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NETWORK FARMING CO-OPERATION CONCEPT FOR SUSTAINABLE AGRIBUSINESS

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This article starts with a broader view on the Hungarian agricultural holding system in order to find improvement possibilities in this segment. It is established on the supposition that a vertically created chain that could bring joint effort to create a group or network among the various actors in agribusiness which can lead to a more profitable operation, it can enhance sustainability and create technological development. The article also represents the energy farm concept where the different agricultural actors can work together in a sustainable system which can generate welfare to their production site and also to their settlement.

Keywords: energy farm concept, agribusiness networks

Introduction

Hungarian citizens and even researchers think of Hungary as an agriculturally rich country which is true if we only consider that agroforestry uses 72,650 km^2 of the total land of 93,360 km^2 which is 78% of the landside. If we only consider agriculturally utilized area, it covers almost 58% of Hungary's area (according to the Hungarian Central Statistics Office). But the size and the coverage of land usage cannot show the structure of this branch which we would like to introduce in this article in order to show later a new kind of farming idea that is sustainable and suitable for the current agricultural holding system in Hungary. Káposzta and Czabadai (2016) has shown that representing agribusiness with statistical data could be a hard task, because sometimes the suitable measurement system is not available and the performance indicators do not represent the actual state of agriculture. First, I wanted to examine the size of agricultural holdings throughout the EU28

Figure 1 represents the average utilized agricultural area per agricultural holdings in the European Union. In Hungary, the average size of these holdings is below the international average and from that point of view we are definitely not in the leaderboard of agribusiness holdings by size (KSH 2014, KSH 2015).

In our surrounding area Slovakia has a more concentrated agribusiness sector according to this data and the Czech Republic shows the highest rate in agricultural area per holding in the EU28. Figure 2 shows the distribution of agriculturally utilized land and holdings in the EU28. It represents how much percentage is governed in the selected country from all the agricultural holdings and from all the utilized lands in the European Union. Hungary is highlighted with red rectangle.

The number of agricultural holdings is about the average that is expected in among the EU28 countries but land utilization data here also shows that farming structure segment is quite fragmented.

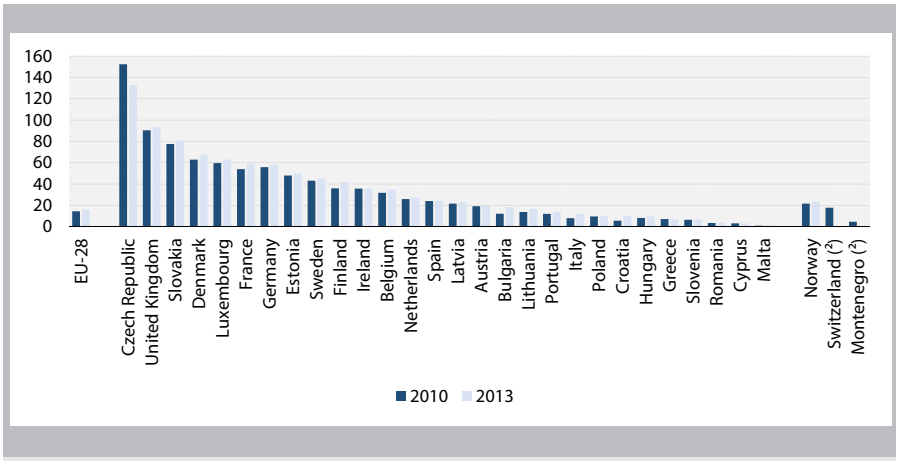

Figure 1 Average utilized agricultural area per holding in hectares 2010 and 2013
Source: Eurostat: online data code: ef_kvaareg

The average land usage of public companies in 2013 was about 308 hectare while individual farmers used only 5.4 hectares. Public company area utilization decreased with 5% while individual farmers increased their territory with 17%. Nevertheless, two-thirds of individual farmers used less than 1 hectare in 2013. Most of the individual farmers use land territory between 20 and 50 hectares. Further investigation about the link between land usage and regional development is represented by Gódor and Káposzta (2016).

The agricultural holdings can be also examined from another point of view. If we set the agriculturally utilized land as 100%, Figure 3 shows the rate of agricultural area governed by holdings. The third highest rate in the EU28 in this aspect is in Hungary, which means that the weight of agricultural holdings is high when we think about the average land utilization in the whole country. Thus, most of the agriculturally utilized land is governed by holdings. Forestry management shows a much higher average rate, where only Austria is ahead of Hungary. This means that both for individual farmers and agricultural holdings a new kind of co-operational solution can be good for enhancing their capabilities to reach economies of scale. There is a lot of agricultural holdings and individual farmers, who use separately small portions of landside so they must co-operate with each other to achieve better results.

Figure 4 shows the standard output, labour force and livestock of Hungary and the EU28 which shows us the tendency of using less labour, having less livestock but creating greater value in this sector (Eurostat, 2015).

The fragmentation of the Hungarian agribusiness sector and the lack of co-operation is one of the most important issues nowadays.

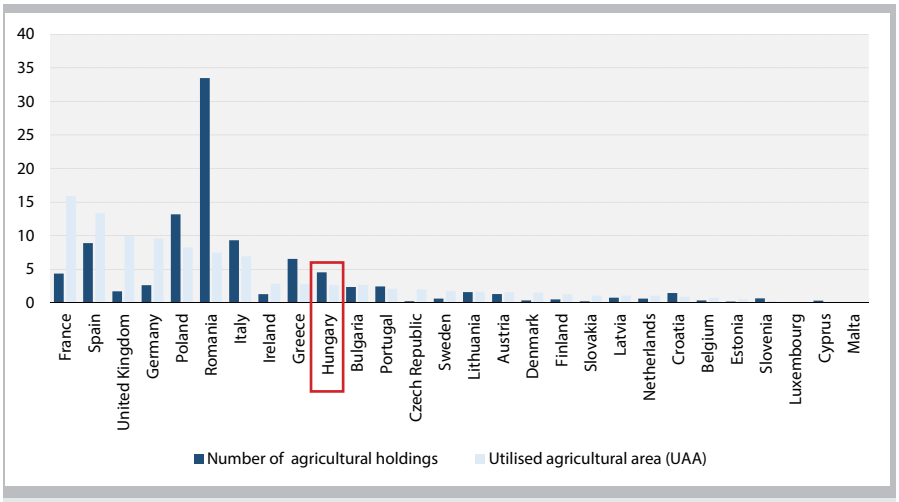

Figure 2 Share of agricultural holdings and utilized agricultural area in the EU28
Source: Source: Eurostat: online data code: ef_kvaareg

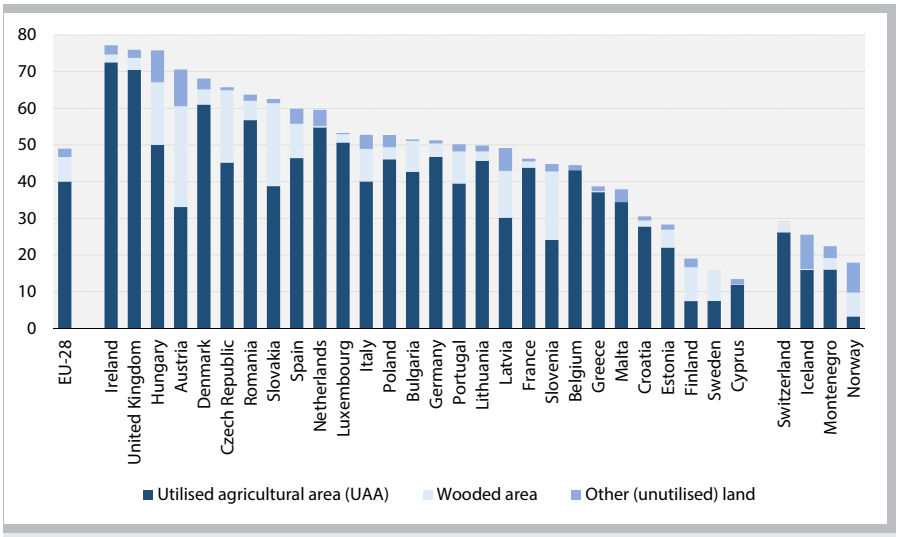

Figure 3 Land belonging to agricultural holdings, 2013
Source: Eurostat: online data code: ef_kvaareg

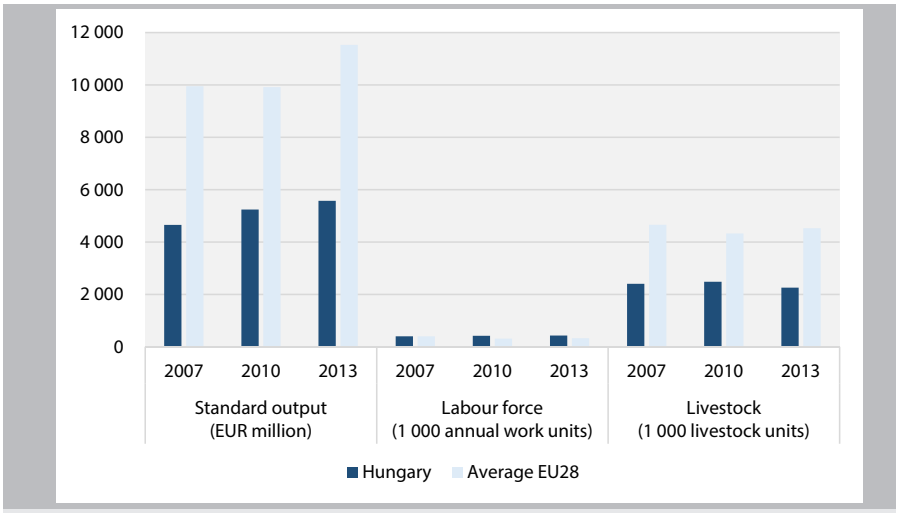

Figure 4 Output, Labour force and livestock comparison of Hungary and the EU28 average
Source: Eurostat: online data code: ef_kvaareg

Different levels of the Hungarian agribusiness system can be defined. On the bottom of the system we find primary producers (mostly individual farmers) in a high number with low amount of agriculturally utilized land governed by them.

According to the Hungarian Central Statistics Office, about half-a-million primary producers in Hungary make their operations without having any collaboration with each other. Product placement in the market is difficult for them so for several purposes (such as marketing, recycling management, common equipment utilization, etc.) co-operation would be beneficial for everyone in order to utilize their business in a better way. It is very significant, because primary producers as the first level of the system produce about 60% of the whole added value of agribusiness so if such a huge part of agribusiness can find win-win solutions, spin-off effects can be also high. In order to enhance network co-operations, funds and scenarios are needed so in this article I will show one possible solution. Any form of co-operational solutions that enhance productivity, reduce waste and use the resources in a better way is worth an analysis. This kind of new cooperation can be handled as a horizontal or vertical network where the coordinator actor will manage the collection and merchandise of the products and also can handle waste management tasks together with other individual farmers.

Different aspects of co-operation can be visionized by the investigator of this field which are usually connected to production efficiency, procurement, equipment utiliziation, marketing activity, or waste management. Waste is interesting for us, because every agricultural activity can be greener if proper waste management systems can be used and also these co-operations can enhance profitability of the network when more co-operatives, individual farmers or holdings work together. Production management or even marketing cannot be handled in the same way because of the significant differences of the products and the customers. Waste and facility management are the two fields where new kind of solutions can enhance productivity and lead to green solutions.

Material and methods

The most reliable data are from 2011 and we used this database for our primary research. According to that the largest amount of waste created in Hungary was coal ash in an amount of more than

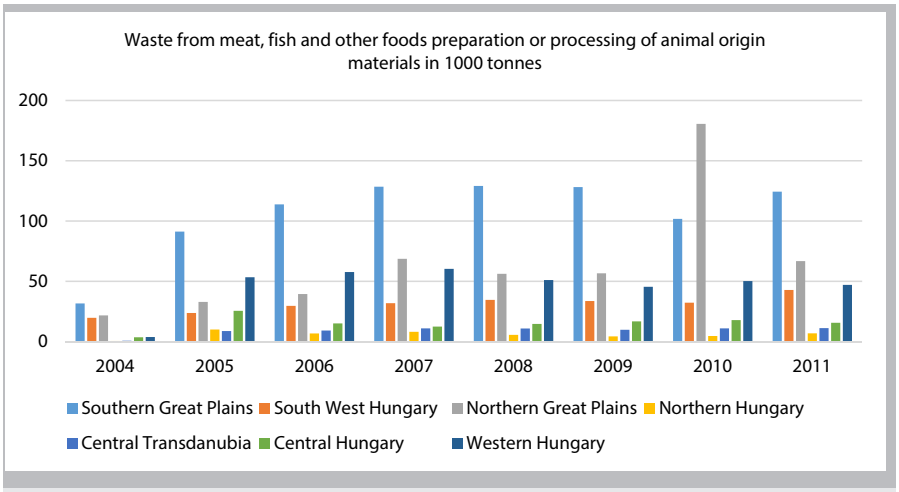

Figure 5 Agribusiness related waste in the Hungarian regions between 2004 and 2011
Source: Edited by the author according to Hungarian Central Statistical Office data

1 million tones. We are not interested in all kinds of wastes so we searched for the specific types that are created in agriculture.

Annually, about 400,000 tons of waste is generated by agribusiness which can be reused in different types of waste management technologies. Additive data is only useful for identifying the types of materials which are suitable for recycling activities but also the greatest waste generators must be identified. First, let us have a look on the different agribusiness activities that create significant amount of wastes in Hungary in Table 1.

The biggest amount of waste is generated due to dairy cattle breeding and milk production and the amount almost equals the output of the Northern Great Plains in agribusiness which was about 180 thousand tons in 2011. The second biggest output producer segment is related also to livestock farming, especially to swine farming. These two activities generate almost one third of agricultural wastes annually. Besides Northern Great Plains, the region of Southern Great Plains also generates high amount of agricultural waste. The two regions together generate more the 40% of agribusiness waste of the country. According to the data mentioned above, the two regions of Northern- and Southern Great Plains are interesting for further investigation and the segments of livestock farming (especially dairy cattle and swine) must be in focus. According to this, farms with significant amount of reusable agribusiness related must be identified and informed about the possible solutions that can create value from their wastes.

Table 1 Agribusiness related wastes in Hungary in 2011

Farming wastes in thousand tonnes	
Dairy cattle	172.42
Pig farming	152.08
Sugar Production	142.06
Meat processing and preserving	128.68
Poultry meat processing, preservation	124.56
Production of milk products	43.90
Poultry farming	40.03

Source:Hungarian Central Statistics Office edited by the author

Table 2 Usable materials for A* farming concept

Livestock related wastes	Plant related wastes
Animal manure	Arable crops
Cattle Manure	Corn silage and cereal whole plant
Swine Manure	Sugar beet and beet leaves
Poultry manure	Grass silage
Cattle slurry	Food processing by-products
Pig slurry	Molasses
	Grapes and Fruits
	Brewers' grains
	Grain stillage
	Kitchen food waste

Source: Company data edited by the author
In the next few pages I would like to introduce the processes of the energy farm

One possible value generation can be establishing co-operatives, clusters or networks where primary producers, investors and other related elements create a system in order to collect and reuse waste in order to create value. I examined a good practice for this activity in a farming ecosystem which is called in this article as A* farms at A* Agricultural Plc. In this paper the actual company won't be named but always referred as the A* Agricultral Plc. and the idea as A* farms.

The sketch vision of the A* farm concept is based on the total recycling system of agribusiness activities especially where livestock waste management is needed due to this kind of farming activities. The recycling of these materials is based on a complete logistics and technology intensive system that can be adjusted to the certain expectations of the users. The recycling has different phases but most of the activities are based on anaerobic fermentation. The output of this technology is biogas which further on can be used to generate electricity and heat production that is consumed locally by the farm itself. If the farm cannot use all the energy that is produced by the biogas the supplies can be traded. Besides of the fermentation and biogas production the remaining material can be used in a biomass power plant where further energy is created. A short summary below shows the possible material which can be used in the biogas fermenting room and in the biomass plant:

Results and Discussion

A* farm concept

A* Agricultural Plc. has more than 2.000 bovines. After the increased attention on CO_2 emission and recycling policies the Plc. decided to create a pilot programme of the A* farm where the manure

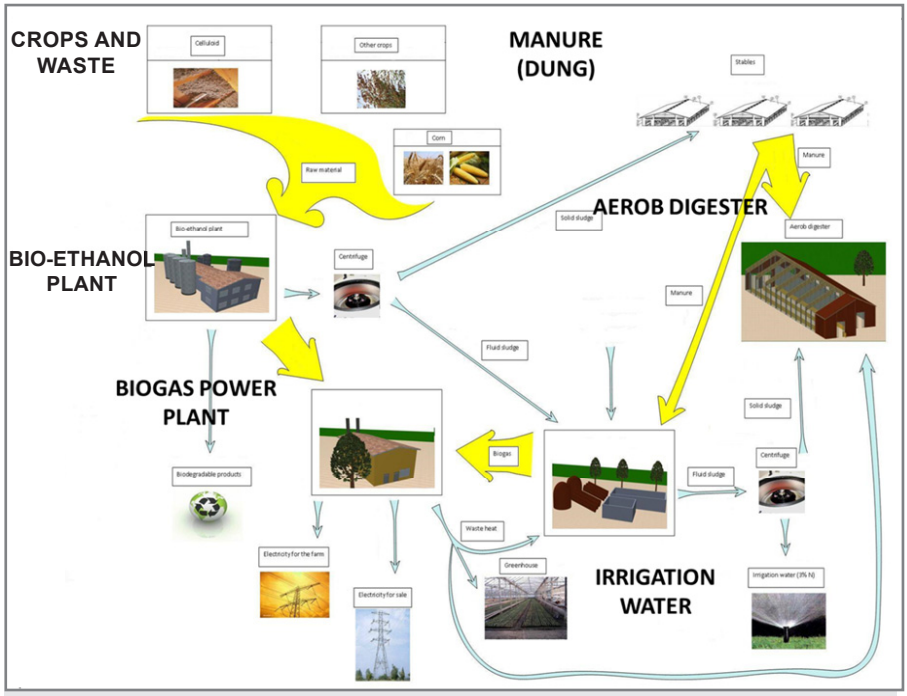

Figure 6 Processes of the A* farm
Source: Company data edited by the author

of the animals is transformed and used to create energy, bio-ethanol is produced from crops and the remaining material is used as fodder.

The A* farm concept can be defined as an embedded sector in the agricultural production line using the hardly marketable material which can be used in a more efficient and useful way creating higher value in the value chain. These A* farms can be also used as centers of energy supplier for different touristic sights in the surrounding area where new kind of co-operations can be developed where we can use the results of Káposzta, Nagy and Nagy (2013).

The investment of the A* farm project was altogether 8.4 million euro. This contains a 640 kW power plant, the anaerobic digesters, the gas storages and all the new equipment used for the recycling of manure and crops. The energy created by the farm is partly used for inside power consumption and one part is sold. With the new technology they reached about 28% reduction of the energy costs. The biogas module and the power plant can consume about 50,000 tons of dung per year. The power plant could also use municipal waste water as an input so not only animal waste can be used. Approximately 2.3 million stere of biogas arises. After the burning of gas 5.3 million kWh electricity and 6 million kWh heat energy is extracted. The final product is weed-and germ-free, odorless, high nutritious humus, which is sold commercially. Throughout the whole process, the new technology reduces the emission of CO_2 with 30,000–40,000 tons per year which values about 1 million Euros in the emission trade.

This means that the return period is about 9 years for the whole project which is considerable good. The cost benefit analysis used here is acknowledging the long-term amortization of the equipment, the working capital and the tax reduction due to cleaner production of energy. Benefit data contains:

- Power generation: Sold energy to the power grid or replaced previous outside energy.
- Sludge: using it instead of chemical fertilizers.
- Irrigation water containing Nitrogen.
- Waste heat used for heating inside the stables.
- Ethanol and ethanol based utensils.

This calculation contains actual data only from the past three years and all the other costs and benefits are the extrapolations of the owners' interests. A holistic overview about development funds was summarized by Káposzta, Nagy and Nagy (2014) which can be also adapted from tourism to energy sector investment. This is important to know because later on in the paper I will show the possible difficulties of a kind of investment where we can see that the return period is usually much more longer than the credit given to the companies.

Agricultural experts assume that Hungary has a great potential in the use of bio-energy, nevertheless only a few pioneering projects are on the way. The main idea would be to create an integrated approach to agricultural activities where energy sector, recycling and fertilizing are linked together. This could be an opportunity to change the energy sources and to support local farms to lessen their power consumption and to handle their wastes in a more intelligent and useful way. Nowadays a rightful question arises: Should we use agriculture for food or for energy production. The example shows that both ways can be considered in parallel. The bio-ethanol plant uses about 15,000 tons of crops to decoct alcohol, and to produce bio-degradable wrappers and other utensils. By separating the drung water and the ethanol dish-water into solid and fluid parts the A* farm can save up to 25–30% of fodder costs and can also use the liquid part as irrigation water which is nitrogen-rich and enough to irrigate 500 hectares of soil. By the method of bio-ethanol production serious amount of waste heat is released which is used to heat up greenhouses where vegetables are grown and there is a piggery with 2.500 swine where the heating can be also solved with the waste heat of the power plant.

The scale of economy is optimal by about 600 cattle. To achieve this big scale farming or co-operation between the farmers is required. In Hungary all together there are about 700.000 bovine (including 312.000 cows). (In Northern-Hungary the numbers are 80.000 and 20.000) This means that with a full spectrum co-operation hundreds of A* farms can be established. Of course the future investors should consider the location of cattle farms and find the optimal place for A* farms (KSH, 2015).

Resources are used primarily for electricity production and in lesser extent for heating. The power extracted from biomass is almost the 90% of the whole renewable energy. Using firewood is problematic because the police reports show that not only waste wood is used in the processes. Other bio-fuels such as bio-gas or bio-ethanol can be created from different crops but mainly from green maize. Sustainability questions are really important in these kinds of co-operations where further analysis is provided by Horváth, Erdélyi and Nagy (2016). Hungary is a relatively big maize grower with 8.1 million tons of production per year (Hungarian Statistical Report on Agriculture, 2011). If Hungary wants to change the fuel consumption in such a way where 10% of the complete fuel consumption is bio-fuel then the industry needs 2 million tons of maize annually. Maize is one of the best export wares of the Hungarian agriculture so decisions about energy

Table 3 Individual and common benefits of agricultural clusters

Member	Benefit for member	Benefit for cluster
Seed industry	new markets, market concentration, publicity	bargaining options for primary producers
Agri Machinery	new markets, market concentration, publicity	bargaining options for primary producers
Primary producer	concentrated technology and resource base, fix buyer chain	producing market demanded high quality competitive products – primary product comes from them
Food industry	predictable quality and amount of products, cost reduction	integrated chain "from farm to table", Purchase power
Wholesaler	bargaining options (cost reduction for wholesaler)	qiven purchasing chain
Logistic services	new markets	bargaining options (cost reduction)
Universities, civil sector	rield of research, Relational capital	knowledge transfer, Information flow from customers

Source: Edited by the author

Hopefully, the benefits above can enhance the cooperation between the potential members

or food specific growing should be considered. The new technologies ensure that the waste of the bio-fuel production (solid ethanol dish-water) can be used as fodder but of course loss of input material could happen.

In case the following conditions are fulfilled, biogas plants will definitely become a success. A dissemination program is then strongly recommended.

If we would like to launch biogas plants, investment costs are likely to transcend the financial capability of the investor. In addition, larger investments occur during the lifecycle of the investment as well. Only one group of costs could be financed from the revenues of the plant. These are the so called recurring costs, which are necessary for operation. The other group (non-recurring or periodical) costs can be covered only from loans or other forms of outside capital. A liquidity analysis can show how far the net expenditures have to be financed from outside and how much contribution can be expected from the expected income. As it is seen, the construction of biogas plants demands financial means which can only be covered by outside capital.

Developing the cooperation

Basic ideas about the creation of agricultural clusters are the following:

- ❒ We must start from the lowest point of the agricultural system (Primary Producer)
- ❒ Human relations must be used to create the network
- ❒ Business network starts from the beginning, so the scale is also small
- ❒ Further development is based on the original network, but the experiences can be used to create new networks as well

To ensure that people want to join the network, I collected the potential benefits for future cluster members. This table shows a mature cluster form, where all the member-types are involved in the common work.

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