Regional and Business Studies (2020) Vol 12 No 1, 45-55
Kaposvár University, Faculty of Economic Science, Kaposvár
doi: 10.33568/rbs.2459

Global Agrucfiltural Responsibility: The Role of Agroforestry Systems in Sustainable Food Production

Boglárka Szerb, András Bence Szerb, Arnold Csonka
Kaposvári University, Faculty of Economic Science, H-7400 Kaposvár Guba S. u. 40.

ABSTRACT

Today global agriculture is confronted in several areas with various interests in environmental protection. The global food economy will face major challenges in the coming decades. There is a need to use new technologies that can increase productivity while preserving natural resources and biodiversity, in a climate-friendly way and by maintaining site-specific ecosystem services. The purpose of this study is to explore the potential role of agroforestry systems in the sustainable development of global food production. In order to achieve this goal, we carried out the systematic processing of international and domestic literature and secondary data.
Keywords: sustainable agriculture, biodiversity, agroforestry systems

INTRODUCTION

We are experiencing an era of unprecedented and rapid change in several ways on Earth, which are often extreme and affecting the entire planet. For a long time, humans have sought to benefit from change, but it has now become clear that there is a close relationship between the destruction of the Earth's natural ecosystems and the satisfaction of human needs (food, security, health, well-being). Our planet's ecosystem is based on biodiversity. Since the second half of the 20th century, man has already been aware of the loss of biodiversity. Several global efforts and agreements have been made to remedy the problem, but their implementation has failed. These include the Convention on Biological Diversity in Rio in 1992. Although the problem is well known, climate change and sustainability commitments are now more likely to reduce damage. However, the only solution can be to reverse the declining trend of harmful processes, including the loss of biodiversity (*WWF*, 2018).

As *Friedman* (1970) wrote, the primary mission of companies is to maximize profit. While theoretically they can follow multiple target systems at the same time, the sad reality is that environmental and social profit maximization is only addressed secondarily and tertiary. Nowadays, farms often see natural factors as a usable resource over which they have unlimited power to maximize profits. The authors of the study wish to identify more closely with *Georgescu-Roegen's* (1993) paper, which states that the economy should be regarded as a subset of the environment. Accordingly, there can be no limit to economic development, there are natural constraints which man must respect. Today's global environmental crisis is partly the result of disregarding these natural barriers.

The purpose of this study is to explore the potential role of agroforestry systems in the sustainable development of global food production. In order to achieve this goal, we carried out the systematic processing of international and domestic literature and secondary data.

THE SITUATION OF GLOBAL AGRICULTURE AND BIODIVERSITY TODAY

Global agriculture is today confronted with a variety of environmental interests, including soil erosion, loss of biodiversity, and high nitrate-containing groundwater resulting from excessive fertilizer use. In addition, extreme weather in recent years has affected both natural vegetation and the qualitative and quantitative parameters of production (*Vityi et al.,* 2018).

According to the FAO (2017) Report on the Future of Food Production, the global food economy will face major challenges in the coming decades. The world's population could be close to 10 billion by 2050, which, given the most likely economic scenarios, will result in at least a fifty percent increase in food demand (as the base year of 2013). Given the scarcity of land that can still be taken into production, this enormous increase in demand requires a radical increase in agricultural productivity. On the other hand, however, intensive food production systems are already eroding natural resources, reducing biodiversity and increasing the spread of global pests and diseases of plants and animal species. There is a need to use technologies that can increase productivity while preserving natural resources and biodiversity, in a climate-friendly way and by maintaining site-specific ecosystem services.

Achieving these goals together is a controversial task. *Landis* (2017) points out that the current model of agricultural intensification is constantly reducing landscape diversity, leading to a decline in agricultural biodiversity, ecological balance and critical ecosystem services. There is a need to design agricultural areas that can resolve this contradiction. Based on the results of *Kennedy et al.* (2016), it is possible to increase agricultural production as well as biodiversity and ecosystem services through conscious landscape-level planning that simultaneously takes into account economic and environmental goals. *Allen and Hof* (2019) propose the use of environmental taxes and agri-environmental subsidies to spread biodiversity and landscape conservation systems.

In our opinion, agroforestry systems meet the conditions described here. The specifics of these systems and their possible role are described below.

AGROFORESTRY AS A SOLUTION FOR SUSTAINABLE FOOD PRODUCTION

What do we call agroforestry?

The aim of agroforestry is to integrate woody crops into agricultural activities so that they create an economically and ecologically beneficial structure (*Kiss et al.,* 2017;

Csonka et al., 2018). The different agroforestry systems have different traditions from region to region. Agroforestry systems (*Mosquera-Losada et al.,* 2016; *Vityi et al.,* 2018) include plant protection zones (coastal and field hedges, forest strips), grazed forests, wooded pastures, wooded groves, forest gardens, crop production in forests, crop cultivation with alleys and municipal green infrastructure. Their significance is that they can have a positive impact on both the environment and farming. By choosing the right system you can increase your yield. In the case of arable crop production, agroforestry systems can provide protection for the crop, so farmers can expect higher yields (*Gyuricza and Borovics,* 2018). For livestock, better living conditions can be created, which can also have a positive impact on livestock. We should not forget the importance of agroforestry in the production of industrial wood, as large quantities of goods can be produced. In addition, agro-forestry plays an important role in improving air quality, protecting the soil and developing appropriate water management. It can contribute to halting the loss of biodiversity, as native woody and herbaceous plants can provide living space in different systems. Indigenous species will also be brought back to life in the associations formed. In addition to economic and ecological benefits, agroforestry can also have a positive impact on tourism, landscape diversity and the quality of the life of locals (*Szarvas,* 2010).

A Hungarian example: the situation of agroforestry systems in Hungary

In the Hungarian agricultural history, systems and technologies known as agroforestry today have centuries-old traditions, traces of this can be also found in the current land use.

Takács and Frank (2008) collected the following traditional domestic agroforestry practices:

- "acorning" pig keeping,
- pasturing of ruminants and horses in the forest,
- utilizations of wooded pastures,
- windbreaks and field hedges, forest strips,
- intercropped agricultural land or forests (crops between wood strips in monoculture, or crop rotation).

Out of the listed agroforestry practices, acrylic pig keeping and forest grazing are no longer possible due to laws protecting and restoring soil quality in forest areas. Utilization of wooded pastures, especially for ruminants, remains still available. *Varga and Bölöni* (2009) have pointed out that this form of land use is significantly diminished: most of the abandoned wooded pastures and grazing forests have a total domestic area of only 5,500 hectares. Almost half of this area (2500 ha) is located in Southern Transdanubia. Smaller amounts of wooded pasture are found in the Transdanubian Mountains (1300 ha), the North Central Mountains (500 ha), the north-eastern Great Plain (400 ha) and the Little Plain (250 ha). This land use heritage can provide a good basis for increasing the spread of wooded pastures. North European and North American examples demonstrate that this type of so-called silvopasture systems have significant environmental services (*Brann,* 1988; *Shrestha and*

Alavalapati, 2004) and also provide significant socio-economic benefits (*Escribano et al.,* 2015; *Gaspar et al.,* 2007; *Gaspar et al.,* 2016).

A wide range of ecological and economic benefits also characterize the shelterbelts, field hedges and forest strips (*Forman and Baudry,* 1984; *Earnshaw,* 2004). Against this background, it is particularly worrying that the domestic area of shelterbelts has decreased by 15% between 2011 and 2015 (*www.teir.hu*). At present, 40% of the approximately 11,400 hectares of land are located in the Great Plain, and another 20% in the Central Transdanubian region. South Transdanubia (884 ha) and Central Hungary (668 ha) are the least shelterbelts.

It can be seen from the above that the use of agroforestry technologies in Hungary has been limited and traditional agroforestry practices have been reduced to the end of the 20th century. At the same time, mitigating climate change and adapting to climate change as a double constraint is a great reason for the wider spread of agroforestry systems. In addition, the country has a high proportion of agro-environmentally sensitive agricultural areas, which justifies the use of systems providing complex ecosystem services (*Vityi and Marosvölgyi,* 2014). From the point of view of technology adaptation, nearly fifty percent of the Hungarian agricultural areas are used by individual farms, which are typically small-scale (*KSH,* 2019). The sustainability and rural development functions of agroforestry systems can prevail in such small farms (*Coulibaly et al.,* 2017; *Cole,* 2010).

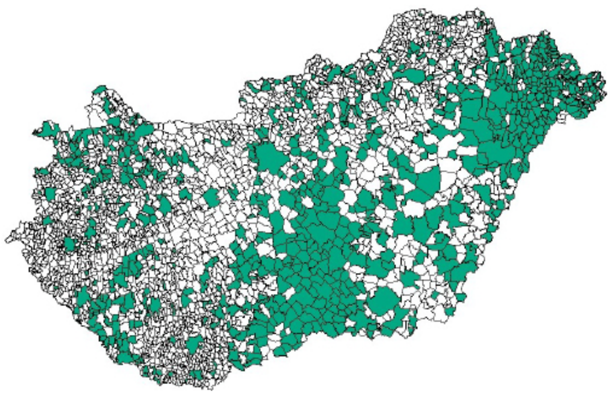
However, the existence of agricultural policy incentives and subsidies are indispensable for the better exploitation of the domestic potential of agroforestry (*Gaspar et al.,* 2016; *van Zanten et al.,* 2013). Due to the complex effects of sustainability and rural development, the promotion of the introduction of agroforestry systems has become part of the European Union's Common Agricultural Policy (CAP) 2013-2017 and 2014-2020. *Mosquera-Losada et al.* (2016) highlight, from the 2007-2013 rural development program, 27 support measures that are (directly or indirectly) linked to agroforestry. Of these, measures 221 („First afforestation of agricultural land") and 222 („First establishment of agro forestry systems on agricultural land") have the highest agroforestry relevance in Hungary.

The primary purpose of the aid for the first afforestation of agricultural land is to support forestry in areas less suitable for agricultural production (*MVH,* 2010). Through its primary objective, the measure contributes to mitigating climate change and its effects, improving soil quality and water management, and enhancing biodiversity. In addition, the aim is to improve rural employment and living conditions. The support is available for the first afforestation, for up to five years after planting and to compensate for the loss of income from the planting. We agree with *Mosquera–Losada et al.* (2016) that Measure 221 does not directly support the spread of agroforestry systems as it subsidies afforestation and forest management in a given area rather than as a complement to agricultural activity. At the same time, it is important to emphasize that the first afforestation subsidies indirectly contribute to the spread of agroforestry in Hungary. They encourage farmers to include forestry in their activities, especially in areas with less agricultural potential. As a result, the measure can also be seen as the first step, the „vestibule", towards the establishment of agroforestry systems. However, this indirect agroforestry potential can be only realized if agricultural activities in the newly established forest lands and the active management of wooded areas are supported by the CAP in the future.

In the 2007-2013 programming period (with payments until 2015), farmers received around HUF 47.5 billion in subsidy for the first afforestation of agricultural land. The settlements affected by the subsidy are shown in green in *Figure 1*. The settlements of the receiving farmers form two contiguous zones in the Great Plain. One of the affected areas is the north-eastern part of the country, Szatmár-Bereg Plain, Nyírség, Hortobágy and Hajdúság. The area covering the Kiskunság, the Solti-plain and the Bácska-loess is even larger. In addition to these two large zones, the settlements of Nagykunság, Körös-Maros, Inner and Outer Somogy, and some settlements of the Little Plain have subsidized farms.

Figure 1

First afforestation of agricultural lands (code:221) supported in settlements between 2007 and 2015 (marked with green).



Source: Based on www.teir.hu

The spatial inequality of supported afforestation is a controversial phenomenon from an environmental and especially agri-ecological point of view. On one hand, the predominance of support for the Great Plain is favourable: the Great Plain forests play a key role in the protection against deflation and desertification, thus preserving the fertility of agricultural land (*Kovácsevics,* 2014). According to *Führer and Járó* (2005) the effect of forests on soil protection and landscape improvement also justifies the Great Plain as the most important target region for forest plantations. On the other hand, afforestation of arable and grassland areas in sub-humid climate areas may lead to a reduction in groundwater levels and salt accumulation (*Jobbágy and Jackson,* 2007; *Nosetto et al.,* 2008; *Szabó et al.,* 2012). The results of *Balog et al.* (2014) from 31 pairs of forest control boreholes in the Great Plain confirm the groundwater level reduction effect of the forests planted. The large-scale afforestation of agricultural land in the Great Plain is therefore a ‚double-edged weapon' which, besides its many positive effects, has serious environmental risks.

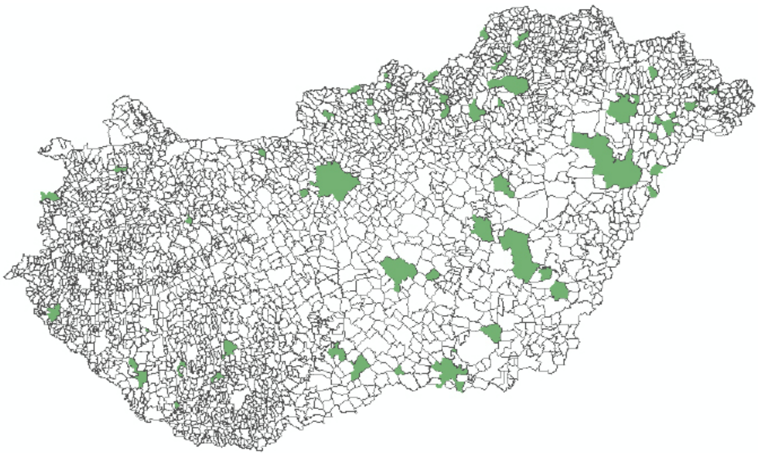
Let us turn to the other side of the same problem! The high proportion of settlements in the Great Plain also means that farmers from settlements outside the Great Plain received a much smaller share of the afforestation subsidy. It should be noted here that this is not due to the practice of processing aid applications: far fewer aid applications were submitted by farmers from these areas. *Mosquera–Losada et al.* (2016) points out that Hungary has used less than sixty percent of the planned amount of afforestation support for the period 2007-2013. This does not mean that users of agricultural land outside the Great Plain did not have access to the aid because of competition for subsidies or an unfavourable allocation mechanism for them. Rather, regional disparities are due to differences in the willingness of farmers to afforest. However, a lower propensity to afforestation does not mean that afforestation of agricultural land will not have a positive environmental effect in these areas.

The uneven and contradictory use of afforestation subsidy presented here illustrates the need to develop systems where afforestation and agricultural production are not a substitute but a complement to domestic agricultural holdings. To this end, subsidy has been given since 2007 for the first establishment of agroforestry systems. This item is intended to cover the installation and maintenance of woody plants and other investment costs necessary for setting up the system. The utilization rate of the measure in the 2007-2013 and 2014-2020 cycles was very low. It gives some hope for the future that the range of eligible activities will continue to expand in the next funding cycle. If farmers across all parts of the country understand that the introduction of agroforestry can improve both their income-generating capacity and their biodiversity and ecological services, as well as their climate-adaptive capacity, subsidy can become an important tool on the road to sustainable agricultural development. *Louah et al.* (2017) highlight the importance of path dependency and cognitive lock-in as barriers to the development of temperate agroforestry. Usually, farmers accept common old technologies as established and unquestionable, so they react negatively to new technologies. Path dependency and cognitive lock-in effects can be reduced by ecological education and learning within innovation networks. Based on a semi-quantitative questionnaire, *Sereke et al.* (2016) have concluded that payments for ecosystem services (e.g., agroforestry systems) cannot change attitude lockin as long as farmers' expectations and knowledge are not appropriately addressed. It therefore appears that agroforestry-related CAP subsidies should be supported by well-designed training systems and innovation networks in order to motivate agroforestry adoption.

Considering the measure 222, which is more directly related to the establishment of agroforestry systems, the Hungarian implementation rate was extremely low (28%, in contrast to the 58% utilization of measure 221) between 2007 and 2013 (geographical distribution of settlements implementing measure 222 can be seen in (*Figure 2*). Thus, the findings regarding cognitive lock-in, training systems and innovation networks are also of great importance in direct agroforestry subsidies.

Figure 2

First establishments of agroforestry systems (code:221) supported in settlements between 2007 and 2015 (marked with green).



RICHER BIODIVERSITY AND A LIVELIER COUNTRYSIDE

Today's globalized world has had an impact on the outlook, the ingredients and the tastes of food, or even their uniformity (*Nábrádi,* 2010). Foods and products sought by consumers can have a negative impact on the sale of traditional and regional products, which can trigger a number of negative processes. The livelihoods of local communities, food choices, local economic growth and cultural heritage can be threatened. An important element of a livelier area is traditional and regional food, which is specifically linked to the region. The re-emergence of native wild plants, herbs and animal species that once found in agroforestry systems and forest edges could partially incorporate them into short food chains. In order to preserve the biodiversity of the countryside, the image and the characteristic of the landscape and to improve it, it is important that agriculture is not only seen as a productive sector, but as it is closely linked to culture, traditions and rural life. Locally produced traditional and landscape foods play an important role in achieving this goal (*Pallóné Kisérdi,* 2010).

CONCLUSIONS

In the coming decades, agroforestry systems will be an important tool, both globally and domestically, for developing agriculture that enhances biodiversity, ecosystem services and climate adaptation. The promotion and support of agroforestry activities in the less favored areas and in areas at risk of erosion and deflation should be promoted. Successful technology adaptation requires, in addition to financial support, the development of an appropriate consultancy and innovation support network, as well as the development of a training system providing the competences required for new technology.

The CAP-measures related directly or indirectly to agroforestry need a further revision during the next planning period. Although the range of eligible agriforestry activities and costs increased in the 2014-2020 period, the issue of utilization of subsidies and territorial inequality is still unresolved. Both increasing the utilization rate and reducing territorial inequlaties require the development of a national implementation strategy that takes into account territorial disparities. This territorial strategy must be based on the different natural, social and economic conditions of the different regions and micro-regions of the country, as well as on the resulting challenges, even on the settlement level. By currently ignoring the territorial dimension, neither an increase in the utilization rate nor a reduction in inequalities is achievable.

ACKNOWLEDGEMENT

This paper was supported by EFOP-16-2017-00018 project entitled „Termeljünk együtt a természettel! – Az agrárerdészet mint új kitörési lehetőség" and EFOP-3.6.1-16-2016-00007 project entitled, „Intelligens szakosodási program a Kaposvári Egyetemen".

REFERENCES

Allen, A.M., Hof, A.R. (2019): Paying the price for the meat we eat. In: Environmental Science and Policy, 97. 90-94. p. doi: 10.1016/j.envsci.2019.04.010

Balog, K., Gribovszki, Z., Szabó A., Jobbágy, E., Nosetto, M. D., Kuti, L., Pásztor L., Tóth T. (2014): Alföldi telepített erdők hatása a felszín alatti sófelhalmozódásra sekély talajvizű területeken. In: Agrokémia és Talajtan, 63. 2. 249-268. p.

Brann, G. (1988): Farm scale agroforestry in the eastern Bay of Plenty. In: McLaren P. (ed.) Agroforestry Symposium Proceeding Forest Research Industry. Rotorua, New Zealand.

Cole, R.J. (2010): Social and environmental impacts of payments for environmental services for agroforestry on small-scale farms in southern Costa Rica. In: International Journal of Sustainable Development & World Ecology, 17. 3. 208-216. p. doi: 10.1080/13504501003729085

Coulibaly, J.Y., Chiputwa, B., Nakelse, T., Kundhandle, G. (2017): Adoption of agroforestry and the impact on household food security among farmers in Malawi. In: Agricultural Systems, 155. 52-69. p. doi: 10.1016/j.agsy.2017.03.017

Csonka, A., Bareith, T., Gál, V.A. (2018). Spatial distribution of the demand for CAP-measures to promote agroforestry: The Hungarian case. 14th Annual International Conference on Economics and Business, Sapientia Hungarian University of Transylvania, 10-12th May 2018. Csíkszereda/Miercurea Ciuc. 59-68. p.

Earnshaw, S. (2004): Hedgerows for California Agriculture - A Resource Guide. Community Alliance with Family Farmers. [online] <URL: http://www.caff.org/wp-content/uploads/2010/07/Hedgerow_manual.pdf>

Escribano, A.J., Escribano, M., Gaspar, P., Mesias, F.J. (2015): The contribution of organic livestock to sustainable rural development in sensitive areas. In: International Journal of Research Studies in Agricultural Sciences, 1. 1. 21-34. p.

FAO (2017): The future of food and agriculture – Trends and challenges. Rome: Food and Agriculture Organization of the United Nations. [online] <URL: http://www.fao.org/3/I8429EN/i8429en.pdf>

Friedman, F. (1970): The social responsibility of business to increase profits. In: The News York Times, 13. September

Forman, R.T.T., Baudry, J. (1984): Hedgerows and Hedgerow Networks in Landscape Ecology. In: Environmental Management, 8. 6. 495-510. p. doi: 10.1007/bf01871575 Führer, E., Járó, Z. (2005): Az erdővagyon bővítése a mezőgazdaságilag gazdaságosan nem hasznosított földterületek beerdősítésével. In: Molnár S. (Ed.) Erdő-fa hasznosítás Magyarországon. Sopron: NyME FMK. 130-136. p.

Gaspar, P., Escribano, M., Mesias, F.J. (2016): A qualitative approach to study social perceptions and public policies in dehesa agroforestry systems. In: Land Use Policy, 58. 427-436. p. doi: 10.1016/j.landusepol.2016.06.040

Gaspar, P., Mesias, F.J., Escribano, M., Rodriguez De Ledesma, A., Pulido, F. (2007): Economic and management characterization of dehesa farms: implications for their sustainability. In: Agroforestry Systems, 71. 3. 151-162. p. doi: 10.1007/s10457-007-9081-6

Georgescu-Roegen, N. (1993): The Entropy Law & the economic problem. In: Daly, H.E., Townsend, K.N. (Eds.) Valuing the Earth: economics, ecology, ethics. Massachusetts: The MIT Press Cambridge, 75-88. p.

Gyuricza, Cs., Borovics, A. (2018): Agrárerdészet. Gödöllő: NAIK, 259 p.

Jobbágy, E.G., Jackson, R.B. (2007): Groundwater and soil chemical changes under phreatophytic tree plantations. In: Journal of Geophysical Research, 112. 2156–2202. p. doi: 10.1029/2006jg000246

Kennedy, C.M., Hawthorne, P.L., Miteva, D.A., Baumgarten, L., Sochi, K., Matsumoto, M., Evans, J.S., Polasky, S., Hamel, P., Vieira, E.M., Develey, P.F., Sekercioglu, C.H., Davidson, a.D., Uhlhorn, E.M., Kiesecker J. (2016): Optimizing land use decision-making to sustain Brazilian agricultural profits, biodiversity and ecosystem services. In: Biological Conservation, 204. 221-230. p. doi: 10.1016/j.biocon.2016.10.039

Kiss-Szigeti N., Vityi, A. (2017): Amit az agrárerdészetről tudni érdemes. In: Őstermelő Gazdálkodók Lapja, 21. 4. 48-49. p.

Kovácsevics, P. (Ed.) (2014): Magyar erdők. A magyar erdőgazdálkodás. Budapest: Vidékfejlesztési Minisztérium – Nébih Erdészeti Igazgatóság, 76. p.

KSH (Hungarian Central Statistical Office) (2019): Földhasználat művelési ágak és gazdaságcsoportok szerint. STADAT tábla. [online] <URL: http://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_omf001a.html>

Landis, D.A. (2017): Designing agricultural landscapes for biodiversity-based ecosystem services. In: Basic and Applied Ecology, 18. 1-12. p. doi: 10.1016/j.baae.2016.07.005

Louah, L., Visser, M., Blaimont, A., de Cannière, C. (2017): Barriers to the development of temperate agroforestry as an example of agroecological innovation: Mainly a matter of cognitive lock-in? In: Land Use Policy, 67. 86-97. p. doi: 10.1016/j.landusepol.2017.05.001

Mosquera-Loasada, M.R., Santiago-Freijanes, J.J., Pisanelli, A., Rois, M., Graves, A., Burgess, P.J. (2016): Extent and success of current policy measures to promote agroforestry across Europe. Deliverable 8.23 for EU FP7 Research Project: AGFORWARD 613520. (8 December 2016). 95 p.

MVH (2010): Tájékoztató a mezőgazdasági területek erdősítéséhez támogatást igénylők részére (segédlet a 88./2007 (VIII.17.) FVM rendelet értelmezéséhez). [online] <URL: https://www.mvh.allamkincstar.gov.hu/documents/20182/222798/8030/7f9c199d-9b4c-4d1c-ba72-6e83941b11ff>

Nábrádi, A. (2010): A hagyományos és tájjelegű élelmiszerek gazdasági jelentősége. In: Szakály Z., Pallóné Kisérdi É., Nábrádi A. (Eds.) Marketing a hagyományos és tájjellegű élelmiszerek piacán. Kaposvár: Kaposvári Egyetem, Gazdaságtudományi Kar, 30-37. p.

Nosetto, M.D., Jobbágy, E.G., Tóth, T., Jackson, R.B., (2008): Regional patterns and controls of ecosystem salinization with grassland afforestation along a rainfall gradient. In: Global Biogeochemical Cycles. 22. 2. 1–12. p. doi: 10.1029/2007GB003000

Pallóné Kisérdi, I. (2010): Európai Uniós és hazai programok a hagyományos és tájjellegű élelmiszerek piacán. In: Szakály Z., Pallóné Kisérdi É., Nábrádi A. (Eds.) Marketing a hagyományos és tájjellegű élelmiszerek piacán. Kaposvár: Kaposvári Egyetem Gazdaságtudományi Kar, 51-69. p.

Sereke, F., Dobricki, M., Wilkes, J., Kaeser, A., Graves, A.R., Szerencsits, E., Herzog, F. (2016): Swiss farmers don't adopt agroforestry because they fear for their reputation. In: Agroforestry Systems, 90. 3. 385-394. p.

Shrestra, R.K., Aalavalapati, J.R.R. (2004): Valuing environmental benefits of silvopasture practice: a case study of the Lake Okeechobee watershed in Florida. In: Ecological Economics 49. 349-359. p. doi: 10.1016/j.ecolecon.2004.01.015

Szabó, A., Kiss K., Gribovszki, Z., Tóth, T. (2012): Erdők hatása a talaj és altalaj sóforgalmára, valamint a talajvíz szintjére. In: Agrokémia és Talajtan 61. 1. 195-209. p.

Szarvas, P. (2010): Mezővédő erdősávok, fasorok jellemzése, ökológiai feltárása, kihatásai. Doktori értekezés, Debreceni Egyetem.

Takács, V., Frank, N. (2008): The Traditions, Resources and Potential of Forest Growing and Multiourpose Shelterbelts in Hungary. In: Rigueiro-Rodríuez, A., McAdam, J., Mosquera-Losada, M.R. (Eds.) Agroforestry in Europe – Current Status and Future Prospects. Springer Science & Business Media, 450. p.

van Zanten, B.T., Verburg, P.H., Espinosa, M., Gomez-y-Paloma, S., Galimberti, G., Kantelhardt, J., Kapfer, M., Lefebvre, M., Manrique, R., Piorr, A., Raggi, M., Schaller, L., Targetti, S., Zasada, I., Viaggi D. (2013): European agricultural landscapes, common agricultural policy and ecosystem services: a review. In: Agronomy for Sustainable Development. 34. 2. 309-325. p. doi: 10.1007/s13593-013-0183-4

Varga, A., Bölöni, J. (2009): Erdei legeltetés, fás legelők, legelőerdők tájtörténete. In: Természetvédelmi Közlemények 15. 68-79. p.
Vityi, A., Kiss-Szigeti, N., Kovács, K. (2018): Az agrárerdészet magyarországi helyzete. In: Czupy, I., Horváth, A. (Eds.) Kutatások a 210 éves Erdőmérnöki Karon. Sopron: Soproni Egyetem, 34-40 p.
Vityi, A., Marosvölgyi, B. (2014): Role of Agroforestry in Climate Change Adaptation of Hungary. In: Polgár A., Bazsó, T., Nagy, G., Gálos, B. (Eds) Local and regional challenges of climate change adaptation and green technologies. Proceedings. Sopron: Nyugat-magyarországi Egyetem Erdőmérnöki Kar, 85-88. p.

Corresponding author:

Arnold Csonka
Kaposvár University, Faculty of Economic Science
H-7400 Kaposvár, Guba S. 40.
Tel.: +36 82 505 800
email: csonka.arnold@ke.hu