almost all governments had different ideas about it.[54] These changing ideas were also partly followed by legislation. The current regulations on Hungarian land policy (e.g. the Land Act, the National Land Fund Act)[55] focus on the objective of the spread of family farms. At the same time, fragmentation is not hampered by Hungarian law, nor is it able to prevent land property concentration. The operation of the National Land Fund is not fully in line with the agricultural policy goals[56] that have been declared because it promotes the industrial concentration of land.

2.2.3. Tax equity rules adjusted to precision agriculture

Precision farming is not subjected to specific regulations in tax law, so I examined the main agricultural features in the tax system.[57] Compared to the general income tax rules, several tax equity regulations apply to farmers (e.g. simplified declaration, exemption from tax liability under a certain level of income). It may be a question of how the farmers performing PA can benefit of these. The answer, however, does not depend on the use of precision tools, but on, for example, the amount of revenue, the type of farming (company, individual), etc. In addition, it is interesting to know what costs can be accounted (e.g. the purchase of the machine and the cost of the internet can be) and for how long (i.e. what rule of amortization / depreciation applies). There are also agricultural subsidies within the VAT rules, for example the so-called compensation surcharge (this, however, is related to the supply of goods or the provision of services - the latter may be interesting because machine rental is an agricultural service). The legal status of the producer is also important here, and whether there is any other activity / income beside

[53] Ultimately, in the absence of a long-term, coherent agricultural policy, Hungarian regulation is the framework for original capital accumulation that has taken place in the agricultural sector ever since the change of regime (this is reflected in the fact that since the change of regime there has been a significant reorganization - ownership concentration - regarding ownership and use conditions).Kovách, pp. 22-26.

[54] The point of one of the concepts is the development of small plants, the promotion of the spread of medium-sized farms, the point of the second is the provision of industrial farming and the position of companies. The acquisition of land by companies (that was one of the most controversial ideas) in the end was not made possible by the Hungarian law.

[55] According to the Preamble to the Act LXXXVII of 2010 on the National Land Fund, one of the objectives of the regulation is to promote the development of a modern farm structure based on family farms. The Preamble of the Act CXXII of 2013 on the transfer of lands used for agriculture and forestry defines the goal to organize rural family communities as a production community and to spread medium-sized agricultural enterprises and to ensure the stable operation and further development of small farms.

[56] Until 2014, the Land Fund could also help the establishment of farms with a higher than the maximum land, and could also enter into long-term lease contracts with tenants for up to 50 years. These solutions were criticized from an agricultural policy point of view by Gy. Domé: A földtörvény néhány elméleti és gyakorlati kérdése. [Some Theoretical and Practical Questions of the Land Act] *Gazdaság és Jog*, 2002/7-8, 39. Stability in land use rights has been compromised by the fact that in 2015, because of the changing law it has been made possible to terminate previously concluded lease contracts that have not expired, so that new owners could easily deprive those tenants their right to use the land, who have signed a contract with the state,. I note that in recent years the rules for utilizing land-based land have come closer to land policy, but the legality of the operation of the Land Fund has been questioned in many cases, which I have already referred to.

[57] Based on the 2019 detection and interpretation of the Hungarian national tax authority. https://www.nav.gov.hu/data/cms489589/06_Mez_gazdasagi__stermel__maganszemely_adozasanak_alapvet__szabalyai_20190125.pdf (last access: 20.05.2019).

agriculture. PA mostly means field crop production in Hungary, so it is interesting that in some cases the buyer pays the VAT instead of the producers (this is called reverse taxation, e.g. in case of corn, wheat, sunflower seed production).

It is important to see that the national regulation of taxation and the EU regulation of agricultural subsidies is linked (not only because of the financial situation of farmers, but also because there are subsidies in the tax system, and because some tax rules also apply to subsidies, e.g. when calculating income, or a t the cost accounting of assets purchased from the subsidy).

As I and most likely the farmers themselves view, additional benefits for PA (for the time being) are difficult to imagine.

2.2.4. The role of PA-friendly political environment

From the statements made by the Hungarian Minister of Agriculture, [58] the EU Commissioner for Agriculture or the interest groups (National Agricultural Chamber, farmers" organizations, associations)[59] conclusions can be drawn on the future regulatory efforts on the field of agricultural policy. Farmers can formulate expectations regarding the institutional system and the legal framework (including the conditions of subsidies). It is difficult to research this sphere with legal science methods, but it is certain that the PA is an actual topic, and it is expected that both EU and national legislators will put the issue of regulation on the agenda to promote the spread of PA. Therefore, in the press news (at least recently) signs of a PA-friendly political environment has been shown, and farmers have also attached importance to it, even if not to the extent as to the institutionalized agricultural policy or to the predictability of land use. In addition to political statements, however, it is important that PA - together with all its advantages and potential disadvantages – to be more widely known by society (not only by farmers but also by consumers).

3. Conclusions

This Study reviewed the legal regulatory issues relevant to the spread of PA, based on an empirical research. Research questions were primarily determined by the opinion of the farmers. Other methods and considerations could definetly raise additional regulatory challenges (e.g. in the fields of the market regulation, labelling, nature protection, farm management, soil protection etc.). Other factors that are important to farmers – additional costs, availability of labor, farm size, land market development, etc. – are subject to further research.

The research focused on Hungarian law, but the experiences in Hungary (due to the similarities of economic and social environment, land ownership and use, CAP effects, common problems in the field of co-operations, etc.) seem to be exploitable in several respects regarding other countries in the Eastern European region.

In the light of the CAP and the Member States" agricultural policy margin including several elements of national agricultural regulation, it seems that solving issues relevant to PA is not possible only within the framework of national legislation, i.e. action at EU level is also necessary, especially as regards the subsidy system.

[58] According to the Hungarian Minister of Agriculture (2019), the precondition for competitiveness is the spread of PA. https://www.agrarszektor.hu/gepek/nagy-istvan-precizios-gazdalkodas-nelkul-nem-lesz-versenykepes-a-magyar-mezogazdasag.12821.html (last access: 20.05.2019).

[59] E.g. the Hungarian Chamber of Agriculture has successfully initiated legislation in many cases.

These problems are extremely diverse from a legal point of view, affecting most of the classic areas of agricultural legislation. In addition, constitutional law, EU law, environmental law, tax law, water law and other regulations have an important role to play. It can be concluded from this that the promotion of the spread of PA cannot be solved by a single intervention (e.g. with subsidies).

The legal and administrative barriers that the farmers have indicated does not only affect precision farmers but also other farms, in a more or less the same way. Concludingly, the requirement can be set to legislator to promote the spread of PA but not only directly (specifically) through PA measures.

If all of the above is considered by the regulations, it can have positive effects for the whole economy and society, and the risk of regulatory failures can be kept low, in addition to the costs of interventions.

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