

Sustainable Rural Renaissance: The Case of a Biorefinery



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Executive Summary

In 2012, a bioethanol plant using state-of-the-art technology commenced operations in Dunaföldvár, the very heart of Hungary's maize-producing region. Our study aims to shed light on the local social and economic impacts of the biorefinery. Previous research on the employment and economic impacts of the Dunaföldvár ethanol plant is complemented by surveying the social and agricultural impacts.

One of the main characteristics of the present research is that it is *ex post*, i.e. it attempts to determine the local social and farming impacts of a plant that is already operational. Another of its characteristics is that it analyses the results based on the concept of rural renaissance. Accordingly, we focused on the effects related to social issues in rural areas (ageing, migration and social and economic decline) and on the factors mitigating and moderating such effects (diversifying of the local economy, impacts on investments, job creation, and the strengthening of social ties).

One of the main findings of the study is that this development in the rural space has contributed significantly to reversing earlier adverse social and economic trends. The plant, the result of an investment in one of Hungary's most disadvantaged regions, has created new steady jobs, has helped to keep skilled labour in place and to mitigate selective outmigration. After long years, the number of new 'settlers' has grown, and decline in the number of local residents due to outmigration has stopped. The establishment and the operation of the plant have had far-reaching effects on stakeholders.

The stakeholders include the local government, whose financial situation has been fundamentally reshaped by a plant that contributes substantially to local business tax. The improved financial position of the local government of Dunaföldvár has directly contributed to maintaining or improving the standard of essential infrastructure (the road network) and public services (health care, social care, education and public transport), which is apparent at first hand to inhabitants of the town and smaller settlements in its catchment area.

Another significant group of stakeholders are the employees of the plant, who are mostly experienced, skilled workers living in the vicinity. Groups in a disadvantaged position in the labour market – including career starters, soon-to-be retirees, women and the long-term unemployed – are under-represented among the employees of the plant. The 158 jobs directly created have not, therefore, directly improved the job prospects of the unemployed living in the region. Importantly, however, indirect jobs created and maintained, as revealed by previous research, vastly outnumber direct jobs, by a factor of about ten. The plant has slowed job-related out-migration and has kept mainly young skilled labour in the region. In addition, those now employed by the bioethanol plant had to be replaced at their former work places, opening up new opportunities for those entering the labour market. The new plant in Dunaföldvár offers attractive conditions to employees, reflected in an increase in the number of taxpayers in the highest personal income tax bracket. Higher wages also boost the development of the economy of the town and its surroundings. Indirect job creation has occurred mainly through external service providers in the agriculture, manufacturing, trade and services industries around Dunaföldvár.

A bioethanol plant is distinguished from other business investments by being embedded in the local agricultural network. The bioethanol plant does business with hundreds of maize farmers, fundamentally impacting on their business environment. The research confirms that, overall, the plant in Dunaföldvár has reduced the business risk for such farmers. Predictable demand for maize from the plant plays an important role in reducing risks for farmers, while also exerting a price-stabilizing effect. The plant also contributes to improved payment discipline in the maize market. Small farms, can contract directly for the supply of maize, which, in turn, enables farmers to realize

higher purchase prices than they could if they were to do business with wholesalers. The survey found that only age group influenced respondents' replies; neither highest educational qualification nor the size of the farms turned out to be influencing factors, which suggests that the plant impacts farms positively irrespective of size.

The study finds that climate change has made maize production riskier in Hungary in recent years. To manage such risks, the farmers have adopted diverse adaptation strategies such as reducing the sown area of maize, growing drought-tolerant maize hybrids, changing the method of cultivation and improving irrigation. Overall, five years into the operation of the bioethanol plant, there has been no increase in the sown area of maize in the country; on the contrary, there has been a 5% decrease. The steepest fall has been experienced by the traditional maize-growing regions in the vicinity of the plant. Half of the respondent farmers remarked that, due to increasingly high weather risks, they had reduced the sown area of maize over the past years.

Therefore, the maize farmers have been subject to conflicting impacts over the past five years: on the one hand, the emergence of a buyer supporting predictable demand has compelled them to increase the quantity of maize available for sale; on the other hand, however, increased risks posed by climate change have forced the farmers to adapt. The study confirms that both effects have had major investment-related implications, with respondent farmers claiming that they have invested heavily in recent years, upgrading and improving their competitiveness of the farmers. Over half of the farmers said that the Dunaföldvár bioethanol plant had stimulated the implementation of their investments and technological upgrades. Every second (53%) farmer said that the presence of the local ethanol plant contributed to their investment decisions on farming technology. In other words, the plant encouraged increased levels of on farm technology investment, and up to half of decisions by farmer to invest in new technology would have been negatively affected in the absence of the plant. Being able to rely on predictable demand from the plant, they implemented their investments and upgrades either earlier or on a larger scale than they had planned. The survey confirms that the presence of an ethanol plant stimulates more frequent investments and more intense technological upgrades by the farmers and other business partners that boost job creation and increase the competitiveness of the local agriculture in the long term.

The results of our analysis reveal that, on the whole, the operation of the bioethanol plant contributes to rural renaissance through four main channels:

- It directly and indirectly creates jobs requiring skilled labour in the rural space, thereby helping to keep qualified and skilled labour in place, and preventing selective out-migration which could lead to a decrease in human capital.
 - As a significant contributor of local business tax, it helps maintain or improve the standard of public services provided locally, which is apparent to each member of the local community.
 - It creates permanent and predictable demand for a wide range of suppliers, which boosts competitiveness of the local economy, diversifies activities and stimulates employment.
 - Investment in farming technology is stimulated by providing a predictable and stable demand, reducing risks for investments. Every second investment in farming technology was found to be less likely to materialize without the presence of the ethanol plant.
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1. Preface to the Study: Scope and Aims

The Pannonia Ethanol biorefinery is set in a rural area on the banks of the Danube is a hundred km from Budapest. The nearest town, Dunaföldvár (population 10 thousand), is 5 km from the plant. Family farming is the predominant economic activity in the surrounding area. Although Dunaföldvár and its environs are the main beneficiaries of the plant, other towns such as Dunaújváros located within a 20 km radius also benefit. The biorefinery, which is also a nursery for development of new bio technologies, commenced operations in 2012 and has doubled in size since then.

The Pannonia Ethanol plant is an agriculture based industry operating a biorefinery. Feed grade corn is the biomass raw material that provides the feedstock from which the biorefinery produces animal feed and bioethanol. Farms in the region supply 1 million tons of corn to the plant each year. Local processing for export adds considerable value to the corn to the benefit of the local and Hungarian economy, as shown by the Hetfa studies. The animal feed is exported by barge on the Danube to countries all over Europe and further afield. It is in strong demand because of nutritional and health characteristics that make it superior to raw corn as a feed. The ethanol is exported by train from a dedicated Pannonia Ethanol rail terminal to oil refineries in Europe where it is blended with petrol to reduce carbon emissions from fuel.

Social impact studies are normally carried out in the preparatory stage of extractive and processing projects as part of the mandatory licensing procedure. The primary goal of these studies is to identify the impacts that the implementation of an investment are expected to have on local economies, local communities and natural assets (Vanclay, 2006). Such studies emphasize two issues: they assess the possible impacts and make recommendations for mitigating measures (Hildebrandt and Sandham, 2014). Recently, however, the focus of social impact studies has become broader. They now tend to regard investments as processes. As a result, their objectives are no longer confined to the assessment and mitigation of impacts but also include impact management. This takes into account the potential for unexpected impacts from the implementation of a project, which should, if possible, benefit the communities concerned (Dendena and Corsi, 2015).

This study expands upon the traditional features of impact assessment, mitigating measures and impact management with a rural development perspective. The concept of rural renaissance is central to the research approach. This concept has been used by researchers in rural development for several decades and is an important one within Horizon 2020, the EU Framework Programme for Research and Innovation. Conducting a dialogue about rural renaissance is now a dominant narrative in rural studies. Alongside 'rural crisis' and productivist concepts, rural renaissance narratives frequently visualize the traditional values and natural assets of rural space from an urban perspective.(da Silva et al 2016). The European Union attaches importance to the rural renaissance theme for the EU 2014–2020 programming period. This is seen as a response to social and economic processes that have adversely affected rural space over time. They include negative demographic trends in migration, ageing and economic and social decline in the rural space. Rural renaissance is interpreted in the context of sustainable growth to pave the way for the rejuvenation of the European rural space (European Commission 2016). In this context it envisages responsible use of natural resources, innovation-based synergies spanning different sectors, the development of local businesses, the initiation of cooperation between the city and the country and an increase in human capital.

Therefore, our research addresses the issue of whether the Dunaföldvár operation of Pannonia Ethanol Zrt. can be interpreted contributing to rural renaissance. The structure of this study is based on the methodological guidance of the International Finance Corporation (IFC), a member of the

World Bank Group. The logical sequence of the milestones determined in IFC's methodological guidance is as follows:

- Scoping
- Establishing the Social Baseline
- Analysis of Social Impacts.

In our case, these content elements are explained below.

Scoping

The economic and environmental impacts of establishing bioethanol plants have been exhaustively explored and presented in other studies and commentaries. However, much less emphasis has been placed on the impacts on local communities directly affected (Browne 2011.; Gomes 2009.; Tysk and Eklund 2002; Panichelli and Gnansounou 2015; Kocar and Civas 2013). To determine the extent to which such plants contribute to rural rejuvenation, the stakeholders affected by their operation and the manner in which they are affected must be clearly identified. Accordingly, the target group of our research is those stakeholders. As we lacked prior information about them, the identification and mapping of stakeholders was an important task for the exploratory phase. This was done mainly by conducting key interviews.

Establishing the Social Baseline

We assessed the social well-being of the town hosting the plant and its environs by collecting and analyzing statistical data. The social and economic environment in which the Pannonia Ethanol Plant was established was profiled by retrospective analysis of previous decades that mainly examined the regional characteristics of economic performance, the labour market and migration.

Analysis of Social Impacts

The most important part of our study is the identification, analysis and presentation of the social impacts generated by the plant. The analysis deals with the stakeholders identified in the exploratory phase of the research, thus enabling us to assess the importance of the plant and its role in rural renaissance. The aim of the analysis is to show how relations with the plant affect business partners, generate positive or negative impacts for employees and for residents of Dunaföldvár as a result of its operations.

Methods Adopted

Due to the complexity of the issues raised by the research and the diversity of the five groups of stakeholders identified, we tried to be as comprehensive as possible in the application of data collection methods. Both qualitative and quantitative methods were used in order to form a comprehensive picture of the social impacts generated by the plant and the quality of such impacts. Using complementary methodologies increased the validity of the results through the established method of triangulation wherever possible. They were particularly applicable when the study dealt with the workers and suppliers of the plant. The methodology of the research, was based on conducting a total of 24 key interviews, 2 questionnaire surveys and 2 focus group interviews. In addition, we carried out a comprehensive analysis of statistical data to explore social and economic trends in the region.

2. Social and Economic Impact Assessment

2.1. Macro Level: Review of the Hétfa studies

Two studies by the Hétfa Research Institute in 2012 and 2016 respectively (Szabó-Morvai 2012, and Major 2016) assessed the economic impact of the Pannonia Ethanol Plant¹. The first one, conducted prior to the launch of the operation (2012), made preliminary assessments of the expected positive and negative impacts and mapped the economic actors most affected. The second one, conducted in 2016, assessed the macroeconomic and employment-related impacts of the plant by means of econometric models and, based on that, offered alternative scenarios for the future operation of the plant. The findings of these two studies formed the starting point of our research. Besides using their findings for guidance, we sought to answer the questions put by the two studies within the framework of our own research. We examined to what extent the conditions and trends assumed, but not analyzed, by the two studies were validated. Below is a summary of the most important findings of the two studies.

In 2012, Pannonia Ethanol planned to develop two bioethanol plants, one in Dunaföldvár and the other in Mohács. The Dunaföldvár plant was constructed and is in operation today. The Mohács plant did not proceed due to biofuel policy changes in the EU. The combined employment-related impact of the two envisaged was assumed to be 152 directly created jobs. The employment of both skilled and unskilled labour was seen as necessary for their operation. The skilled-to-unskilled ratio was planned at 80-to-20%. Moreover, in the case of the skilled workers, it was expected that roughly every other one would hold a higher education qualification. The authors of the study projected that another 3.000 jobs would be created, mainly among suppliers and contractors as an indirect employment-related impact. The models used also postulated a corresponding increase in consumer demand generated by the new jobs and supported by secure incomes and financial security.

The study looked primarily for the economic impact of the plants' activity on Hungary's maize sector. Drawing on data from the two years prior to 2010, the study calculated that the two plants would have capacity to process one-third of the national maize crop. Increased demand was expected to result in a moderate increase in the price of maize, but the strong effect of the international maize market on domestic prices was also noted. According to the models, higher demand was not accompanied by a corresponding increase in the sown area of maize. Instead, improved production efficiency was forecast. It was anticipated that this would materialize through the development of production technologies which, with the background of a stable market, could also lead to a decline in production risks.

The models calculated that EUR 7.4 to 8.4 million would be paid in local and central government taxes. A EUR 1.2 billion contribution to GDP was projected in the period through to 2020. In terms of contribution to GDP, the direct impact accounts for two thirds, with the remaining one-third arising from the operation of the plant. As regards employment, direct and indirect job creation can lead to sizeable cost savings in unemployment benefits.

Making different assumptions the 2016 study developed two alternative scenarios. One of these, the investment scenario, deals with internal conditions, that assumes the company's investment activity

¹ When the Hétfa Research Institute was conducting its first study, the Dunaföldvár plant was still under construction and the second plant in Mohács was still in the pipeline. In the end the plant in Mohács was not built; however, the plant in Dunaföldvár doubled its capacity in 2015. Consequently, the 2016 study only analysed the economic impact of the plant in Dunaföldvár [Ed.].

will continue to grow at an annual rate of circa 12%, similar to the level experienced in 2015 and 2016. This scenario does not make any assumptions about external factors. The investment scenario assumes a strong increase in capacity at the plant, which enables the company to contribute even more to GDP, generate extra revenues for the local and central governments and improve overall employment.

The other scenario is termed the farmer scenario and projects changes in the positions of external actors. It assumes that in response to a stable rise in demand for maize from the ethanol company, maize producers will utilize technologies and develop means of production to increase the volumes of maize available for sale rather than increase the sown area of maize. This scenario has the potential to benefit the national economy more because its impact on employment is much stronger, creating new jobs for both farmers and their suppliers.

Table 1: Employment Impact by 2020 under Different Scenarios

	Baseline Scenario	Investment Scenario	Farmer Scenario
Direct job creation	147	147	147
Indirect job creation	1,268	2,509	11,240

Source: Major, 2016

The three scenarios in Table 1 paint strikingly different pictures of possible future trends on the employment impact. This table shows that the number of direct jobs is likely to peak at approx. 150 under all three scenarios, with a difference only in the number of indirect jobs. The main engine of indirect job creation in the long run is likely to be expansion by service providers, suppliers and their business partners. The plant's business partners, their respective business partners and other multipliers respond to continuous development and expansion by creating more jobs, setting off a chain reaction of expansion. The investment scenario model forecasts the number of the jobs thus created at 2,509 and the farmer scenario forecasts the number at 11,240. Findings related to direct and indirect job creation, the farmers' willingness to invest and local and central taxes are of key importance to the present study. The approach adopted by our research enabled us to analyze those findings in greater detail, with the results constituting an important part of our conclusions.

2.2. Scoping

This phase of the research identified the stakeholders who were to become the target groups of subsequent analyses. To achieve this, we relied on the findings of the economic impact studies conducted earlier (Szabó-Morvai, 2012 and Major, 2016) and the experience drawn from our interviews with the representatives of Pannonia Ethanol Zrt. The interviews (24 interviews), conducted in June 2016, were key to identifying stakeholder groups. Each interview was recorded, abstracted and analyzed. Based on this, we finally identified five groups for analysis to determine the social impacts of the plant:

- employees of Pannonia Ethanol working at the plant in Dunaföldvár;
- maize farmers;
- external service companies;

- the local government;
- local social, cultural and educational institutions and civil society organizations.

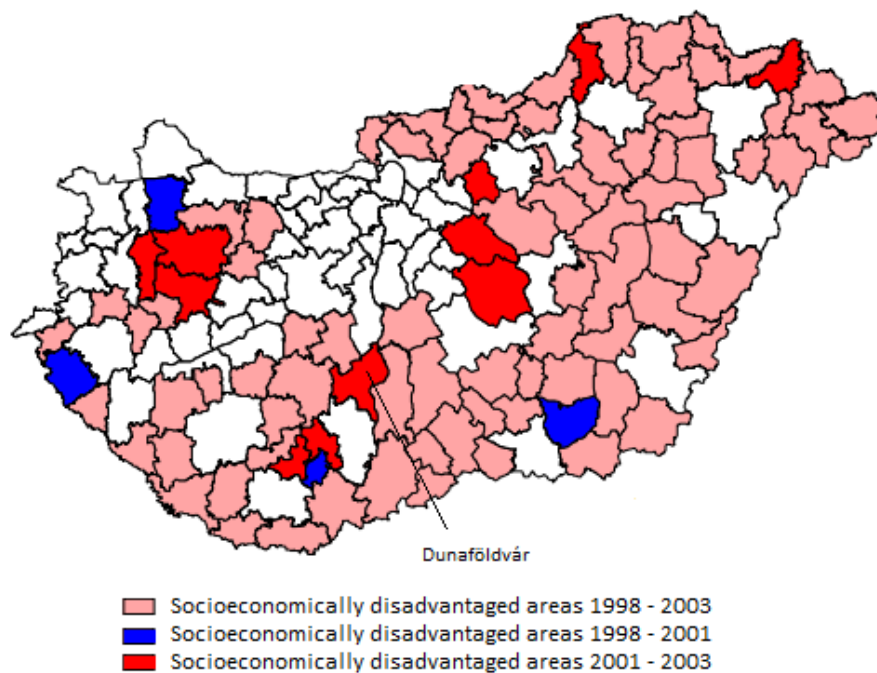
Our next task was to construct a picture of the direction and intensity of changes resulting from the establishment of the plant. We commenced this task by analyzing the social/economic situation in Dunaföldvár, and the trends that characterized it, at the time of construction of the bioethanol plant.

2.3. Social Baseline – Trends in the Past Decades

The economic impacts of the establishment of the bioethanol plant are determined fundamentally by the social and economic characteristics of and trends in the wider region of the plant. Dunaföldvár, where the plant operates, had long been overshadowed by the two neighbouring settlements of Dunaújváros and Paks. Both had major businesses located in their environs, an ironworks and a nuclear power station respectively. Dunaföldvár residents began commuting into these industrial centres in the 1960s, when there was little or no investment or development in the local economy.

After the collapse of state socialism in the first half of the 1990s Hungary experienced a transformation (Kornai, 1993), leading to mass unemployment. The region was badly affected, with long-established employers in Dunaföldvár going out of business and large companies in Dunaújváros resorting to mass lay-offs. Commuters seeking employment were adversely affected by these developments. By the turn of the new millennium, these unfavourable labour market trends led to Dunaföldvár and its wider region (the Paks micro-region) becoming one of Hungary's most disadvantaged settlements. Based on data indicating high unemployment, government decree no 91/2001. (VI.15.) categorized the Paks micro-region as favoured for regional development (Figure 1).

Figure 1: Disadvantaged Areas in Hungary around the Turn of the New Millennium



Source: VÁTI: Compiled by the authors based on a Review of the National Regional Development Concept adopted by the Hungarian Parliament through its resolution no 35/1998. (III.20.) OGY, on the basis of the figure on page 2005.63

The low point of the labour market crisis occurred at the turn of the millennium. Subsequently, the reorganization of the local economy began. The creation of new jobs through greenfield investments counterbalanced a steady decline in the number of long-established employers, in particular the ironworks in Dunaújváros. The economic rejuvenation of the region was facilitated by the establishment of an EU-funded (PHARE²) industrial park in Dunaföldvár in 1998 that created suitable conditions for the establishment and further development of businesses. A 2004 review removed the Dunaföldvár-Paks region from the category of favoured regions for development due to an improvement in labour market conditions (government decree no 64/2004. (IV. 15.)), The labour market situation in the Dunaföldvár-Paks region has been more favourable than the national average since that time, as shown in Table 2.

Table 2: Trends in Unemployment Rates, 1998–2014 (%)

	1998	2001	2006	2011	2014
Dunaföldvár	6.6	5.0	5.8	7.0	5.7
Paks District	6.4	5.5	5.8	7.4	5.6
Tolna County	7.7	6.7	7.6	9.2	6.7
Hungary	6.2	5.3	6.2	8.7	6.4
Population-weighted average of small towns	6.8	5.8	6.7	9.2	6.8

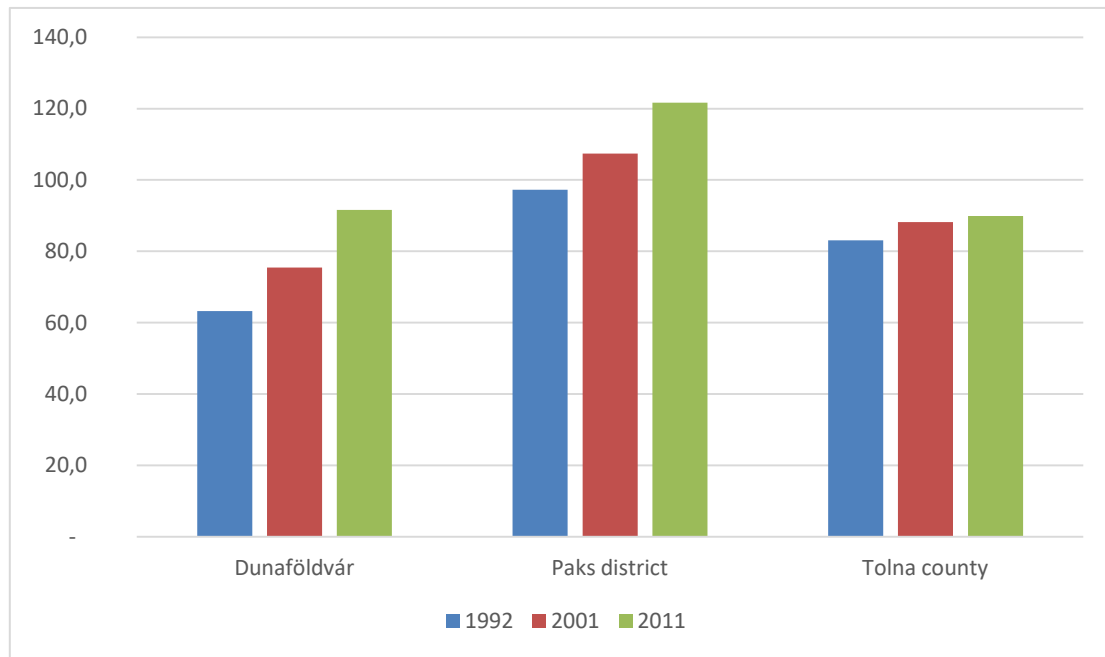
Source: Calculated by the authors based on the corresponding years as shown in the Hungarian Central Statistical Office's T-STAR (Database System of Settlement Statistics)

Note: Small towns are urban settlements excluding the capital and county towns

A stronger labour market brought with it an improvement in incomes. While in 1992 the average wage of the residents of Dunaföldvár barely reached 63% of the national average, 20 years later it had risen to 91%. Income convergence within Tolna County (Figure 2) was strongly positive. In the early 1990s, the difference was close to 20 percentage points, while in 2011 the average income per inhabitant exceeded the county average.

² Poland and Hungary: Assistance for Restructuring their Economies (PHARE) aid fund set up in 1989

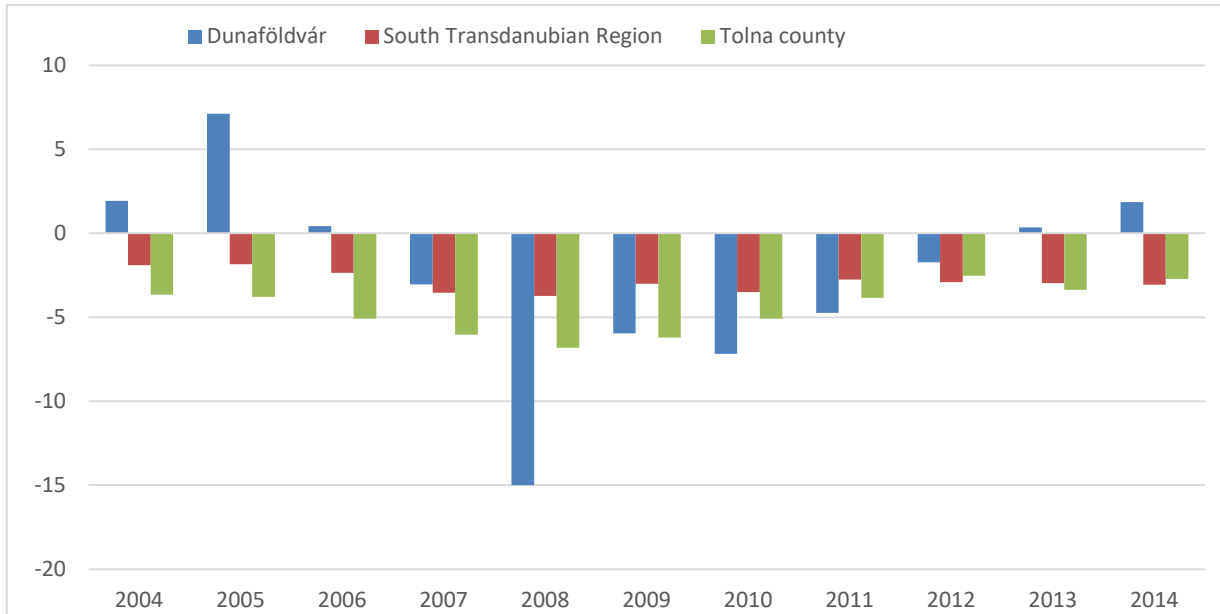
Figure 2: Average Annual Income per Inhabitant as a Proportion of the National Average (%)



Source: Calculated and compiled by the authors based on the corresponding years as shown in the Hungarian Central Statistical Office's T-STAR (Database System of Settlement Statistics)

Improved employment and income conditions also had beneficial effects on demographic trends. Natural decline in the population of the town and of the entire country was exacerbated by significant out-migration from Dunaföldvár during the past decade (see Figure 3). In the wake of the global economic crisis in 2008, there was a sharp rise in the number of those leaving Dunaföldvár, with an increase in those seeking of employment abroad becoming an important feature. The balance of migration turned positive in recent years, which suggests a stronger labour market makes Dunaföldvár is an attractive place to live for larger numbers of people. It is noteworthy that Dunaföldvár has succeeded in improving its position despite continued population loss through migration of inhabitants to Paks District in its immediate neighbourhood and to Tolna County in the wider area.

Figure 3: Trends in the Balance of Migration in Dunaföldvár and its Surroundings, 2004-2014



Source: Calculated and compiled by the authors based on the corresponding years as shown in the Hungarian Central Statistical Office's T-STAR (Database System of Settlement Statistics)

Note: mid-year data on the balance of migration per thousandth permanent inhabitant

The evidence clearly shows that – thanks to vigorous development –Dunaföldvár has become one of Hungary's most developed towns today, having overcome the crisis in the 1990s. It can be concluded that Dunaföldvár's improved economic and labour market situation has stimulated favourable demographic changes, turning the balance of migration positive. The bioethanol plant has been a factor influencing this change.

The section below assesses how the establishment of the processing plant has affected the stakeholders identified in the preparatory stage of our research.

2.4. The Impacts of the Bioethanol Plant on the Local Economy

Direct impacts from the establishment and operation of the bioethanol plant have influenced the quality of life in Dunaföldvár's immediate neighbourhood and wider area in a variety of ways. The most obvious and the most lasting impact has been the creation of permanent full-time jobs that have helped to reduce unemployment. An important impact is the significant contribution that the local business tax paid by the plant makes to the financing of public services and adds to the funds earmarked for development of the settlement. The plant also impacts incomes in the area because it offers competitive compensation packages to its employees that are higher than levels typical for the locality.

2.4.1. Direct and Indirect Job Creation

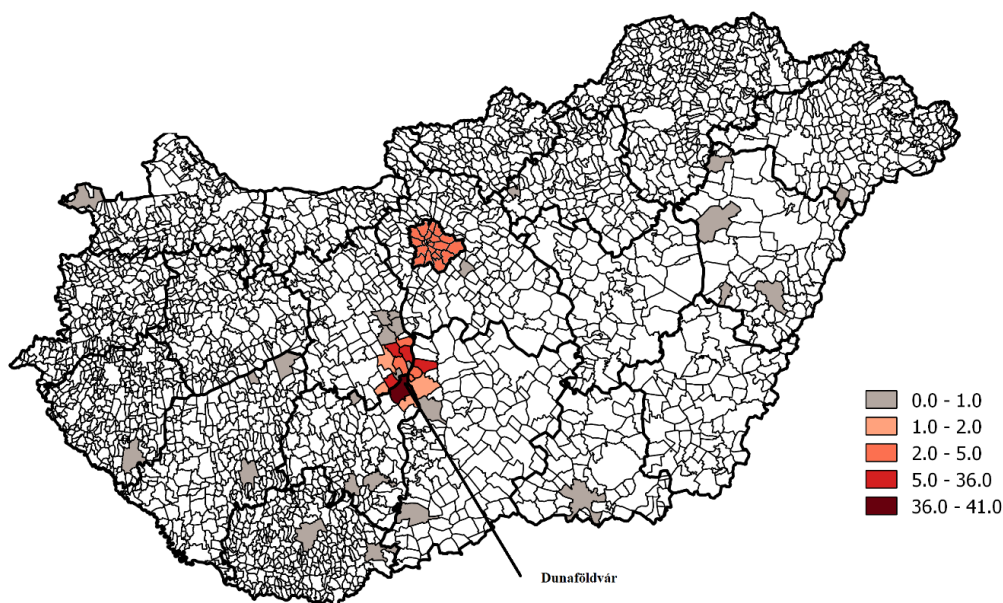
The construction and expansion of the plant had a considerable impact on seasonal employment. The macroeconomic impact study estimates that the construction of the project created jobs for close to 3.000 people in 2011 (Major, 2016). The operation of the bioethanol plant has a much lower impact on direct employment. Major calculates 1.300–11.240 job creation potential by 2020 depending on the scenario in question; however, 90% of these jobs are expected to be created indirectly, outside of the plant.

Concerning direct job creation, the numbers employed have risen from 78 in 2012 to the current 158, following investment that doubled the capacity of the plant. This level of employment is higher than that projected in the models. Most employees work at the plant in Dunaföldvár. The number working in the central office is below 10. As is shown in Figure 4, most employees – 133 out of 158 (84%) – commute from within a 25 kilometre radius of the Dunaföldvár plant, and positively impact the labour market situation in the region. It should be noted that the permanent place of residence of some employees is located outside of the commuting zone. Some employees use a temporary place of residence in Dunaföldvár or the surrounding area to reduce commuting.

Employees typically hold a certificate of secondary or higher education (75% and 22% respectively). These data clearly show that the plant impacts selectively on the local labour market as the employees' level of education far exceeds the local average. In terms of gender distribution, the plant mainly employs men; women account for only 28% of the employees.

Analysis of employee data shows that the jobs created at the plant have been mainly for experienced skilled workers in the neighbourhood of the plant. The direct employment impact on disadvantaged groups in the labour market, i.e. career starters, soon-to-be retirees, women and the long-term unemployed, was marginal. These findings accord with the results of the key interviews with executives and those of the focus group discussions conducted with the employees.

Figure 4: Permanent Place of Residence of Employees as of 2016



Source: Compiled by the authors based on the data provided by Pannonia Ethanol Zrt.

The economic analyses show the plant has a significant impact on indirect job creation. To support continuous operation, the biorefinery contracts with a wide range of service providers. It is the hypothesis of our research, as well as the findings of the economic impact study, that the contractual relationship of the plant with the service providers indirectly influences employment and business development strategies in the service providers (Szabó-Morvai 2012 and Major 2016). The services that the plant contracts, together with the advantages and opportunities that their purchase create for service providers, are described below.

To keep the biorefinery in efficient continuous operation, regular maintenance, mechanical upgrades, and industrial cleaning are essential services. The external environs of the premises are cared for with landscaping, ground and façade upkeep. There are strict regulations governing the storage, transport and sale of ethanol. Compliance with regulations requires permanent quality control, insurance, rail, road and barge logistics support for shipment. In addition, working relationships with high-capacity freight forwarders are indispensable for ensuring the smooth delivery of maize.

Interviews with the contracted service providers show that cooperation with Pannonia Ethanol has affected the operation of all the companies interviewed. However, the extent of the impact varies, and is best illustrated by separating the service providers into two categories. The first category covers service providers whose activities and scale of business has not changed. These businesses are firmly established, have secure positions in their respective markets and extensive partner networks, of which Pannonia Ethanol is just a part. The second category covers the service providers for whom cooperation with Pannonia Ethanol has brought about significant changes. They have reported major progress in terms of both employment and infrastructure. We estimate that between 20 and 30 jobs have been created directly to support plant requirements.

The plant also impacts directly the existing jobs of approximately a further 30 external employees. Service providers need to purchase high value equipment and materials (tools, machines and vehicles) on a regular basis to ensure their support is at the highest possible standard. Both an expansion of human resource capacity and an upgrade in infrastructure by service providers have enriched the activity profile of these enterprises. Suppliers have been able to increase the number of their partners, thus also strengthening their market positions. Typically, these companies are local businesses either from Dunaföldvár or its catchment area. The scale of the business partnerships varies. Some companies earn as much as half of their annual revenue from providing services to the plant, while for others it is a less significant 5 or 6%.

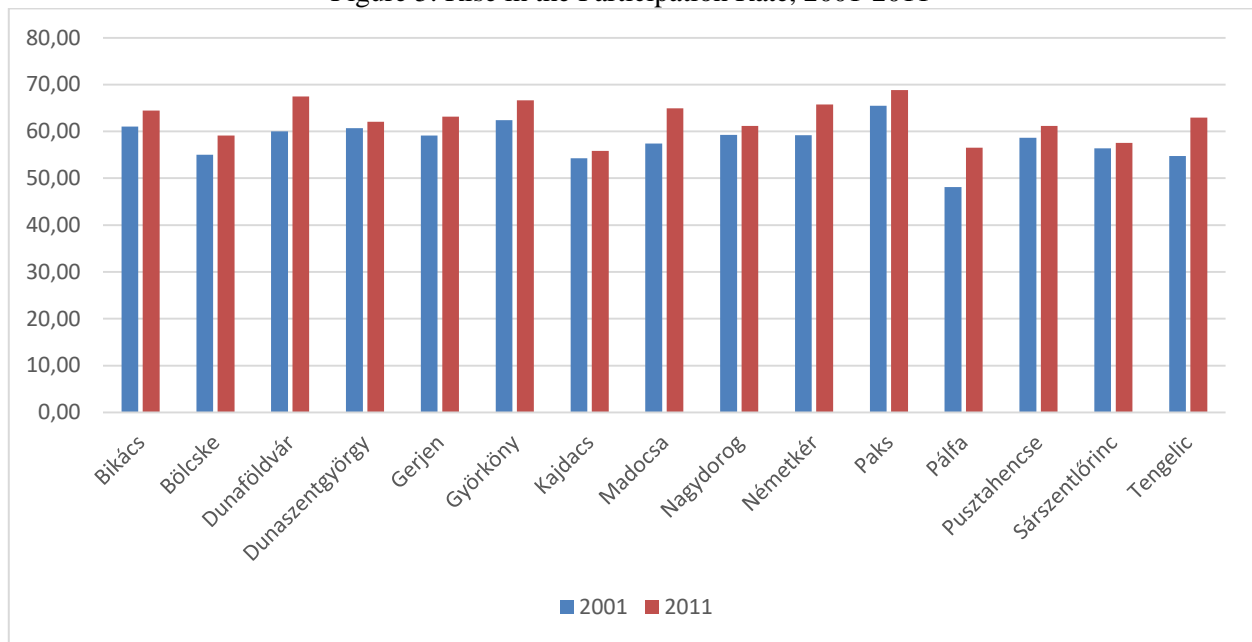
An important observation made from the interviews is that the partners unanimously praised Pannonia Ethanol for its approach to working together. They see its flexibility, adaptability and fast decision-making capability as setting the company apart from other business partners. We conclude, therefore, that cooperation with Pannonia Ethanol has had a game-raising effect, which has led to constant improvement in service providers' investment, development and employment indicators. This, in turn, has enabled them to meet the plant's high expectations and to expand their client base.

2.4.2. Unemployment

The bioethanol plant has not affected unemployment directly as its employees have not been recruited from among the unemployed. However, there has been an indirect impact. Those now working at the bioethanol plant have had to be replaced in their previous jobs. This has opened up new opportunities for those entering the labour market. An increase in the number of locally

available jobs boosts labour market activity which, in turn, raises the participation rate³. Determining increases in the participation rate is problematic in analyzing data. Only censuses can provide comparable and comprehensive data based on identical methodologies. Such data are only available for the period preceding the launch of the bioethanol plant. The data of the last two censuses shows that the participation rate in the Dunaföldvár-Paks region between 2001 and 2011 rose from 60.9 per cent to 65.4 per cent, and the numbers employed by 800. This suggests that the improvement in employment had already begun before the establishment of the biorefinery.

Figure 5: Rise in the Participation Rate, 2001-2011



Source: Calculated by the authors based on the corresponding years as shown in the Hungarian Central Statistical Office's T-STAR (Database System of Settlement Statistics)

However, other sources of data give an indication of trends in participation since 2011. Data on those paying pension contributions are available up to 2015. There is a close link between⁴ the number of those paying pension contributions and the employment figures recorded by the censuses. However, due to differing definitions, the data from the two sources are not directly comparable. The number of people paying pension contributions from their income has grown by over 10 percent since 2011, which indicates that by 2015 income earners in the Dunaföldvár–Paks region had increased to circa 23,000.

Overall, the research shows that the Dunaföldvár bioethanol plant has helped improve employment through creating jobs both directly and indirectly.

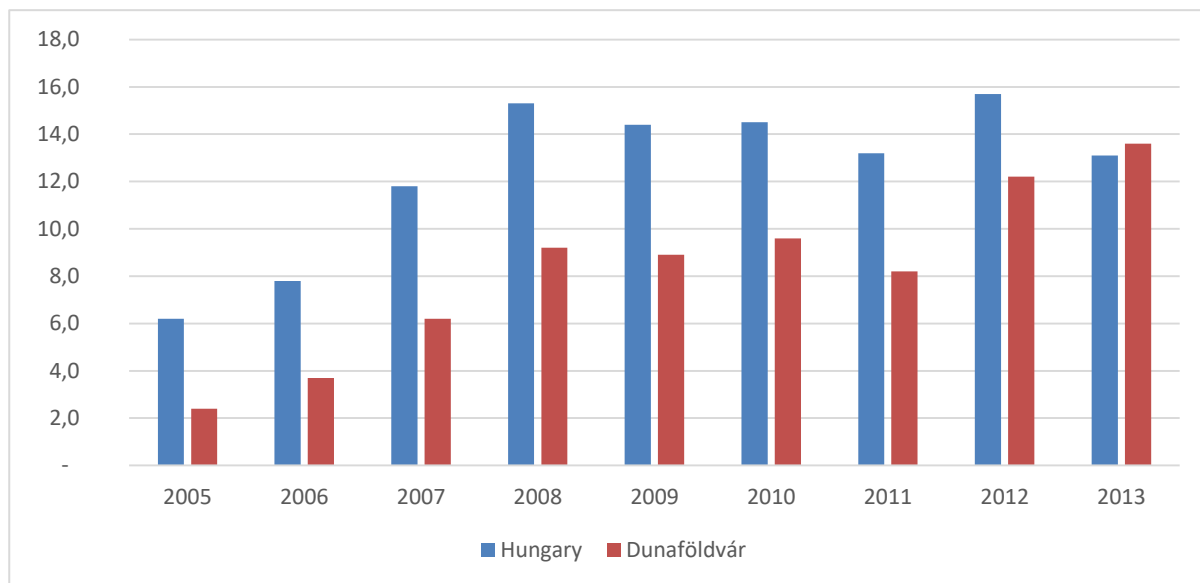
³ The participation rate is a measure of the active portion of an economy's labour force (15 to 64 years of age). It refers to the number of people who are either employed or unemployed.

⁴ The fact that in 2011, based on census data, the number employed was 20,195 and, based on data on contribution payments, the number employed was 20,132 amply illustrates the correlation between the two sets of data.

2.4.3. Impacts on Income

The establishment of the Dunaföldvár plant meant new jobs offering attractive conditions, including, inter alia, remuneration. By offering compensation packages that are competitive by regional and sectoral standards, the biorefinery can fill advertised positions quickly. The plant's direct impact on income is illustrated by the sharp rise in the number and proportion of those paying taxes in the highest income bracket that followed the commencement of operations at the plant in 2012. As a result, the proportion those paying taxes in the lowest and the highest income brackets converged with national data (see Figure 6). The wages paid to employees also boosted the local economy by generating additional demand for goods and services provided locally.

Figure 6: High Income Earners as a Proportion of Low Income Earners, 2005-2013



Source: www.teir.hu, compiled by the authors based on Helyzet-Tér-kép application

Note: The figure shows taxpayers paying tax on income in excess of HUF 5 million per one hundred persons paying tax on income below HUF 1 million.

2.4.4. Impacts on Local Tax Revenue, Local Government and Business

The most important channel through which the bioethanol plant makes a social impact is local taxes. Local governments in Hungary have an exceptionally wide range of duties and powers related mainly to the provision of public services for local residents. Under Act CLXXXIX of 2011 on Local Governments,⁵ local governments are responsible, inter alia, for the provision of:

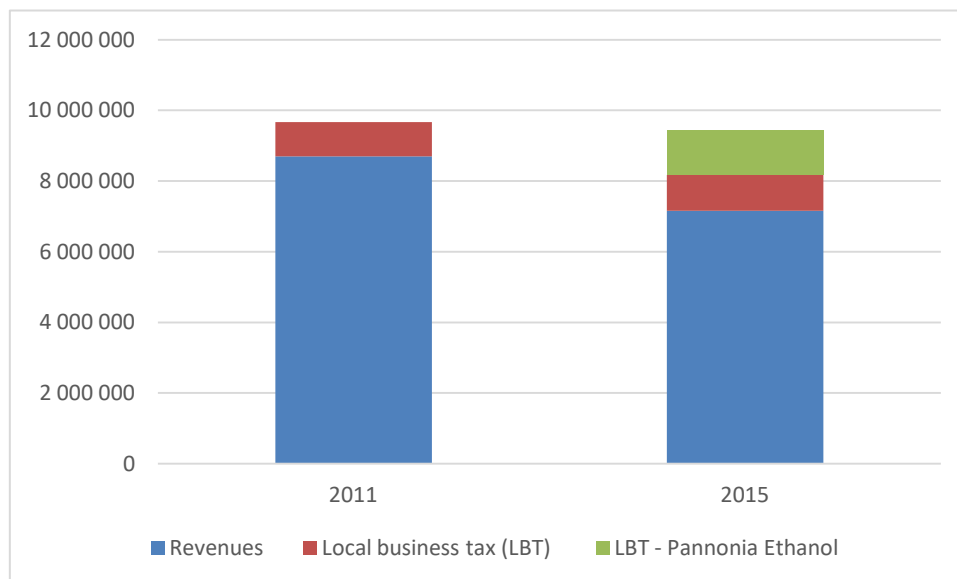
- town maintenance (local public roads, public spaces, street lighting, public parking, and street cleaning));

⁵ The Act drastically reduced the number of the duties allocated to local governments, e.g. pursuant to the no longer effective Act LXV of 1990, the provision of primary education was a local government responsibility.

- primary health care (GPs) and services promoting healthy living (supply of healthy drinking water, and promotion of sport and physical exercise);
- preschool education;
- cultural services (protection of local cultural heritage and support for local community education);
- social, child welfare and child protection services;
- environmental and nature protection; waste management;
- local public transport.

Local governments use both central government financing and their own sources to fund their activities. Most of the latter come from the local business tax paid by enterprises operating in the locality. Business taxes are paid in proportion to the revenues of the business. In keeping with its urban status and the size of its population, Dunaföldvár has responsibility for a series of institutions (e.g. a grammar school, a primary school, a culture centre and a museum) providing in the locality of the plant. This imposes a heavy financial burden on local government. The bioethanol plant has been beneficial in this regard, significantly improving the financial position of the town. The arrival of the biorefinery saw revenues from local business tax nearly double, securing a sizeable financial surplus for the town. Following a doubling of capacity at the plant, Pannonia Ethanol has become the largest taxpayer in the town, accounting for 56% of the total local business tax paid in 2015.

Figure 7: Revenues of the Local Government of Dunaföldvár and Contribution by the Bioethanol Plant (€)



Source: Dunaföldvár's local government regulations on the reporting of the implementation of the municipal budget, and data provided by Pannonia Ethanol Zrt.

Dunaföldvár's current development plan, the Urban Development Concept (Dunaföldvár 2016:42) considers the bioethanol plant the decisive component of the town's economic stability. The revenues from the business tax has enabled Dunaföldvár to reduce its debt, thereby alleviating the financial burden on the town. Surplus funds have enabled the local government to implement important infrastructural upgrades including the paving and renovation of the town's roads.

Changes to the funding of local governments introduced in 2014 have affected the town's funding capacity. For communities with significant business tax revenues, central government funding is progressively reduced relative to the amount of business tax collected locally. This means that the finances available to local governments no longer increase in proportion to the amount of taxes paid by local business. This change makes the local business tax less significant as a channel through which the plant impacts the town.

2.5. Social impact on employees and their lifestyles

The economic impact studies (Szabó-Morvai 2012 and Major 2016) projected that the establishment of the plant would generate both direct and indirect impacts on employment. The latter were expected to be among suppliers and service providers, while the former related to the actual jobs that Pannonia Ethanol Zrt. would create to operate the biorefinery. The number of the employees has grown to 158 over the 4 years since the launch of the plant. The Hétfa studies (2012 and 2016) analysing the economic impacts show a rise in household income as well as in national and local tax revenues, and a fall in expenditure on unemployment benefits as the outcomes of direct job creation.

The economic studies put an emphasis on quantifiable impacts that can be expressed financially, but do not take the human aspects of job creation into consideration. For the plant's social impact to be assessed, it is necessary to understand what working for Pannonia Ethanol means to its stakeholders. To analyze this, we employed both qualitative and quantitative methods of data collection. We supplemented these methods with triangulation to validate our results to the highest possible degree.

In the preparatory phase of our research we conducted keynote interviews of an exploratory nature with mid-level managers. Based on these interviews, we designed a questionnaire to survey employee opinions of the company and then analyzed the results in the framework of a focus group interview. This section of the study is a detailed presentation of the results of the questionnaire survey and the experience gained from the focus group interview.

2.5.1. Results of the Employee Questionnaire Survey

The survey was conducted on the 21st and 29th of July 2016. The survey covered the employees at the Dunaföldvár site. Employees could complete the questionnaire survey online or in a paper-based format. The number of questionnaires returned was 101, representing a 64% completion rate. The questionnaire covered four topics:

- key demographic data of respondents;
- experience of respondents related to places of work other than Pannonia Ethanol;
- satisfaction of the respondents with the working environment;
- impacts related to employment by the company.

Overall, we wanted to learn who could be employed and how this could be achieved, by a company that seeks to be an engine of sustainable rural development by offering high added-value products, using advanced technologies, providing a multinational working environment and exercising social and environmental responsibility.

2.5.2. Social impact on Pannonia Ethanol employees

Employees who got jobs resulting from the plant's direct job creation are a key stakeholder in the Pannonia Ethanol enterprise and a central focus of our research. We envisaged that the social impact of the plant on employees could be delineated and identified without great difficulty. Conducting a questionnaire survey enabled us to systematize these in a manner that could be analyzed for impacts. This chapter presents the results of this survey.

In terms of age, the company employs a particularly large number of young workers. Although the company does not especially target young people, the low average age suggests that working for Pannonia Ethanol represents an attractive opportunity for young people living locally. This is corroborated by the average age of employees from within a 20-kilometre radius of Dunaföldvár being even lower than the average for the entire sample. For those living further away the average age is higher but it is still below 40 years. The youth of the staff and the fact that it is not a disadvantage when it comes to recruiting employees are important characteristics of the company's operation. This is also a factor that may slow down out-migration of local career starters.

Regarding respondents' place of residence, the company has recruited primarily from among people living in Dunaföldvár or its immediate neighbourhood. This category accounted for over 70% of those completing the questionnaire and included the neighbouring town of Dunaújváros. Most of the sample recorded living in Dunaújváros and commuted daily either by car or public transport. The high proportion from there is attributable to the town having a population five times higher than Dunaföldvár's and to highly qualified career starters produced by the local university. Experienced labour is also available from manufacturing companies based in the town. This trend is reinforced by Pannonia Ethanol's recruiting practices follow the principle of concentration. Jobs are first advertised within the company, allowing employees and their family members and friends to apply. The next target is Dunaföldvár and then places further away. Head-hunting companies are employed only for executive positions requiring special experience and qualifications.

The survey responses suggest that staff are highly qualified. Of those who responded, 84% had at least a school-leaving certificate and half also had a degree. Another 20% of those with a school-leaving certificate had a secondary or higher education diploma from a technical school. Those with solely vocational qualifications represent the lowest number of respondents, their proportion being 16.3% indicate.

The results confirm that the company offers job opportunities mainly to the highly qualified. This can be explained by the international working environment and the fact that the technology employed by the company requires specialist knowledge. The results also confirm that Pannonia Ethanol employs mainly young and middle-aged people who live locally or in the vicinity.

In the next section we present the experience that the employees offer to the company. The majority of the respondents (78%) recorded that they had at least 5 years' work experience. Of these, two-thirds had a similar job at their previous place of work. Most joined the company from the private sector, while the proportion of those from the public and non-profit sectors was much lower (8.2% and 9.2% respectively).

In view of the company's international working environment, we examined how common former employment abroad is among the employees. In this context we found that one-fourth of the respondents⁶ had worked abroad for a long or short period of time. However, half of the

⁶ 4.2% of the respondents worked abroad for a period of shorter than 6 months and 20.8% for a period of longer than 6 months.

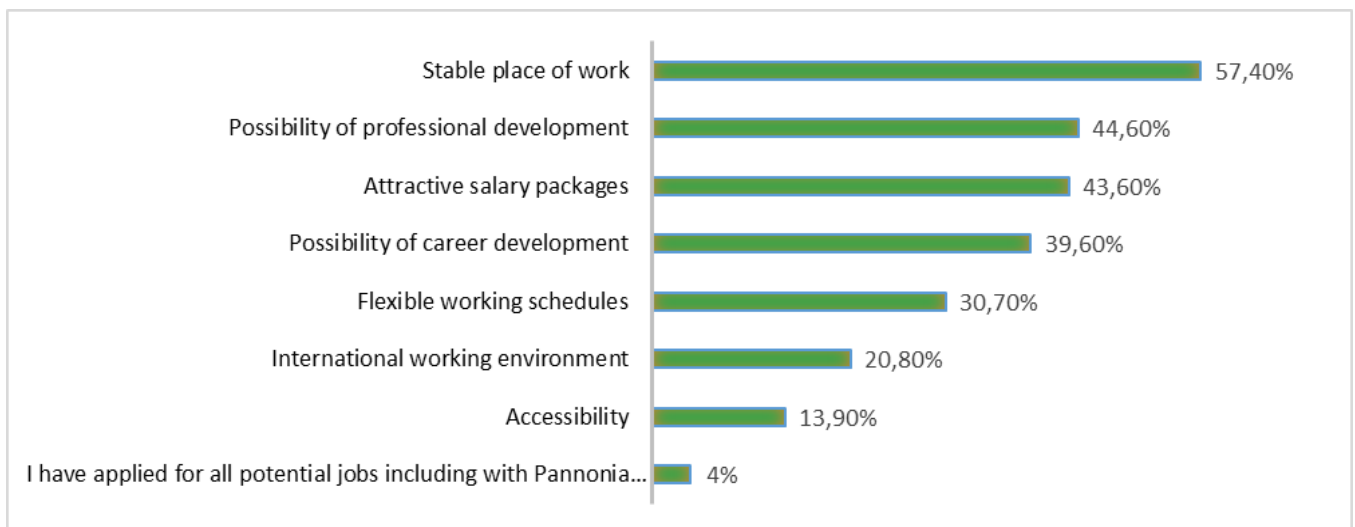
respondents in this group recorded that this had equipped them with experience that was useful for their current job.

We concluded that, in the absence of Pannonia Ethanol, this young, predominantly highly skilled labour force would have sought employment either elsewhere in Hungary or abroad. In the light of the region's earlier employment indicators, it is unlikely that employment opportunities in the region could meet their needs.

2.5.3. How Employees View Pannonia Ethanol

The Questionnaire also investigated what employees think of the company as a place of work. We queried why employees decided to join the company. The results (see Figure 8) show that they saw the company as a stable place of work with the potential for professional development and attractive salary packages. Career advancement and flexible working mattered somewhat less in the decision on whether to apply. The international working environment of the company was an important consideration for 20% of respondents. Some respondents saw accessibility of the plant as a factor, with 14% mentioning this. This demonstrates that the company is attractive as a place of work for reasons such as compensation, working schedule, working conditions, professional development and stability.

Figure 8: Why Did You Decide to Join Pannonia Ethanol? (N=101)

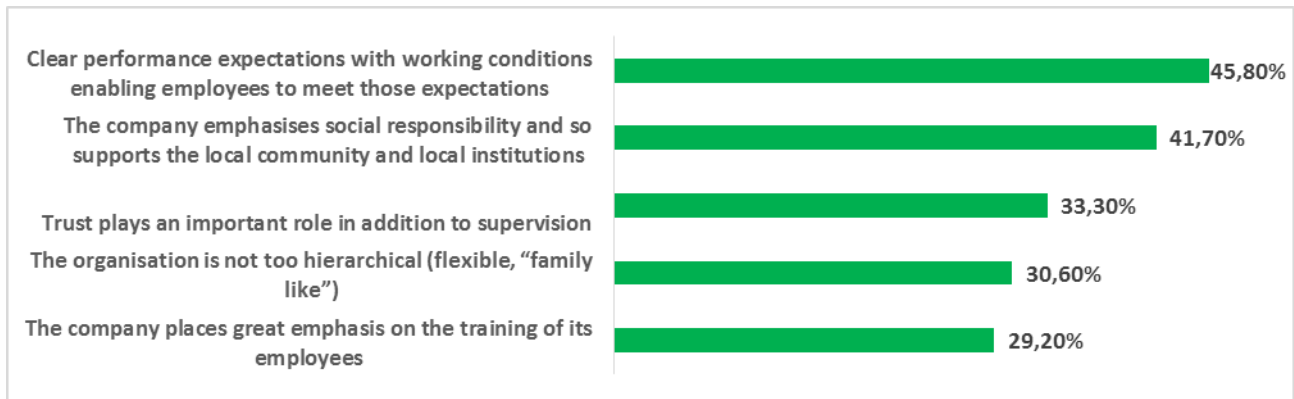


A number of questions examined how employees viewed the company. Firstly, we asked if the working culture at Pannonia Ethanol differed from that of other companies, based on their experience. Those who replied positively were then asked what exactly characterized the company's working culture. 79% of the respondents said "Yes" to the first question. The majority highlighted that at Pannonia Ethanol the working conditions were satisfactory and expectations were clear (see Figure 9). The fact that every third employee highlighted trust and the flexible organization of work suggests that the company's work environment is good.

The responses also suggest that social responsibility is another factor that sets the company apart from the respondents' former places of work. In addition to employees, representatives of the public sector and civil society also complimented the company's social responsibility. They stressed that

before Pannonia Ethanol corporate support for the local community was unknown in Dunaföldvár. Details of the company's corporate support are discussed in depth below.

Figure 9: What Do You Think Characterizes Pannonia Ethanol's Work Culture? (N=100)



The finding that the working environment of the company differs positively from what respondents previously experienced is an important result in itself. To learn more about the quality of the working environment we prepared a set of compound questions to measure it more accurately. Respondents had to rank the working environment and their workplace satisfaction on a scale of 1 to 5 in a series of ten statements/question⁷, depending on how much they agreed with each statement. Based on the answers, we calculated an index-based variable⁸, titled the *workplace satisfaction index*. Within the index range 1 means that the respondent did not agree with any one of the statements and 5 meant that they agreed with all statements. The aggregate average of the index was 3.8, which clearly indicates that the respondents are satisfied with the working environment.

Although an average calculated for the entire sample may serve as a good descriptive statistic, it could mask deeper interconnections. It may well be the case that averages vary widely in the individual sub-sets of the sample. In order to discover whether that was the case, we performed multi-variable analyses on four demographic variables (gender, age, highest educational qualification and place of residence). Our results show that these four factors do not influence workplace satisfaction, i.e. there are no significant differences between the individual sub-sets. This demonstrates that satisfaction is subject to individual characteristics and attributes.

2.5.4. Impacts on the personal lives of employees

The third goal of the employee questionnaire survey was to identify the direct and indirect impacts that working for Pannonia Ethanol had on the personal lives of employees. We approached this question from two directions. Firstly, whether starting to work for Pannonia Ethanol influenced their position in the labour market, and secondly how it affected their leisure time activities.

⁷ My superiors appreciate good work and if we go the extra mile. The working environment is comfortable both mentally and physically. Physical safety is guaranteed at work. I'm satisfied with my current salary. My current position is in line with my career ambitions. The working schedule suits me. Opportunities for further training are good. Travelling to work is no bother. I'm proud of what we have achieved together. I'd like to work here for as long as possible.

⁸ We used the Likert scaling method to calculate an index-based variable.

The presence of companies like Pannonia Ethanol improves employee skills in addition to creating direct and indirect job. To assess this skills impact, we asked employees whether, in their opinion, working for Pannonia Ethanol influenced their position in the labour market. We composed two statements (*Due to the training provided at Pannonia Ethanol, the employees' positions in the labour market improve. Work experience gained at Pannonia Ethanol is a good reference for future jobs*) that the employees had to rank on a scale of 1 to 5 depending on how much they agreed with them.



For ease of analysis, we also calculated an index for these answers. This index aggregates the opinions of the employees on their position in the labour market, and ranges in value between 1 and 5. The average for the entire sample is 3.94. Therefore, the respondents regard their employment by Pannonia Ethanol as enabling them to gain experience and knowledge that improves their standing in the labour market. Similarly, to assess workplace satisfaction, we also investigated whether there were hidden differences between the individual subsets of demographic variables. The results once again confirmed that gender, age, place of residence or educational qualification of the employees did not influence their opinion on this issue. Accordingly, there is a general consensus that working for the company represents progress and development in one's personal career.

According to our hypothesis, a permanent job has a beneficial effect on the personal life of the employees. We were interested to know whether working for Pannonia Ethanol had improved the quality of the employees' lives. The questionnaire mainly contained questions about the use of leisure time. The answers show that employees had either been actively spending their leisure time before joining the company or that they began to practice sport regularly or to take part in community events after joining. In terms of sports and leisure time activities, a positive shift was observed. Half of the respondents do sports more frequently than before joining and 82% have the same amount or more leisure time. 62.7% of the respondents attend community events more frequently than they did before joining the company. This increases the importance of company support for local events, such as that for the local cultural centre that organizes the largest events in the town. In recognition of this, in 2014 Dunaföldvár granted the Maecenas Award of the Year to Pannonia Ethanol.

2.5.5. Validating the Results of the Questionnaire Survey with a Focus Group Interview

One of the most important demands placed on social research is its reliability. To increase reliability, triangulation was used to validate the results of the questionnaire survey. Triangulation is an established method of qualitative research which uses a mixed approach to analyze data from different *sources* or different data collection methods. Data and methods that reinforce and verify each other can be used to ensure the validity of the final outcome of a piece of research (Olsen 2004; Morse 1991).

Our research adopted methodological triangulation, i.e. we used several data collection methods and examined the consistency of conclusions drawn from these. The methods used were the exploratory interviews conducted in the first phase of the research, the questionnaire survey of the company's employees and a focus group interview. Triangulation was intended to underpin the validity of our observations.

The results of the focus group interview are presented below. Seven employees participated in the focus group interview carried out on 15 August 2016. In selecting them we sought to reflect the distribution of the company's employees by gender, by highest educational qualification and place of residence as closely as possible.⁹ During the interview we presented the main findings of the employee questionnaire survey.

For the focus group, we constructed the profile of a typical Pannonia Ethanol employee based on the survey responses. In Pannonia Ethanol's case, this employee is under 40 years of age, has a degree and is from Dunaföldvár or Dunaújváros. The participants only partially agreed with this. They agreed that the employees were mostly from the younger age groups. However, they seemed divided over the claim that most employees have higher education qualifications. There were differences of opinion between the production line and office workers, which may explain why they thought differently about the typical educational background of their colleagues. Typically, the production line operators either had a vocational or a technical qualification, while most of the office workers had a degree.

When discussing the reasons for joining the company, we found that the focus group participants retained the opinion they had when starting their employment – namely, that it was a stable place to work. Based on the time they had spent in the company, they regarded it as having stable foundations and being assured of the conditions for long-term operation. In terms of favourable work schedules, it was mainly the production workers who had more leisure time, owing to the 12/24/12/48-hour shift plan. This had not been the case in their former jobs. The results of the questionnaire survey showed that the accessibility of the plant did not play a large role in the reasons for joining the company despite the fact that the vast majority of people commuted to work from close by. During the discussions on this issue, it became evident that although the company was indeed regarded as an attractive employer locally, they might be able to find even better employers further away. This further corroborates our observation that the company has a positive impact in keeping the local labour force in place.

During the focus group discussion, the opinion was also voiced that those who lived further away did not regard Dunaföldvár as a potential place to live. Dunaújváros, a large town by Hungarian standards, was viewed as a more likely place to live than Dunaföldvár, a smaller town, due to its commercial, service and cultural appeal.

We also outlined to the focus group the results of the workplace satisfaction survey, including that the employees thought favourably of their working environment. These results appeared to be validated as the participants were not surprised by the high proportion of those satisfied with the company. However, they added that sometimes workplace satisfaction also depended on short term factors. For instance, when there was construction work to increase the capacity of the plant, the workplace environment could become more difficult.

There was consensus among participants about the impact that Pannonia Ethanol has on the personal life of employees. They concurred that time at the company served as a good reference and that the experience gained could be put to good use later in their career. Better quality and more

⁹ The composition of those in the group by gender: 2 women and 5 men, by place of residence: 2 from Dunaföldvár, the others from the settlements in the vicinity, by highest educational qualification: 4 with a BSc degree, 1 with a technical diploma and 1 with only school-leaving qualifications. The participants were from various departments of the plant; both production line and office workers were represented.

active leisure time was stated to be related to their earnings being much higher than in their former job. Their improved financial position enables them to have more varied leisure time activities. For example, they opt for travel abroad in addition to holidaying in Hungary.

2.6. Farming: Impact on Lifestyle, Technological know-how and Investments

When assessing the bioethanol plant's macro-economic impact, the author of the study (Major, 2016) concluded that economic impacts depend largely on how stakeholders (in this instance maize farmers) respond to the changing market environment. The author proposed that the impact on employment was the highest when farmers perceived greater stability in the national maize market due to the operation of the bioethanol plant, and when farmers responded to the changed circumstances by modifying their strategies. Their aim is to increase their output of maize. A more stable market encourages them to commit to stronger development and investment strategies, ultimately driving growth in the market.

This study assumes that the four years since the plant commenced operation has been sufficient for maize farmers to gain enough experience to maintain or change their business strategy. To explore the propensity for strategic change, research was conducted among farmers that had a long-term business relationship with the company. CATI (computer-assisted telephone interviewing) data collection was carried out between 12 and 15 July 2016, with the participation of TÁRKI Social Research



Institute. We sought to be more comprehensive with data collection using farmers that sold maize to Pannonia Ethanol as the research population. The only filter criterion during data collection was that the farmers and the plant had to do business with each other repeatedly. Interviews were not conducted with farmers who sold maize to the plant only one occasion. It was considered that their behaviour was unlikely to have been influenced by a once off sales opportunity. As a result of the data collection, 270 questionnaires were received that could be evaluated. The results can be summarized in the following section.

2.6.1. General Description of the Sample

The respondent farmers mostly run large farms¹⁰, with the average size of arable land cultivated by them being close to 500 hectares (number of evaluable answers: N=224). This is well above the national average. The most recent survey of the structure of the economy shows the average size of

¹⁰ During the data collection the respondents talked about all the farms under their actual control. In some cases, these farms have various legal forms.

land cultivated by businesses in Hungary in 2013 was 310 hectares (KSH 2015a:6). The significance of the respondents in our survey is shown by the fact that the arable land cultivated by them accounts for 2.1% of Hungary's farming area. The findings may therefore have significance well beyond the study area.

The age distribution of the respondents follows national trends and, accordingly, members of the older age groups are over-represented. 55% and 31% of the respondents were over 53 and 61 years of age, respectively, at the time of data collection, while those who were born after 1973 accounted for just 20%. This follows the national distribution as 31% of Hungarian farmers were over 65 years of age in 2013 (KSH 2015a:13).

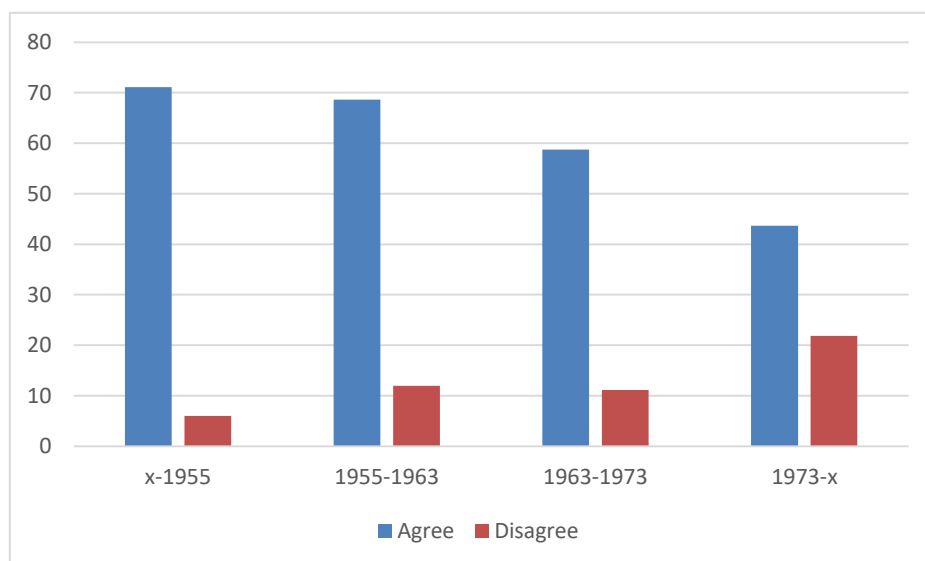
In terms of educational qualifications, the respondents are from a highly qualified group of Hungarian farmers. Half of them said that they had a vocational qualification from an institution of higher education, which is far higher than the national average of 2.7% among self-employed farmers. The sample was not weighted as the data collection was not intended to represent Hungarian farmers in general but aimed to gather the opinion of the farmers doing regular business with Pannonia Ethanol.

2.6.2. The Impact of the Bioethanol Plant on the Maize Market

Our initial hypothesis was that the establishment of the bioethanol plant as a significant and continual buyer of maize represents a force that stabilizes the maize market which, in turn, reduces both the operational and investment-related risks for maize farmers and improves the profits they earn.

61.5% of the respondents agreed with the statement that Pannonia Ethanol's maize purchases represent predictable and stable demand which, on the whole, **mitigates price fluctuations**. Only 12.2% of respondents disagreed. An examination of the age of the respondents showed that age was an important factor; 71% of farmers over 60 years of age (who are expected to be more experienced) thought that purchases by the bioethanol plant mitigated price fluctuations. In contrast, only 43.6% of those under 40 years of age thought likewise.

Figure 10: Pannonia Ethanol's Maize Purchases Mitigate Price Fluctuations. Distribution by Age Group (%)



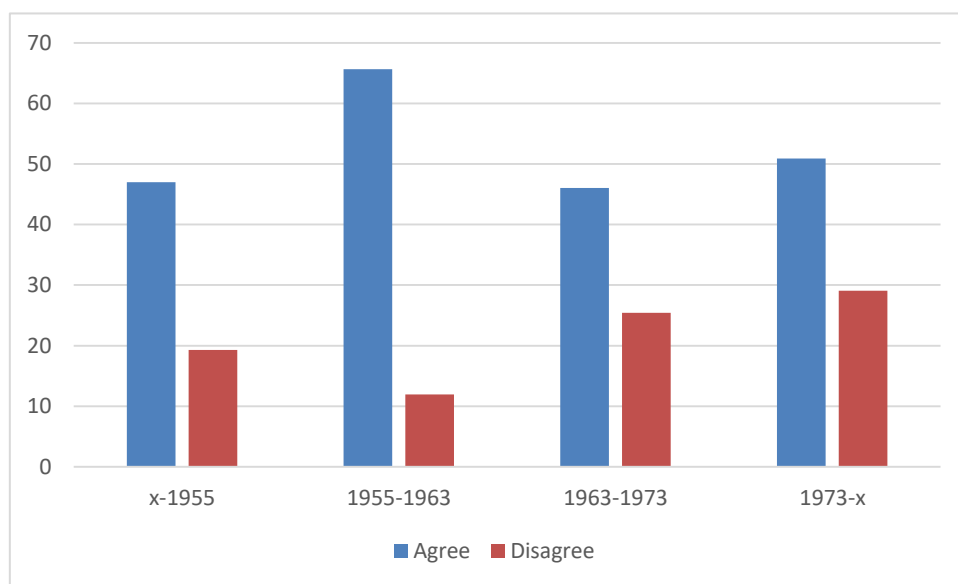
Source: Compiled by the authors on the basis of questionnaire survey data (N=270)

The impact of the other explanatory variables that were studied (i.e. educational qualifications and land size) did not prove significant. It is particularly important to point out that farm size did not prove to be a differentiating factor. This suggests that the impact of the ethanol plant is not selective, i.e. the company does not disproportionately benefit large farms. In other words, **benefits are spread evenly, irrespective of farm size.**

This is all the more important because other ethanol companies in Europe typically purchase maize from wholesale merchants – they do not purchase directly from farmers except for a few very large ones. By contrast, Pannonia Ethanol employs area representatives through whom the plant can contract with both small and large farmers. With the lowest contracted supply quantity at 25 tonnes, farmers with small areas (typically over 10 hectares) of arable land can also sell maize directly to the biorefinery. This direct purchasing of maize also ensures **farmers can charge higher prices**, as intermediaries (i.e. wholesale merchants) are not part of the process.

Answers to this question again showed the division among farmers, because most respondents (51.9%) fully or partially agreed, and only 21.0% fully or partially disagreed with the statement. Similar to the previous question, a higher proportion of respondents from the younger age group disagreed with the statements. Educational qualifications were not a significant factor, although a higher proportion of less well-educated respondents disagreed. When the results of the questionnaire survey were presented during the focus group discussion, farmers agreed that they could charge higher prices through direct sales. However, this price advantage is dependent on distance, because it is the price of produce delivered to the plant that applies. In the case of delivery over distances of 100-150 kilometers, the price advantage for avoiding intermediaries can be eroded.

Figure 11: Farmers are Able to Charge Higher Prices, Distribution by Age Group (%)



Source: Compiled by the authors on the basis of questionnaire survey data (N=270)

We assumed that the market entry of a significant buyer contributes to **improved payment discipline** which, in turn, reduces the business risk for farmers. The respondents confirmed this assumption with the majority (50.1%) fully or partially agreeing and only 10.0% fully or partially disagreeing with the statement. Age was a decisive factor in this case as well. While a higher

proportion (60%) of the respondents from the older age group agreed, respondents from the younger age group were more tentative with the “both agree and disagree” response being most common (49%). The farmers participating in the focus group agreed that the buyers’ market was undoubtedly more transparent than previous years. The number of questionable business partners has significantly diminished thanks to buyers with a stable background and industrial consumers.

In view of the above results it is hardly surprising that, on the whole, the farmers thought that the operation of Pannonia Ethanol’s Dunaföldvár plant **reduced the risks to farmers**. An overwhelming majority (61%) of the farmers agreed, while only 15.9% said that they fully or partially disagreed with the statement. In terms of background variables, age yet again proved significant. In contrast, neither the size of the land farmed nor the respondent’s level of education influenced the answers. Similar to the previous questions, a higher proportion of the younger respondents (those under 41) disagreed with the statement on decreasing risks for farmers. The plant has become **a stabilizing factor** in the Hungarian maize market. The respondent farmers thought that the market entry of a significant industrial buyer had reduced their risks.

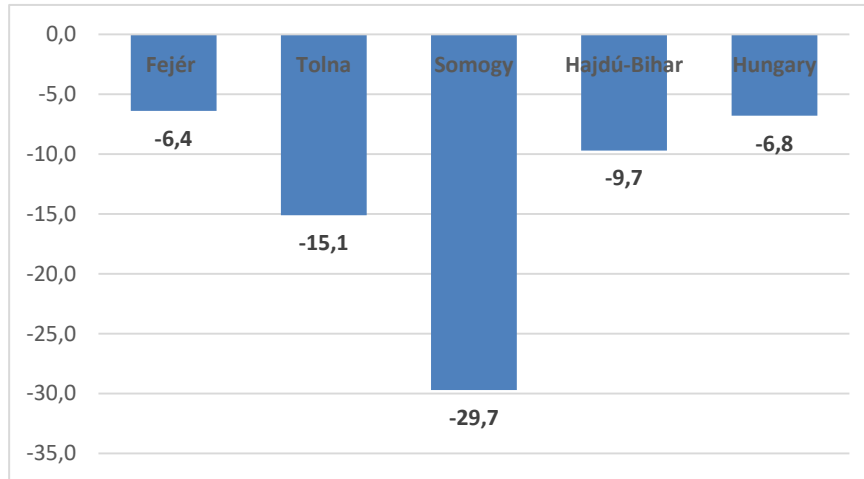


Overall, the telephone-based survey of the farmers strengthened the assumption that the bioethanol plant – which, due its direct sales, enables mainly the farmers living in the vicinity to charge more favourable prices and contributes to improved payment discipline in the maize market –It should be noted that, among the usual factors, only age influenced the answers. Neither educational qualifications nor the size of land proved to be influencing factors, which suggests that the operation of the plant benefits farms irrespective of their size.

2.6.3. Changes in the Sown Area of Maize – Climate Change

According to the findings of economic impact studies, the sown area of maize is unlikely to increase in Hungary in the short term either, due mainly to technology and regulatory issues. However, according to Szabó, Morvai and Major, farmers will respond to shrinkage in the sown area of maize by increasing yield (Szabó – Morvai 2012; Major, 2016). The data provided by the Hungarian Central Statistical Office on trends in sown area supports this assumption (KSH 2015b:1). Despite the market entry of a maize-processing plant, the sown area of maize has not increased. On the contrary, there has been a tangible decrease in the sown area of maize in Hungary. The most recent data shows a perceptible decline in the sown area of maize, with farmers in 2015 only sowing maize on 94.1% of the previous five years' average. This decrease has been even more marked in Hungary's most important maize-growing areas. Compared with the 2011 data, the decrease in some counties was close to 30% (see Figure 122). In Tolna County, where the bioethanol plant operates, the decrease exceeded 15%.

Figure 12: Changes in the Sown Area of Maize at County Level, 2011 - 2015 (%)

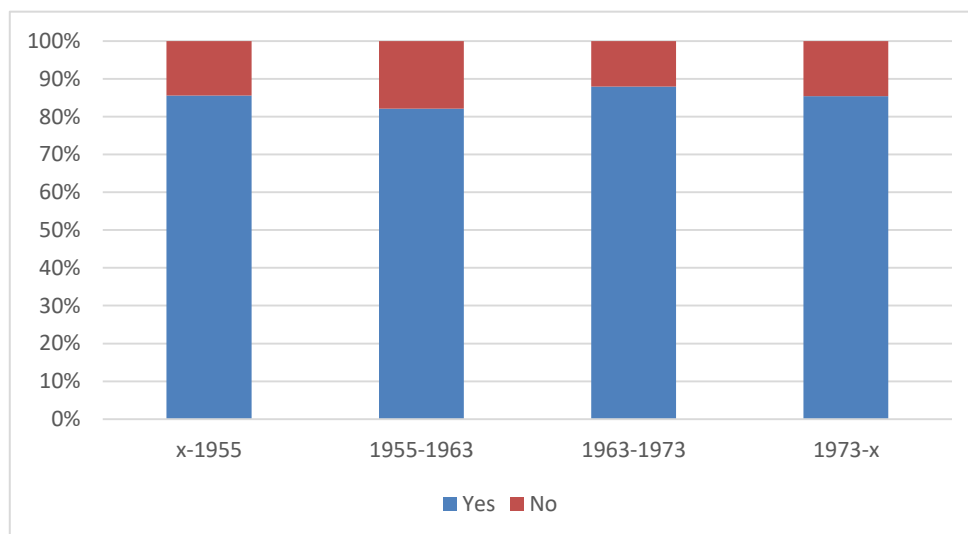


Source: CSO http://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_omn013b.html

The exploratory keynote interviews conducted in the first phase of the research revealed that the **farmers reduced the sown area of maize in response to the increased risk posed by unfavourable weather conditions**. To validate the information gained from the keynote interviews, questions about the reduction were included in the telephone-based survey.

The survey fully supported our assumption based on the keynote interviews. Four-fifths of the farmers (82.9%) regard climate change as the greatest challenge for agriculture. There was almost a general consensus (86.6%) about the conclusion that **maize growing has become increasingly risky over the past decade due to climate change**. It should be noted that almost an identical proportion of respondents from the youngest and oldest age groups (85.4% and 85.5% respectively) said that climate change was the greatest challenge. The proportion of middle-aged (1955 – 1963) respondents who agreed with this was consistently lower (80.9 to 82.1%). The participants in the focus group completely agreed that extreme weather phenomena were more frequent and that maize growing was becoming increasingly risky.

Figure 13: Climate Change Represents the Greatest Challenge for agriculture. Distribution by Age Group (%)



Source: Compiled by the authors on the basis of questionnaire survey data (N=270)

The findings show that the respondents constitute a homogeneous group on the impact of climate change. To lessen the adverse impact of climate change, farmers have adaptation strategies comprising a number of elements. They have the ability to execute a number of interventional methods at the same time. These include new investments and as such are linked to the investment activity presented below.

The farmers' primary response to the increased risk of drought is **growing drought-tolerant maize hybrids**, a strategy adopted by the vast majority (84.8%) of the surveyed farmers irrespective of the size of the land that they cultivate or their educational background. Age group was important in this case as well, as a higher number of older farmers and fewer younger farmers took advantage of this possibility.

To mitigate the damage caused by drought, farmers paid closer attention to **improving the soil's ability to retain water**, adapting their farming methods (86.1%) to these conditions. The research found links between the desire to improve the soil's ability to retain water and the purchasing of tools and equipment (e.g. cultivators). However, it also found that traditional agricultural engineering methods are equally capable of mitigating water loss in soil (fast soil sealing and compaction).

Reflecting the reduction in the sown area of maize referred to above, the majority (51%) of the farmers responded to increasing risks by reducing the sown area of maize. Only 16% said that they improved the irrigation technique they used to mitigate risks. The research found that farmers saw reducing the sown area of maize to be the most feasible adaptation strategy. Adaptation took the form of changes in crop rotation by increasing the sown area of plants other than maize that are typically included in crop rotation (wheat, sunflower) so that no investment costs are incurred.

Table 3: Do You Think You Will Give Up Maize Growing Altogether?
Answers Broken Down by Age

		x-1955	1955-1963	1963-1973	1973-x	N/A	Total
Yes	Persons	17	18	17	18	0	70
	%	20.48	26.87	26.98	33.33	0	26.02
No	Persons	58	46	39	33	1	177
	%	69.88	68.66	61.9	61.11	50	65.8
Did not answer.	Persons	0	0	0	0	1	1
	%	0	0	0	0	50	0.37
Does not know.	Persons	8	3	7	3	0	21
	%	9.64	4.48	11.11	5.56	0	7.81
Total	Persons	83	67	63	54	2	269
	%	100	100	100	100	100	100

Note: Pearson $\chi^2(12) = 139.5398$ $Pr = 0.000$, Cramér's $V = 0.4158$

Source: Compiled by the authors on the basis of questionnaire survey data (N=269)

How permanent the reduction in the sown area of maize will be is a major question for the future. Maize is such a staple plant that its permanent exclusion from crop rotation would be difficult.

Maize is a staple plant in Hungarian arable farming, with the sown area of maize accounting for 28-30% of Hungary's total sown area. Of the surveyed farmers **25% did not rule out giving up maize growing altogether if weather conditions keep deteriorating.**

50% of the respondent farmers identified **lack of capital and the national regulatory environment as the factors that most hinder adaptation to climate change.** Only 20% mentioned lack of information as a factor preventing them from appropriate adaptation. The farmers participating in the focus group added that it would be very important to create the conditions for irrigation, though this would require a major development project and, furthermore, the regulatory environment is surrounded by a high degree of uncertainty. Responding to the danger of drought, the Hungarian government facilitated the use of surface waters for agricultural purposes (Government decree 115/2014. (IV. 3.)) and made the supply of water for irrigation purposes free of charge for users holding the right permissions. However, there is uncertainty about how lasting the provisions of the government decree will prove to be, which may affect the economic rationale for the upgrading of irrigation infrastructures requiring major capital investment. This may, in turn, lead to the abandoning of investments.

2.6.4. Impact on Investments and Cultivation Technologies

One of the most important findings of the economic impact assessment study (Major, 2016) is that the wider the circle in which the macroeconomic and employment-related impacts of the bioethanol plant trigger business partners to invest, the more powerful these impacts are. A key aim of this survey of farmers was to better understand their investment priorities, since intensive investment activity may imply spill-over effects from the bioethanol plant.

Our survey showed that **investment and development activities to improve competitiveness were very common among farmer respondents.** The purchasing of machinery and equipment was most frequently mentioned (87%), followed by improving plant protection practices (83%), changing the method of crop rotation (67%) and creating the conditions for precision farming (i.e. differentiated nutrient management and plant protection) (59%). Creating the conditions for and developing irrigation was the least frequently mentioned (14%), which may seem surprising in light of the droughts of recent years.



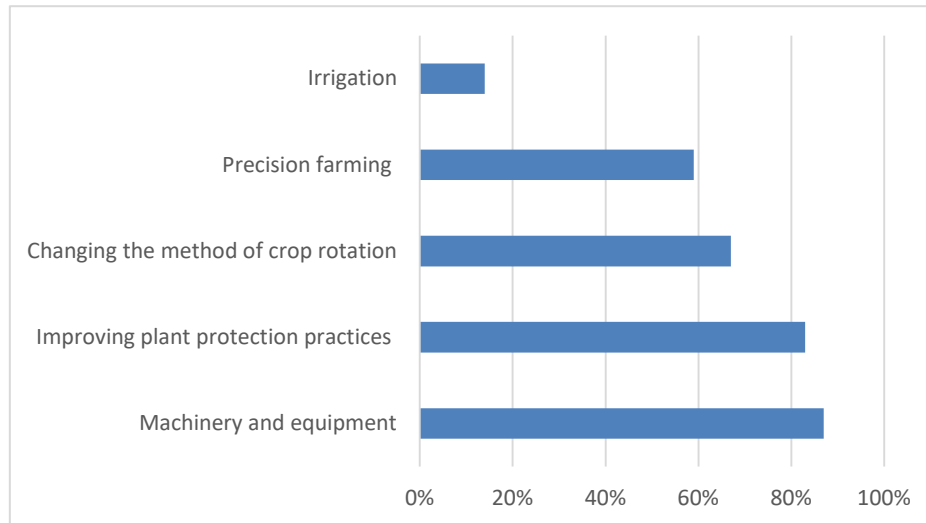
The aforementioned investment and development activities are closely interconnected. Certain categories even overlap with each other. In many cases, they are in a set-subset relationship. Furthermore, the findings reveal the areas in which farmers thought their competitiveness should be improved.

Precision farming has begun to take off in Hungary in recent years. Creating the conditions for differentiated nutrient management is capital intensive, which is also reflected in the responses. 59% of the respondents mentioned this type of development. Those farming large areas mentioned this type of development more frequently (69.1% in the case of those in the upper quartile¹¹) than those farming smaller land areas. Only 53.7% of those in the lower quartile mentioned that they had implemented such development. (It should be noted that the effect of land size did not prove significant). By contrast, both educational background and age were influencing factors. A higher

¹¹ Quartiles calculated on the basis of the 2016 sown area of maize: 0-32, 33-69, 70-222, 223-x hectares

proportion of the older and better-educated farmers said that they had implemented this type of investment. Yet again, those aged under 40 presented a different pattern, a lower proportion (52.7%) having implemented this type of investment than their older peers.

Figure 14: The farm related investments (%)



Source: Compiled by the authors on the basis of questionnaire survey data

Market competition makes investment into technology and machinery necessary. However, the operation of the maize-processing plant lessens the risk inherent in investment. The majority (52.9%) of the respondents agreed that **Pannonia Ethanol's presence and operation contributed to the investments into technology**. In other words, based on our survey, every second investments would have had a lower likelihood of being implemented, if at all. It is an important finding given the weight of the respondents in the total corn market in Hungary. The arable land cultivated by them accounts for 2.1% of Hungary's farming area. Therefore, the finding may have implication well beyond the study area. Investment increases the competitiveness of the local agriculture in the long term.

The research analyzed what group of farmers could benefit from the presence and operation of the bioethanol plant in the form of increased investment leading long term improvements in their competitiveness. Estimating this effect was done by running a Probit regression which showed that the educational qualification of the farmer is the most important factor (see Table 4). Farmers with at least a secondary vocational diploma agreed that the bioethanol plant brought a higher probability of investment and better competitiveness. Higher education was also significant in this comparison but with much smaller coefficient value (0,411 vs. 0863).

The size of the land farmed was not shown to be a significant factor. Respondents farming either large or small land rather agreed with the statement in the questionnaire. Mid-sized farmers rejected the statement which could imply that other factors are at play. This variation may be related to geographical distance from the plant. Small farmer suppliers are mostly located close to the bioethanol plant. Location close to the plant could influence the profitability of these farmers in meeting the plant demand for maize due to lower transport costs. This in turn may assist small farmers in making investment decisions. Profitability of medium – sized farms is less likely to be influenced to the same extent as higher transport costs arising from their less favourable location may offset higher prices. This assumption is confirmed by the covariance of responses given to the following two questions. Those, who agreed with the statement that Pannonia Ethanol's maize

purchases lead to an increase in prices, also agreed with the statement that the operation of the plant contributed to farmers undertaking more development work. At the same time, farmers who did not perceive higher prices, also rejected the investment effect.

Table 4: Probit regression model on the farmers investments

Probit regression	Number of obs	222				
	LR chi2(12)	79.29				
	Prob > chi2	0.0000				
Log likelihood = -113.90958	Pseudo R2	0.2582				
Variable	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Age	-.1499525	.0876893	-1.71	0.087	-.3218203	.0219153
Secondary education	.8635052	.207393	4,16	0.000	.4570225	1.269988
Higher education	.4118477	.2074826	1.98	0.047	.0051893	.8185061
Farm size	-.0000128	.0000277	-0.46	0.645	-.0000671	.0000416
Agree: Higher prices	.4045191	.0971145	4,17	0.000	.2141781	.5948602
Constants	-2.352497	.6043329	-3.89	0.000	-3.536968	-1.168026

During the focus groups in which the results of the survey were discussed, the farmers said that the presence of a stable and reliable buyer in the corn-market was important. As one of the farmers put it: *“Technological development is inevitable, yet it's less challenging to do it if you know that Pannonia is backing you.”* The findings indicate investments and technological developments that improve competitiveness in the long run are feasible at an earlier stage or on a larger scale due to the operation of the bioethanol plant. We conclude that more frequent investments and more intensive upgrades by farmers and other business partners boost job creation and improve competitiveness, contributing to the renaissance of local economy.

2.7. Lifestyle and Culture: Changes in Belonging, Social Cohesion

This chapter analyses what the establishment of Pannonia Ethanol means to Dunaföldvár and its surroundings in terms of local community life, education and culture. Stakeholder perceptions of the company's corporate social responsibility policy are presented. The research examined company practices and the exercise of corporate responsibility with civic leaders, public institutions and associations based in the town, in addition to company employees with knowledge of corporate responsibility.

The findings show clearly that the establishment of Pannonia Ethanol Zrt in 2012 was welcomed. Before the plant was built, the residents of Dunaföldvár had mainly been concerned with job creation, business tax and the environmental impact of the plant's operation. Commencement of the plant's operation did not alter the favourable public perception. Local residents were aware that many from Dunaföldvár work at the plant, but would like to see more employed by the company.

Only a few people had exact knowledge of the amount of local business tax paid by the company to the town, and perceptions in this area were based on supposition. All agreed that it had to be a high amount. Opinions were divided, however, over whether it was spent appropriately.

No complaints have been lodged against the plant relating to its environmental impact. Odour and noise pollution are sometimes a concern for those living in the vicinity of the plant. There is also a belief that large quantities of surface water are used. It is possible that these beliefs arise from uncertainty and lack of knowledge of the facts. Overall the findings suggest that the plant has lived up to residents' prior expectations, though for this to be fully tested it would be necessary to conduct a detailed survey on the population. That falls outside the scope of this study.

The company's corporate responsibility initiatives have contributed to its acceptance by the residents. Direct impact on Dunaföldvár takes two forms. One is the local business tax, which accounts for a large part of local tax revenues and is one of the most important components of the town's budget. The arrival of the company and the reliable flow of tax revenue it provided each year increased the town's capacity to prepare, fund and implement development. Overdue infrastructural investments has been enabled, in particular the renovation of roads. Leaders in the town are conscious of potential vulnerability to the town's budget from over-reliance on a particular source of revenue, as its loss would create difficulties for town management. These findings should be seen as important factors motivating townspeople to take a long term supportive view of the value of the plant's contribution to the town.

The other channel of direct impact is patronage of local government and public institutions. Patronage and sponsorship are examples of corporate social responsibility (CSR). The company's expressly stated CSR objective is to contribute to the development and prosperity of the town that hosts it. In most cases, the company gives financial support directly to individual institutions. In other instances, it relies on local government to manage the support. The beneficiaries have so far included social, educational and cultural institutions.

Financial support for needy families has been provided for items such as meals and toys. Furniture and IT equipment has been purchased for the town's nursery, infant school and grammar school. In addition to the company's financial support, its employees organize Christmas collections of clothes and toys for the town's nursery and infant school. The Town Cultural Centre receives regular support that it uses to finance four major annual events. Townspeople are unaccustomed to such support from business and greatly appreciate it. The employee Christmas collection in particular represents a new form of support for the town. Many attribute the company's support to the employment of mainly Dunaföldvár residents, who are seen as advocating and promoting the interests of the town. In their opinion, the many young employees with families can see better where help is most needed.

We have also observed other important implications of corporate responsibility. The practice has resulted in reciprocal activity by the managers of the beneficiary institutions within the resources available to them. For example, company representatives are invited to events where children perform plays and give small gifts. The relationship between the company and the town has strengthened in more ways than one as the two parties have got to know each other better. In our opinion, this is an important achievement in the light of the vague and sometimes incorrect perceptions residents have about what and how the plant produces.

The research confirms that Pannonia Ethanol has taken an active CSR role in Dunaföldvár from the outset. The company has supported mainly local social, educational and cultural institutions. Moreover, on the employees' initiative, social and giving events are organized around Christmas. In addition to direct job creation and the payment of local taxes, such active participation in the life of the town adds a new element to the favourable public perception of the plant.

3. Conclusions

The research has revealed that the establishment of a medium-sized production company can generate favourable and tangible social impacts in the rural space even in the short term. A key issue in rural development and rural renaissance is whether the out-migration of the local population, especially the economically active population, can be stopped. According to our findings, this is feasible through the establishment and development of businesses that offer stable jobs, attractive working conditions and competitive wages, which can mitigate the selective out-migration of the skilled labour force to cities and, hence, the irreversible erosion of social capital.

The establishment and operation of the Pannonia Ethanol plant has clearly benefited its host town because, thanks to higher revenues from business tax, the town's budget has more room for manoeuvre. Relying on such an increase in revenues, the town of Dunaföldvár has managed to improve the standard of public services and develop its basic transport infrastructure, thus improving the quality of life of its residents.

The direct impact that the company has had on employment is already greater than that estimated in earlier economic models. In light of recent trends in migration in Hungary, the company's employment of close to 160 people has improved the region's ability to retain its labour force, which has, in turn, slowed down out-migration. Furthermore, based on the young average age of the employees, the region's demographic indicators are also likely to improve thanks to an increasing number of young families.

Besides creating jobs, the bioethanol plant has also contributed indirectly to job creation. The underlying reason for this is that the service providers that have partnered with the company typically develop concurrently with it. They have developed their equipment and machinery and increased the number of their employees in order to be able to deliver on time. Such qualitative and quantitative change has enabled these service providers to enter new markets which were previously out of reach.

The operation of the bioethanol plant has also influenced the situation of maize-growing farmers to a significant degree. Based on the data in the interviews with farmers who have a long-term business relationship with the company, the plant in Dunaföldvár has reduced the business risks for farmers. In the farmers' opinion, the predictable demand for maize by the company has played an important role in this, while also exerting a price-stabilizing effect. Another important factor is that, through its business practices, the company has contributed to improved payment discipline in the maize market. The plant's policies favour farmers in its vicinity as the plant also contracts small farms directly for the supply of maize, which, in turn, enables the farmers to realize higher purchase prices than they could if they were to do business with wholesalers. It should be noted that the positive impacts work irrespective of size; it is not only larger farms that benefit from them.

In this respect, the situation of farmers has improved but, at the same time, climate change has made maize production riskier in Hungary in recent years. To manage this risk, farmers have adopted diverse adaptation strategies including reducing the sown area of maize (which is also confirmed by national data), growing drought-tolerant maize hybrids, changing the method of cultivation and improving irrigation. Overall, five years into the operation of the bioethanol plant, there has been no increase in the sown area of maize in the country; on the contrary, there has been a 5% decrease.

Therefore, maize farmers have been subject to conflicting impacts over the past five years: on one hand, the emergence of a buyer supporting predictable demand has compelled them to increase the quantity of maize available for sale; on the other hand, however, increased risks posed by climate change have forced the farmers to adapt. Both effects have had major investment-related implications, which was confirmed by the respondent farmers claiming that they have invested

heavily in recent years. Such investments and upgrades fundamentally improve the competitiveness of farmers and are a natural concomitant of market competition. Nevertheless, it should be noted that over half of the respondent farmers said that the Dunaföldvár bioethanol plant had stimulated the implementation of their investments and upgrades. Being able to rely on predictable demand from the plant, they implemented their investments and upgrades either earlier or on a larger scale than they had planned. More frequent investments and upgrades by farmers and other business partners boost job creation and improve competitiveness.

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