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Obsah

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EVA and its Determinants for Selected Groups of Farms: Conventional and Organic Farming

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Anotace

Příspěvek se zabývá analýzou ekonomické přidané hodnoty a jejích determinant ve skupinách vybraných zemědělských podniků – právnických osob hospodařící konvenčním a ekologickým způsobem. Je řešen vliv vážených průměrných nákladů kapitálu na hodnotu ukazatele EVA a rovněž efektivnost využití investovaného kapitálu, včetně kapitálové struktury, ve vazbě na způsoby hospodaření. Příspěvek si rovněž klade za cíl ověřit hypotézu, zda jsou sledované podniky schopny bez dotační podpory, konkrétně přímých plateb, dosáhnout kladné ekonomické přidané hodnoty a efektivního využívání kapitálu.

Panelová data pro článek byla získána z databáze CreditInfo firemní monitor, poskytovaná společností CreditInfo Česká republika, s.r.o. Konkrétně byla využita data z účetních výkazů za roky 2006 – 2010 u vybraných podniků. Příspěvek je součástí grantového projektu IGA 20121069 „Identifikace hlavních determinant výsledku hospodaření zemědělských podniků právnických osob a určení jejich specifik“.

Klíčová slova

Ekonomická přidaná hodnota, kapitálová struktura, vážené průměrné náklady kapitálu, jednotná platba na plochu, kapitál, konvenční zemědělství, ekologické zemědělství.

Abstract

This paper analyzes the economic value added, as well as its determining factors, for selected groups of agricultural enterprises - legal persons, farming in conventional and organic ways. The impact of the weighted average cost of capital to the value of EVA, as well as the efficient use of invested capital, including capital structure, in relation to farming, are both evaluated. The article also aims to verify the hypothesis that selected farms are able to achieve, without subsidies, particularly direct payments, positive economic value added and an efficient use of capital.

The panel data set we use is drawn from the database of the Creditinfo Company Monitor, collected by Creditinfo Czech Republic, s.r.o. Specifically, we use information from the final accounts of chosen farms in the years 2006 - 2010. This paper is part of the research grant IGA 20121069, „Identification of the major determinants of the farm profits of legal persons and a determination of their specific characteristics”.

Key words

Economic value added, capital structure, weighted average cost of capital, single area payment scheme, capital, conventional farming, organic farming.

Introduction

The current economic model has its roots in theories formulated by Smith as early as the mid-18th century (Dlouhý et al., 1992). People who have power and modern technology, enabling them to process and refine raw materials from natural sources, can produce surplus value and thus achieve higher living standards. Conventional agriculture is defined by a view of nature which conforms to the prevailing European view on the relationship between man and nature, namely, that man is superior to nature, and there is a clear boundary between man and nature. By contrast, alternative agricultural practices, which include organic farming, are dominated by the belief that natural laws governing organic production take precedence over economic goals. Organic farming favours agricultural systems that preserve natural resources.

The financial viability of organic farming has been

debated since its origins. Despite this uncertainty, there has been a steady, worldwide expansion of organic industries in recent years. Annual growth in the U.S. has exceeded 20 percent since 1992, while the European Union has seen a 25 percent increase each year (Lotter, 2003).

Many studies have compared the financial performance of conventional and organic farming systems in relation to income, prices, and costs. Other influential factors include the relative performance of one production area, farm size, and the understanding and application of economic principles. A summary is given in the following Table 1.

In conclusion, many studies have shown that organic farming can be a financially viable alternative to conventional farming practices for a range of circumstances and farming sectors.

Economic Value Added, being one of the most important indicators of business performance, should be regularly monitored and evaluated. In particular, this indicator plays an important role when comparing conventional and organic farming.

Economic Value Added (EVA) is used in the practice of economics for a wide range of activities. These activities include its use in managing and evaluating effectiveness and business performance, as well as its use for business valuation. The concept of EVA is not so new as it might seem. Its origin can basically be dated, in connection with the concepts of economic profit and economic value added, to the methodology of the 1950s, and even earlier.

The official creation and comprehensive management of the EVA concept can be attributed to the EVA consulting firm Stern Stewart & Company in the U.S., where EVA was constructed in the 1990s and subsequently registered under a trademark.

EVA is currently used for various purposes, one of which allows for its use as a tool of financial analysis, replacing the previously used indicators while overcoming their shortcomings, namely their inability to take into account the time value of money and the risk of investors, or affect the amount of gain. In financial analysis, such indicators mainly include various indicators of profitability.

In the Czech Republic, EVA is also used for a comparison of local companies carried out by the Czech Capital Information Agency (ČEKIA), a member of Bisnode.

Data and Methodology

This article aims to analyze EVA and its determinants for two groups of farms - legal persons, farming in organic and conventional ways. At the same time, it seeks to verify the following hypotheses:

Organic farming enterprises achieve better EVA values, and their capital structure is more efficient.

Organic farming enterprises are unable to reach positive EVA, even without the receipt of SAPS.

To meet this goal, or verify the defined hypotheses, as the case may be, EVA was used, and constructed using EBIT (Earnings Before Interest and Taxes) and WACC (Weighted Average Cost of Capital). Because legal persons were being evaluated, EBIT was subsequently adjusted each year by the corresponding rate of income tax. To determine the impact of direct payments on the amount of EVA, it was calculated by both - including and excluding direct payments, in EBIT and WACC. A generally known method, based on a definition of WACC using cost of equity and loan capital, was used in the article to calculate WACC.

The first evaluated group was represented by 10 farms (legal persons, organic farming) with the largest area of land (in 2010), and for which it was possible to obtain necessary data for the period 2006 - 2010. Specifically, these were companies with a land area of between 1,000 – 2,500 ha. The average size of organic farms decreased over the last three years by almost half (from 237 ha in 2007 to 127 ha in 2010). Most organic farms are represented by categories of businesses with an area of 10-50 hectares (35.4%). The number of organic farms with an area over 1,000 ha stagnated, while in the last two years, the number of farms over 2,000 ha fell by half (from 11 farms to 5). Organic farming enterprises were selected from the database of the Ministry of Agriculture, which provides a summary of the organic farmers in the country. Given the small sample of organic farmers in the FADN database and the five-year analysis period, the data were drawn from the CreditInfo Company Monitor database, which provides more current data.

The second group is represented by 10 enterprises - legal persons, farming conventionally. These companies were chosen in a similar land area to that of organic farms, so that the results would be comparable. For these farms, it was also possible to obtain financial statements for the period 2006 - 2010.

Factor	Author	Key fidings
yield	Morris (2001)	on average, the yields of organic crops have been reported as lower than conventional yields
	Mäder (2002)	results from a 21-year study of farming sectors in Central Europe found crop yields to be 20 per cent lower in organic systems
	Offerman a Nieberg (2000)	in a review of the relative yield performance of farming systems in 18 European countries,) showed that, despite the overall lower yields of organic farms, some individual crops had yields as high as or higher than nearby conventional reference yields
		organic livestock production levels per hectare are also generally lower than those of conventional farming systems although differences in per head production are minor
price	Offerman a Nieberg (2000)	reviewing prices in 18 European countries, found substantial variation amongst countries. They concluded that it is difficult to calculate an average organic farmgate price, even within a country, because there are a large number of sales channels for organic products (amongst which prices vary considerably) to which producers have unequal access.
		In most European countries the farmgate price for organically produced wheat has typically been 50 to 200 per cent higher than for conventionally produced crops, premiums for organic milk in Europe ranged from eight to 36 per cent, and prices for organic beef were in most cases on average 20 to 30 per cent higher than the conventional prices.
	Christensen a Saunders (2003)	found that retail prices for organic milk were 51 per cent higher than conventional milk prices in Nwe Zelend
cost	Morris (2001)	total costs for operating most organic farming systems are lower than those for comparable conventional farms, and there are differences in the relative importance of individual cost elements. The restrictions on the use of fertilisers, pesticides and feed concentrates on organic farms result in reductions in these costs of production
	Mäder (2002)	inputs of fertilizer and energy were 34 to 53 per cent lower and pesticide inputs 97 per cent lower on organic than conventional farms in 21 European countries
	Offerman a Nieberg (2000)	organically produced inputs, such as feedstuffs and seeds, often incur higher prices, reducing these benefits and, as inputs such as herbicides are replaced by labour in organic systems, wages and salaries are often higher under organic systems. Registration and certification fees are an additional fixed cost in organic farming.
profitability	Offerman a Nieberg (2003)	CAP measures such as compensatory payments, which are linked to production area rather than the amount of production, effectively reduce the difference between conventional and organic farm revenues. Profitability per hectare was generally lower on organic farms, although profits per family work unit were generally equal to or higher than those of comparable conventional farms.
	Tzouvelekas (2001)	organic profitability often depends on the application of knowledge of organic farming principles and techniques that optimise input–output ratios in production
	Lansik, Pietola a Backman (2001)	believe that organic farms are on average more efficient relative to their own technology, but use less productive technology than conventional farms

Source: Our own processing

Table 1: Studies comparing conventional and organic farming from different perspectives.

The panel data set used is drawn from the database of the Creditinfo Company Monitor, collected by Creditinfo Czech Republic, s.r.o., for selected enterprises. Specifically, the data used is from financial statements for the years 2006 - 2010 from selected enterprises, well as publicly available data from a database maintained by the State Agricultural Intervention Fund (SAIF), containing information about direct payments provided.

The area of individual companies was determined using a publicly available database maintained by the SAIF, which contains information about provided single area payments in agricultural subjects. On the basis of the ratio obtained of the SAPS subsidy per unit rate in a given year, an area of individual farms was defined. Selected farms were further tested and evaluated in terms of EVA as well as aspects that affect its size.

1. Economic Value Added

The economic value added (EVA) indicator and the basic idea that goes with it is not new. Alfred Marshall, the well-known Cambridge economist, talked about the idea of economic profit as early as the 1890s. This concept assumes that a firm is able to make a profit only if its income is large enough to cover its operating costs and capital costs (Young, 1997). In the twentieth century, this idea was then implemented under many names, including residual income[1] (Biddle, Bowen & Wallace, 1997). The concept of residual income is also based on economic value added.

Economic value added, as we now know it, originated in the USA, where it was developed in the 1990s by Stern Stewart & Company as a technique for measuring the value of a company and as a management tool (Deyá & Brusco, 2003). Basically, it is a very specific formulation of residual income, which has been used in the past (Lovato & Costigan, 2003). The basic concept of this indicator is based on the principle of economic income[2], which is achieved only if companies recover not only current costs but also capital costs. The EVA indicator is currently being examined by authors, among whom there are both supporters and opponents.

It is therefore evident that the cost of capital is one of the main determinants of this indicator (Sharma & Kumar, 2010), and that it greatly affects not only its value, but also the effectiveness of financial resources in the enterprise. A prerequisite for achieving positive EVA is **effective capital spending**, i.e., with minimal cost. The agricultural sector, however, has a specific cost of capital which has not yet been resolved (particularly in terms of defining the cost of capital which was obtained in the form of non-investment grants). In the literature there are many approaches for the expression of EVA, and most of them have assumed a conversion in the view of the undertaking from the accounting approach to the economic reality approach (Pavelkova & Knapkova, 2005). EVA is then typically expressed using the following method of calculation (Kumar & Sharma, 2010):

$$EVA = NOPAT - (TCE \times WACC) \quad (1)$$

Where:

NOPAT = Net Operating Profit After Tax,

TCE = Total Capital Employed,

WACC = Weighted Average Cost of Capital.

This calculation method is based on net operating profit, known as NOPAT, which is reduced by the cost of the total invested capital. From the above it is clear that increasing the cost of capital results in a reduction of EVA, with the value of NOPAT unchanged.

For the purposes of this paper, and due to data availability, a different approach to calculating EVA was used. It is an approach that respects the "international" use of this indicator, based on EBIT (Earnings Before Interest and Tax). According to this principle, EVA is defined as follows (Petrik, 2009):

$$EVA = EBIT * (1 - SdpPO) - TCE * WACC \quad (2)$$

Where:

WACC = Weighted Average Cost of Capital,

EBIT = Earnings Before Interest and Tax,

SdpPO = Tax rate on a legal person's income,

TCE = Total Capital Employed.

1.1 Cost of Capital

In general, the cost of capital represents a very important indicator for the assessment of capital structure, or of effectiveness in the use of various sources of funding. It combines different sources of

[1] Residual income is generally defined as after-tax operating profits less a charge for invested capital.

[2] Economic profit is seen by many authors in different ways. For the purposes of this paper and for further calculation of EVA, economic profit is expressed as the value EBIT * (1-t).

financing used in the enterprise. Proper adjustment of the capital structure is thus not a simple matter for the company, and in relation to the cost of capital, it is clear that decisions concerning the various sources of corporate finance, in particular, must be the deliberate, strategic decisions of management. The estimated cost of capital has been explored by a number of scientists (Pederson, 1993; Miller, 2009; Aleknevičienė & Jaktünaité, 2007; Babusiaux & Pierre, 2009; Da, Guo & Jagannathan, 2011), who dealt with their definition as well as different approaches and methods for their calculation. The weighted average cost of capital is one way of calculating the cost of capital, and for the EVA calculation it represents a key determinant in the outcome of EVA. The most common method used in practice to calculate the cost of capital is the WACC method. The basic idea of this indicator is based on the weighted average of the already-taxed cost components of equity and debt, where the weights are represented by the ratio of equity and debt to the total capital structure of the enterprise (Pederson, 1998). The formula used for the calculation of WACC is then defined as follows (Miller, 2009):

$$WACC = w_d r_d (1-t) + w_e r_e \quad (3)$$

Where:

WACC = Weighted Average Cost of Capital

wd = weight of debt = (value of debt/value of debt + value of equity)

we = weight of equity = (value of equity/value of debt + value of equity)[3]

t = tax rate on corporate income

re = weights, based on market values, frequently calculated as the risk-free rate plus a risk premium, based on the capital asset pricing model

rd = weights, based on the market, reflects the market rates on a firm's outstanding debt and on the rd of similar firms.

(1−t) = the standard treatment included in the WACC calculation to reflect the deductibility of interest payments. It is necessary to avoid double counting the tax "advantage" of debt.

2. Cost of Equity

Determining the cost of equity, when costs are largely determined by business risk, is one of the most problematic parts of the WACC indicator. For the purposes of this paper, we have used a sophisticated method of determining the average cost, the so-called CAPM. According to the CAPM, the cost of equity is defined as follows:

$$r_e = r_f + \beta \cdot (r_m - r_f) \quad (4)$$

Where:

r_f = risk-free rate – respectively, the appropriate rate of return on government bonds, treasury bills. The value of the risk-free rate of return was derived based on the value of the ten-year government bond yield in the years 2006 - 2010, using a database of the Czech National Bank - an ARAD time series database **(http://www.cnb.cz/docs/ARADY/HTML/index.htm).**

β = coefficient representing the degree of market risk through the balance and sensitivity to changes in a stock market portfolio. For the agricultural sector, this factor has been based on data available on the website Aswath Damoradan (**www.damoradan.com**), section „Updated data", Farms/Agriculture in Europe

$r_m - r_f$ = risk market premium – this value was also estimated on the basis of the above procedure for beta

3. Cost of Debt

The cost of debt (rd) is another important component of the WACC. Quantifying it is not as difficult as for the cost of equity, and it is possible to proceed in two ways. The first method is based on defining the cost of debt as the cost of the corresponding average interest rate (without a distinction between long-term and short-term loans) of non-financial enterprises, with the use of information from the Czech National Bank - time series database ARAD (http://www.cnb.cz/docs/ARADY/HTML/index.htm).

Both methods of calculating the cost of debt are considered to be costs that the company is obliged to pay to creditors, thereby reducing the business tax base. Therefore, the cost is adjusted in the calculation of WACC as follows:

The second method, used for the purposes of this paper, defines the cost of debt as a cost corresponding to the average interest rate, determined on the basis of the size and price of loans up to the present (Kislingerová, 2007). On

[3] The sum of the ratio of debt to the total and the ratio of equity to the total is equal to 1 (wd + we = 1)

the basis of the data obtained, it was not possible to determine the volume of short- and long-term loans, and therefore these are calculated together as one item, bank loans:

$$i(r_d) = \frac{Interest\ Expense}{Bank\ Loans} \quad (5)$$

According to this method, cost of debt is considered to be a cost that the company is obliged to pay to creditors, thereby reducing the business tax base. Therefore, the cost is adjusted in the calculation of WACC as follows:

$$N_{CK} = i(r_d) * (1 - d) \quad (6)$$

Where:

NCK = Cost of Debt %

i (rd) = Loans Interest %

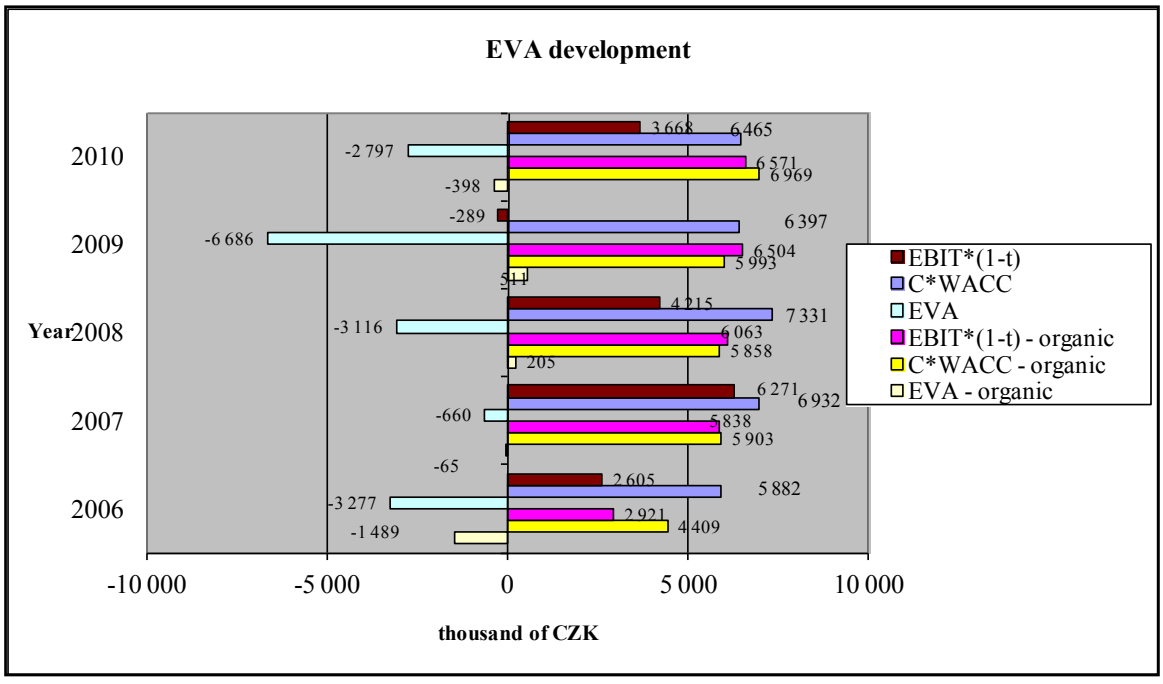
d = Tax rate on corporate income

4. Direct payments

The capital structure of individual companies, across sectors of the economy, has its own specifics with regard to the proportion of equity and debt. Subsidies, as an external source of financing, may be present in all sectors. Agriculture is unique in this respect, and subsidies are a very important source of its corporate financing, whether by SAPS (Single Area Payment Scheme), the national additional payments TOP – UP, or grants related to capital business activity. SAPS can be considered an entirely specific source of funding; when this type of subsidy is provided, it is tied to the land area in hectares and to the farm used for farming, and is registered in the database of LPIS (Land Parcel Information System). No consideration in the form of interest is required for this source of funding. In terms of business economics, SAPS is reflected in operating income and affects the company‘s operating profit, and consequently its equity. Thanks to subsidies, there is some distortion of business profit from this point of view. Based on the reason given above, all calculations for the purposes of this article have been made in two versions, namely with and without SAPS, which represents the largest share of the grants obtained. Related items from the financial statements (operating income, operating profit, and equity), which enter the values of EVA and WACC, were reduced by SAPS.

Results and Discussion

Both groups of farms / legal persons were monitored for the years 2006 - 2010. Based on the financial statements, individual components of economic value added were evaluated according to the formula (2), both including and excluding direct payments which companies have pursued. The first group



Source: Financial statements from the selected enterprises, and our own calculations

Graph 1: Development of EVA and its components (in thousands of CZK, 2006 - 2010) for the selected groups of enterprises.

WACC (in %)	Year				
	2006	2007	2008	2009	2010
Conventional farming	6.06	6.96	7.28	6.54	6.70
Organic farming	5.42	6.38	6.41	7.09	8.47

Source: Our own calculations

Table 2: Development indicators of WACC (in %, 2006 - 2010) for the selected groups of enterprises.

Indicator in thousand of CZK	Year				
	2006	2007	2008	2009	2010
Equity	45 500	53 561	58 914	60 512	63 250
Debt	44 012	44 322	41 098	33 648	37 317
Total Capital	89 512	97 883	100 011	94 160	100 567
Bank loans	10 023	10 707	10 675	7 618	12 923
Interests	227	388	355	362	364
Equity/Total Capital	0.39	0.46	0.53	0.59	0.64
Debt/Total Capital	0.61	0.54	0.47	0.41	0.36
EBIT	3 843	7 682	7 675	8 131	8 112

Source: : Financial statements from the selected enterprises, and our own calculations

Table 3: Development of selected indicators (in thousands of CZK, 2006 - 2010) for organic farming.

consisted of conventional farming enterprises, and the second was a group of organic farmers. For a better interpretation of the subsequent results, the data from both sets of holdings were averaged.

Based on Graph 1 above, it is clear that the average EVA, calculated by formula (2) and using formulas (3, 4, 5, 6), for the reference period ranging from -1,489,000 to 511,000 CZK, is **demonstrably better** for the group of organic farmers. In this group, the group of organic farmers, the indicators show a growing trend by 2009, then a decrease in 2010, and even a regression to negative values that were seen in 2006. In terms of development over time, it can be stated that the lowest value of EVA was achieved in 2006 and the highest in 2009. The gradual improvement in the value of EVA over time was mainly due to improved business performance, which was reflected in EBIT * (1-t)[4], the overall development of invested capital, and of course the development of the individual determinants of WACC.

Regarding the development of **WACC for organic farmers**, it can be stated that in the first three years reviewed, that group treated capital more efficiently and **achieved better capital costs** than the group of conventional farmers (see Table 1). We can then see the reverse development in 2009 and 2010, when financial resources were spent effectively by the group of conventional farmers. In terms of development over time, the lowest WACC was achieved in 2006 and the highest in 2010. The overall trend of the WACC indicator was **clearly increasing**, i.e., the efficiency with which various funding sources were spent declined. WACC growth was affected mainly by the cost of debt development and related developments in corporate tax, and also by the relative proportion of equity and debt - over time the proportion of equity to total capital increased, i.e., a decrease in „cheaper“ debt capital and growth in „more expensive“ equity.

The group of conventional farmers doesn't achieve positive EVA values (see Graph 1) for even one evaluated year, and it is thus possible to conclude that the performance of this group of companies **does not limit opportunity costs**, represented by WACC. This also reflects the inefficient use of financial resources or invested capital within firms. This is clearly evident from Graph 1, where EBIT and C * WACC are growing apart from each other; in 2009, EBIT *(1-t) is even negative. During the evaluated period, EVA for the group of conventional farmers is very unstable. The lowest value of EVA was achieved in 2009 and the highest in 2007. The development of these values was especially influenced by the high annual increase in capital invested in the evaluated enterprises (especially

[4] The value of EBIT * (1-t) was affected by a change in corporate income tax. In the evaluated years 2006 - 2010, corporate income tax decreased from an original 24% to 19%.

Indicator in thousand of CZK	Year				
	2006	2007	2008	2009	2010
Equity	51 213	57 536	60 398	58 212	59 716
Debt	34 244	32 025	39 197	37 238	33 807
Total Capital	85 457	89 561	99 596	95 450	93 524
Bank loans	7 939	8 301	12 764	12 206	10 495
Interests	549	734	963	820	707
Equity/Total Capital	0.52	0.56	0.54	0.56	0.55
Debt/Total Capital	0.48	0.43	0.45	0.44	0.45
EBIT	3 428	8 252	5 335	-362	4 528

Source: Financial statements from the selected enterprises, and our own calculations

Table 4: Development of selected indicators (in thousands of CZK, 2006 - 2010), conventional farming.

between the years 2006 to 2008, see Table 3) and by the development of WACC, or the capital structure of the enterprises..

In terms of development over time, it can be stated that the lowest WACC value was achieved in 2010 and the highest in 2008. The development of these values was affected mainly by the development of the **costs of debt, which were more than twice as high in comparison with the group of organic farmers**, and also the relative proportion of equity and debt, where over time there was a decline in the share of equity to total capital, i.e., an increase in debt.

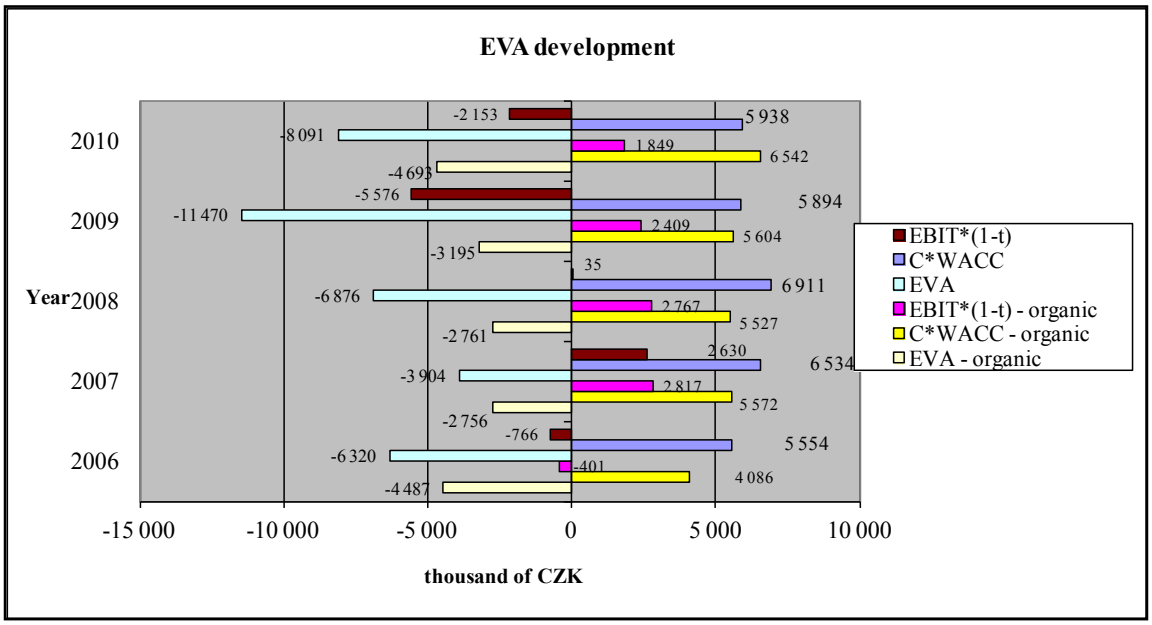
The development of economic value added is also connected with the development of the macro-environment. One should remember that when evaluating this indicator, the tendency of the rate of development, rather than absolute levels, is needed (Kislingerová, 2007). Apart from the last evaluated year, the developmental tendency of EVA for the group of organic farms can be characterized as improving. An opposite trend was observed for the group of conventional farmers; the EVA trends for this group were considerably more unstable and deteriorating, mainly due to the conflicting development of EBIT and total invested capital, and the inefficiency of capital utilization is obvious.

The above discussion should confirm the hypothesis that organic farming enterprises achieved better values of EVA in all the evaluated years. But the hypothesis that organic farmers use capital resources more efficiently, and thus with a lower cost, was not fully confirmed. This fact was only confirmed for the years 2006 - 2008, but over the next two years a more efficient equity portfolio was observed for the enterprises farming conventionally.

With regard to the calculation of economic value added without subsidies - which represent in the agricultural sector a very significant source of funding, affecting operating income and thus the company‘s own capital - it was clearly demonstrated that for both groups of evaluated companies there was a clear deterioration in EVA (see Graph 2). After the reduction of subsidies, positive results were seen in less than one year. This fact is the result of negative EBIT, which is insufficient to cover the cost of capital.

The results of the WACC indicators, excluding SAPS, caused a change in capital structure, namely a decrease in equity. This change resulted in reduced WACC values for both evaluated groups (except in 2010 for the group of organic farmers - see Table 5). This „increase“ in efficiency in the use of capital resources was not enough to cover the loss in operating profit, which occurred just after the reduction in SAPS.

Regarding the impact of direct payments on individual types of capital, it can be stated that direct payments only affect the amount of equity because they enter into the enterprise as another source of their own financing (equity). They have a irreplaceable role in the farm economy, and without their help none of the evaluated groups of enterprises would have a positive EVA value. In addition, their impact on the company‘s capital structure affects the use of their own as well as external funds - for most of the evaluated enterprises it was shown that the values of WACC improved after excluding SAPS, demonstrating a more efficient use of capital.



Source: Financial statements from the selected enterprises, and our own calculations

Graph 2: Development of EVA and its components, without SAPS (in thousands of CZK, 2006 - 2010), for the selected groups of enterprises.

WACC without SAPS (in %)	Year				
	2006	2007	2008	2009	2010
Conventional farming	5.22	5.86	6.46	5.75	5.95
Organic farming	5.20	6.24	6.40	7.04	8.61

Source: Our own calculations

Table 5: Developmental indicators of WACC, without SAPS (in %, 2006 - 2010), for the selected groups of enterprises.

Conclusions

In terms of calculations and comparisons, the following conclusions can be made:

Based on the results, it can be stated that organic farmers achieved much better values of EVA. This is due mainly to improved business performance, characterized by a steady annual increase in EBIT in the evaluated years, 2006 - 2010. It is also attributable to the development of the individual determinants of WACC, namely the development of the costs of debt, which were significantly lower for the group of organic farmers than the group of conventional farmers. In terms of economic value added, there should be a greater possibility of achieving a better EVA value for organic farms. Organic farms generally have a higher ratio of subsidies to sales than conventional businesses.

With regard to capital structure - during the evaluated period the group of organic farmers saw an increase in their proportion of equity to total capital, i.e., a decrease in „cheaper“ debt capital and a growth in „more expensive“ equity.

The hypothesis that legal persons in organic farming have a more efficient capital structure was not confirmed. This group had a more efficient capital structure during the evaluated period of 2006 - 2010 and a lower value of WACC, recognized only in the years 2006 - 2008. In the subsequent evaluated years, WACC values for the group of organic farmers were higher than for the group of conventional farmers. The cost of debt, as one of the components of WACC, was calculated in this case as the average interest rate achieved by the company. The WACC result was largely influenced by making no distinction between the cost of interest on long- and short-term bank loans.

On the contrary, there was a clear confirmation of the hypothesis that direct payments, as an option for farm subsidies, affect the economy and business through their records as operating revenues reflected in equity, operating profit, and consequently EVA. Without direct payments, it is not possible for either group of evaluated companies to achieve a positive EBIT, and thus a positive EVA . Subsidies for farms are an important source of income.

The use of direct payments to finance the operation of farms, being a component of operating income, is reflected in the value of operating profit and „distorts“ the actual business performance achieved. It then becomes a part of the company‘s capital, which affects the structure of financing and of course the cost of capital. This is a specific characteristic of the agricultural sector, the only one which has SAPS, since „without consideration“ sources of funding are not taken into account in calculating WACC. To complete the WACC calculation, SAPS items should therefore be either completely removed from the sources of funding, or incorporated into a cost of equity folder with a separately assigned weight.

EVA and WACC are very valuable indicators of business economics and should be regularly used and evaluated in current economic practice, not only for managers but also for business comparisons.

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Gender Issues on Poverty Alleviation Programmes in Nigeria; the Case of the National Fadama 1 Development Project in Abia State, Nigeria

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Abstract

This study determined the gender issues on poverty alleviation programmes; the case of the National Fadama 1 Development Programme in Abia State, Nigeria. Multi-stage random sampling technique was used in the selection of the local government areas, communities and sample size of 150 respondents (75 men and 75 females). The instrument for data collection was via well structured and protested questionnaires. The result of the poverty profiles indicated that the poverty incidence of the male and female fadama1 farmers was 0.67 and 0.56 respectively. The result on the poverty gap (measures income shortfall) showed that the men required 46.0 percent and the women 48.0 percent of the poverty line to get out of poverty. The result also posted the Gini-coefficient (measures the extent of inequalities in income distribution) of the male and female fadama farmers to be 0.233 and 0.347 respectively. The result of the paired t-test revealed that the farm size and annual fadama farm income were statistically significant at 99.0% and 95.0%. Confidence level respectively. Policy aimed at annulling the land tenure system and replacing it with a gender sensitive system that will redistributive the fadama land equitably. The land tenure system which causes fragmentation of land should be abolished and a policy aimed at redistributing fadama land equitably put in place.

Key words

Gender, poverty alleviation, poverty incidence, National Fadama.

Introduction

Low production and productivity have continued to characterize Nigeria's agricultural sector thereby limiting the ability of the sector to perform its traditional role in economic development. In order to break this cycle and improve the performance of the agricultural sector, the Nigerian government, over the years introduced and implemented several policies and programmes at recuperating the sector (Ajibefun and Aderinola, 2004). A more recent effort towards production and enhancement of farmers' welfare is the introduction and implementation of the National Fadama 1 Development Project funded by the World Bank between 1993 and 1999 which built in the success of pump and wash bore based farming which the Agricultural Development Projects (ADPS) supervised (Blench and Ingawa, 2004)

Fadama – the Hausa name for irrigable land: are flood plains and low- lying areas underlined by shallow aquifers and found along Nigeria's rivers systems. (Qureshi, 1989; Ingawa et al, 2004; Nwachukwu 2006, and Ezeh, 2009). The National Fadama 1 Development Project (NFDP) was established to ensure all year round growing of crops in all the States of the federation through the exploitation of shallow acquifers and surface water potentials in each State using tube well, wash bore and petrol-driven pumps technology (World Bank, 1992; BSADP 1994).

Evidence had shown that men and women were involved in the National Fadama 1 Development Project (Ezeh, 2004). Women constitute not only the major agricultural labour force but they are often also the farm decision makers, FAO (2004) recognized that the empowerment of the women is key to raising levels of malnutrition, improving the production and distribution of food and agricultural products. Indeed, a gender equitable mode of irrigation farming is likely to be more productive than male dominated fadama farming. This is because small farm enterprises characterized by gender role flexibility were found to have much better survival chances than similar farm enterprises lacking such gender role flexibility (Safilious-Rothschild, 2003). Evidently, such agricultural growth will not only

contribute to gender equity but also to long term poverty reduction.

Meanwhile agricultural production in Nigeria has always been seen as dominated by men. This assumption helps in perpetuation of the vicious cycle of poverty and undermines the women's involvement in agricultural production.

Nwaru (2003) is of the view that gender specific nature of farming seems to be disappearing fast, changing the role of women in farming and that women are increasingly taking over tasks and enterprises which belong to men traditionally. Boserup (1987) opined that nearly all tasks connected with food production or the so called agro-industry are performed by rural women, with the exception of tree cutting and other heavy land preparation which are performed by men. Unfortunately, Durno and Stuart (2005) noted that these women are not recognized as farmers and are not critically involved in the process of farm problem analysis, planning and decision and not provided with the training, credit and support they needed.

They equally noted that development opportunities are usually offered to those who are better educated. These people are usually men. Many extension programmes are focused on the family head that is usually the husbands. The presumption is that women are less economically efficient than men.

It is therefore the central motive of this study to:

i. determine the poverty incidence and poverty gap of the rural men and women involved in the programme in the state.
ii. determine the degree of inequalities in income distribution among the rural men and women participants.
iii. determine and compare the impact of fadama 1 technological packages on rural men and women farmers incomes farm size, labour use and farm output in the state.
iv. make appropriate policy recommendation based on research findings.

In line with a research objective, the understated null hypothesis was tested.

HO: There are no significant differences in farm income, farm size, use of labour and output between the men and women fadama participants in the state.

Material and methods

The study was carried out in Abia State. The state was chosen because of its involvement in the National Fadama 1 Development Project. Abia State was created out of Imo State on August 27, 1991. It has a land mass of 700 square km with 17 local government areas. The state lies between longitudes 7^{o} 23^{1} and 8^{0} 02^{1} East of Greenwich meridian and latitudes 5^{o} 49^{1} and 6^{o} 12^{1} North of the equator. Abia State is bounded on the east by the Cross River and Akwa Ibom Sates, on the north by Ebonyi and Enugu States, on the West by Imo State and on the South by Rivers State. Abia consists of three agricultural zones, namely; Aba, Umuahia and Ohafia. The population of Abia State is 2, 833, 999 with 1, 434, 193 males and 1, 399, 806 females.

Multi-stage random sampling technique was used in selecting the local government areas (LGA), autonomous communities and respondents. The three agricultural zones (Aba, Ohafia and Umuahia) were involved in the study. In stage one, one local government area was selected at random from each agricultural zone. The selected L.G.As include Umuneochi in Ohafia zone, Umuahia South in Umuahia zone and Ugwunagbo in Aba zone. In stage two, one Autonomous Community was randomly selected from each of the local government areas. Stage two involved the random selection of 25 males and 25 females fadama 1 participant in each community bringing the sample size to 150. Instrument of date collection was a well structured and pre-tested set of questionnaire.

Per-capital poverty indicators were used to draw conclusion on objective (i) while objective (ii) was analyzed with the use of Gini-coefficient. objective (iii) was realized by the use of paired "t" test.

The following specifications were used to determine poverty level according to Ezeh (2007).

$$H = q/n \quad (1)$$

Where: q = numbers of male and female fadama 1 farmers living below the poverty line.

n = the total number of fadama 1 farmers

H = the head count ratio

$$I = \{(Z-Y)/Z\} \quad (2)$$

Where I = the poverty gap

Z = the poverty line using the mean household expenditure.

Y = the average income of the male and female

fadama farmers.

$G1 = 1 - \sum^{n} (XK - XK\text{-}I)(YK + YK\text{-}I)$ (3)

$k = 1$

Where: G1 = Gini coefficient

Xk = the cumulated proportion of the population variables for K = O,……n with $X_o = O$; $X_n = 1$

YK = The ncummulated proportion of the income variables, for k = .n with Yo = o, Yn = 1

Paired t-test was used according to Koutsoyiannis (1977) thus:

$$T = \frac{\overline{x_1} - \overline{x_2}}{\frac{s_1}{\sqrt{n_1}} + \frac{s_2}{\sqrt{n_2}}} \quad (4)$$

With $n_1 + n_2 - 2$ degree of freedom

Where t = "t" statistic

$\overline{X}_1$ = mean values of crop output, farm size, from income, and use of labour of male fadama participants.

$\overline{X}_2$ = mean values of crop output, farm size, farm income, and use of labour of female fadama participants.

S^2_1 = variance of the male variables

S^2_2 = variance of the female variables

n_1 = number of observation (sample size of males)

n_2 = number of observation (sample size of females)

Results and discussion

The poverty profiles of the male and female fadama 1 farmers in Abia State, Nigeria is shown in Table 1. The result showed that the incidence of poverty also known as the head count ratio for the male and female fadama 1 farmers was 0.67 and 0.56 Respectively. This implies that 67.0 percent and 56.0 percent of the male and female fadama 1 farmers respectively in the study area were poor. This is because their incomes fell short of the mean household expenditure used as the poverty line (N61, 070.00 for the males and N52, 387.00 for the females). This result corroborates with Ayobatele and Amudipe (1999) which found out that 76.4 percent of working women in Ondo State, Nigeria were poor.

The poverty gap also known as the income shortfall is also shown in Table 1.This allows for the assessment of the depth of poverty among the male and female fadama 1 participant in the study area (Ezeh, 2007; Ehiemere, 2008). The result of the study showed that the poverty gap index for the male and female fadama 1 farmers were 0.46 and 0.48 respectively. This showed that the women were at hard hit and at the highest realm of the poverty ladder and required deliberate economic measures to emancipate them from poverty. This means that the males required at least 46.0 percent and the females at least 48.0% of the poverty line to get out of poverty. This result is synonymous with Nwankwo (2004) and Ezeh (2007) who obtained similar results. This showed that the women Fadama I farmers were hard hit at the highest realm of the poverty ladder and required deliberate economic measure to emancipate them from poverty.

The result of the Gini co-efficient signaling the inequality of incomes between the male and female fadama 1farmers is also shown in Table 1. This result showed that the Gini coefficient for the male fadama 1 farmers was 0.233 while that of their female counterparts was 0.347. This means that the degree of inequality in income was 23.3 percent and 34.7 percent for the male and female fadama 1 farmers respectively. This is an indication that the females were in a higher poverty level having reduced income level than their male counterparts. This result is consistent with Ezeh (2007) who had

Poverty Indicators	Male Fadama J Participants	Female Fadama Participants
Poverty Incidence (Head Count Ratio)	0.67	0.56
Poverty gap Depth of Poverty)	0.46	0.48
Gini Coefficient	0.233	0.347

Source: Calculations from field Survey Data, 2008

Table 1 The poverty profiles of Male and Female Fadama I Farmers in Abia State, Nigeria.

Variable		Individual Mean	Mean Difference	Standard Error	Value
Fadama farm output (kg)	Males	374.09			
	Females	335.16	39.93	31.78	1.23
Fadama Farm Size (ha)	Males	3.25			
	Females	2.69	0.56	I.66	2.92
Fadama Farm incomes (N)	Males	82,066.67			
	Females	66,333.33	15,733.34	5912.04	2.66
Fadama Farm Labour use (Man days)	Males	8.13			
	Females	8.32	-0.19	0.28	-0.66

***, ** = Variables significant at 1.0% and 5.0% levels respectively
Source: Calculations from field survey data, 2008

Table 2 Paired Samples Statistics for Male and Female Fadama I Participants in Abia State.

a Gini coefficient of 0.25 for the rural women in Umuneochi Local Government area of Abia State, Nigeria, and Ayobatele and Amudipe (1999) who equally obtained a low GI for women farmers in Ondo State, Nigeria.

The impact of the fadama 1 packages on rural women and men Fadama farmers' income, farm size, labour use and farm output is shown in Table 2. The estimated cultivated mean farm size of the male Fadama 1 farmers was 3.25 ha while that of the farmers was 2.69 ha. The difference in mean between the male and female Fadama 1 farmers cultivated land holding was 0.56 ha. The result of the paired t-test for difference in mean showed that this is statistically significant at 99.0 percent confidence level. This is because the calculated t "value" = 2.917 > the tabulated "t" 0.025 = 1.980. Therefore, the hypothesis of no difference in farm size is rejected. This result compared favorably with Nwachukwu and Ezeh (2007) who obtained similar result.

The mean incomes generated from the sale of various fadama crops (vegetables, rice, maize and okra) from both groups of fadama 1 farmers (males and females) were compared. The result showed that the mean annual farm income of the male Fadama 1 farmers was N 82,066.67 (US$ 547.11) while that of the females was N 66,333.33 (US$ 442.22). The mean difference was N 15,733.33 (US$ 104.88). The result of the paired t test showed that this is statistically significant at 5.0% risk level. This is because the calculated t = 2.66 > the tabulated t = 1.982.Therefore, the hypothesis of no difference is farm income in rejected. Given that the mean values of male participants were higher than those of their female counterparts in mean annual farm income and farm size, it could be inferred that the fadaama 1 project impacted more on the males than the female fadama 1 farmers.

Conclusion and recommendation

The research revealed that the incidence of poverty for the males was 0.67 while that of the females was 0.56. It further showed that the poverty gap (poverty depth) index was 0.46 for the men and 0.48 for the women. The Gini coefficient showing the inequality in income distribution was 0.233 for the males and 0.347 for the females. The research also showed that the farm size and farm income of the males were significantly higher than those of the females.

It is therefore recommended that a deliberate policy aimed at increasing the fadama farm size and incomes of the women fadama 1 farmers should be embarked upon by the federal, state and local governments. The land tenure system which as of custom allocates land to the males only should be abolished and a policy that is gender sensitive and redistribute land equitably put in place.

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Evaluation of the No-Till Demonstration Studies in South East Anatolia Region of Turkey

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Abstract

The practice of no-till in crop production has gained popularity in recent years because it is a superior soil conservation practice and offers reduction in fuel and labor requirements. But, its adaption is very slow in many countries because of lack of knowledge, experience and machines. A series of demonstration studies was conducted to observe the performance of the no-till systems in farmers' conditions in South East Anatolia region of Turkey. Four demonstration sites were established, each of which was also planted with farmers' application for wheat (Triticum Aestivum L.) after wheat, wheat after lentil (Lens Culinaris, L), wheat after cotton (Gossypium hirsutum L.) and lentil after wheat in 2009-2010 growing season. Yield was higher under no-till planting (1.50 t ha-1) than farmers' application (1.10 t ha-1) for lentil production after wheat. The no-till planting had similar yield to farmers' application for wheat production after wheat and lentil. The yield performance of wheat following cotton for no-till ridge planting and farmers' application was not consistent at three demonstration sites. In conclusion, the studies of the demonstration showed that no-till planting may be used in lentil and wheat production following wheat and lentil under these weather and soil conditions in South East Anatolia Region of Turkey.

Key words

No-till, traditional tillage, wheat, lentil, yield.

Introduction

Soil tillage influences agricultural sustainability through its effects on soil processes, soil properties, and crop growth. An important effect of soil tillage on sustainability is through its impact on the environment e.g. soil degradation, water quality, emission of greenhouse gases from soil-related processes, etc. (Aase and Pikul Jr 1995; Ding et al. 2002; Motta et al. 2002). Conventional tillage (i.e. moldboard plowing) has been used in many countries although its effect on soil degration was reported by many researchers (Kruger et al. 1996; Hulugalle and Entwistle 1997; Etana et al. 1999). Besides, many researchers have reported that conservation tillage protects soil from wind and water erosion and improves soil physical, chemical and biological properties, and reduces production costs (Gemtos et al. 1998; Chan and Hulugalle 1999; Lithourgidis et al. 2006; Thomas et al. 2007; Mann et al. 2008). The European Community agricultural policy has strongly encouraged conservation tillage in order to decrease soil loss and degration (European Union, 2001). But, the effect of conservation practices on yield is sometimes contradictory and depends on soil type, climate and management conditions (Prasad and Power, 1991). Besides, it is dependent on a number of interacting factors, including weed control level, residue management, cultural practices and drill performance (Dawelbeit and Babiker 1997; Gemtos et al. 1998; Carefoot and Janzen 1997). Hao et al. (2001), Jalota et al. (2008), Mann et al. (2008), Schillinger et al. (2010) found that conservation tillage was equal to or better than conventional tillage. Also, Hunt et al. (1997) reported that no yield loss was found when no-till system was used in winter wheat agriculture after cotton. But, Ishaq et al. (2001) determined lower wheat grain yields for minimum tillage than for conventional tillage, or deep tillage. Gwenzi et al. (2009) reported that the effect of tillage methods on crop yields was inconsistent in an irrigated wheat-cotton rotation throughout the 6-year period and the lower wheat yield under minimum and no-tillage resulted from the higher weed infestation and poor crop stand, as well as reported by Karlen and Gooden (1987), Hemmat and Taki (2001), Li et al. (2008). Besides, Javadi et al. (2008) stated that no-tillage did not show promising results due to lack of appropriate equipment.

The no-till planting of wheat on permanent beds has been proven in many parts of the world to reduce the cost of production and irrigation water.

Hobbs et al. (1998); Reeves et al. (1999); Sayre and Hobbs (2004); Gürsoy et al. (2010) stated that permanent raised beds proved to be an excellent option for wheat and offered potential benefits in terms of higher crop yield and quality, lower production costs, improved soil structure through controlled traffic and minimum tillage, initial weed control prior to planting, easy access to crop for timely nutrient (especially N) application, lower seed rate, better stand establishment, and the possibility that furrow-irrigation may be more efficient than flood irrigation. Jin et al. (2008) reported that permanent raised bed cropping system had the potential to make an important contribution to agricultural productivity, but ongoing research is needed on several aspects of this cropping system, including the suitability of current wheat varieties and relationships between tillage and water management practices, productivity and environmental conditions.

The adaption of no-till practices in crop production is very slow due to lower crop yields in such systems, and also differences in management that farmers may not be familiar with although it is a superior soil conservation practice and offers reduction in fuel and labor requirements (Cosper 1983).

The objective of this study was to evaluate the performance of the no-till demonstration studies conducted in farmers'conditions in South East Anatolia region of Turkey.

Materials and methods

Four demonstration sites were established at Bismil and Çınar districts of Diyarbakır in South East Anatolia Region of Turkey in 2009-2010 growing season. The demonstration sites are located 37º55'36" N 40º13'49" E at 670 m above sea level. The climate of the region is characterized by a semi-arid climate (humid winters and dry summers). Rainfall distribution is variable within and among years in this region. Mean annual precipitation, based on long-term average, is 491 mm, about 80% of which occurs from November to May. Monthly rainfall during the demonstration studies years and the monthly average rainfall over the long term (62 years) are shown in Fig. 1. In 2009-10 growing season, rainfall was below long-term average in Feb., Apr. and May, above average in Sep., Oct., Dec. and Jan. There was no considerable rainfall difference in Nov. and Mar. between 2009-10 growing season and long-term average.

Temperature records are summarized in Fig. 2. While Jan., Feb. and Mar. had higher mean, maximum and minimum temperature in 2009-10 growing season than in long-term average, there were no considerable differences in the other months.

Wheat was planted at three sites, each of which was also planted with farmers' applications for wheat after wheat, wheat after lentil, wheat after cotton, while lentil was planted at a site after wheat. The

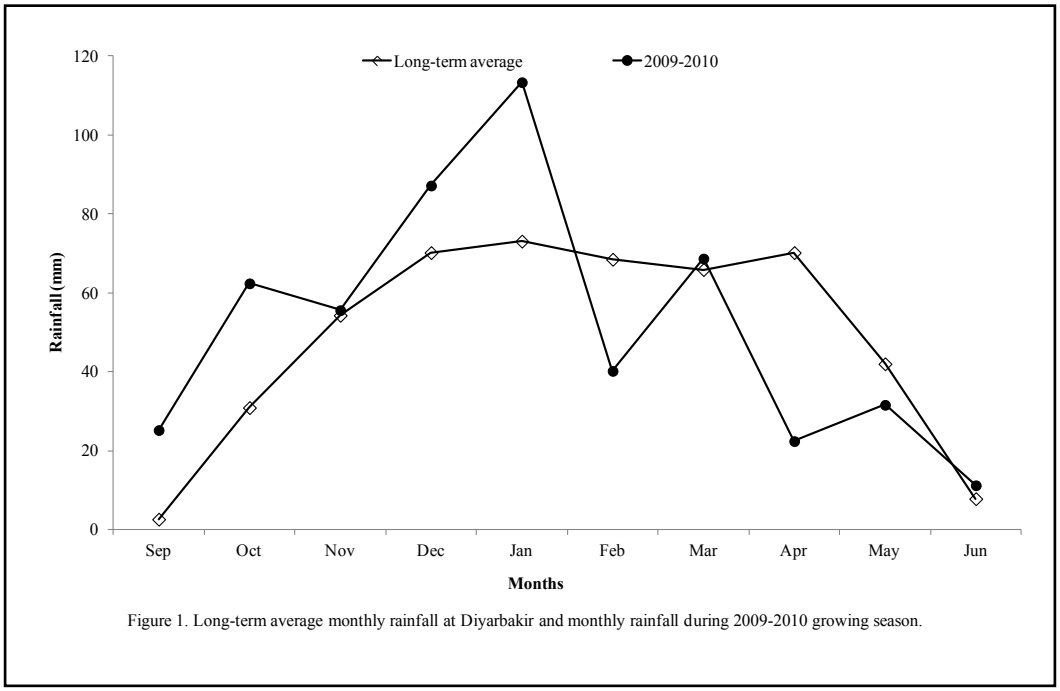

Figure 1. Long-term average monthly rainfall at Diyarbakir and monthly rainfall during 2009-2010 growing season.

Figure 1. Long-term average monthly rainfall at Diyarbakir and monthly rainfall during 2009-2010 growing season.

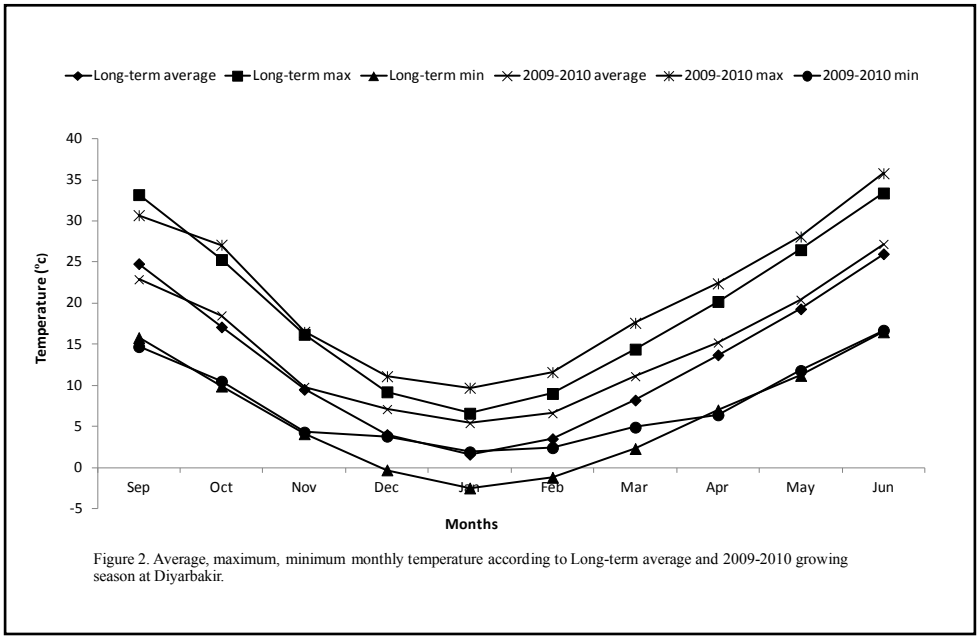

Figure 2. Average, maximum, minimum monthly temperature according to Long-term average and 2009-2010 growing season at Diyarbakir.

Figure 2. Average, maximum, minimum monthly temperature according to Long-term average and 2009-2010 growing season at Diyarbakir.

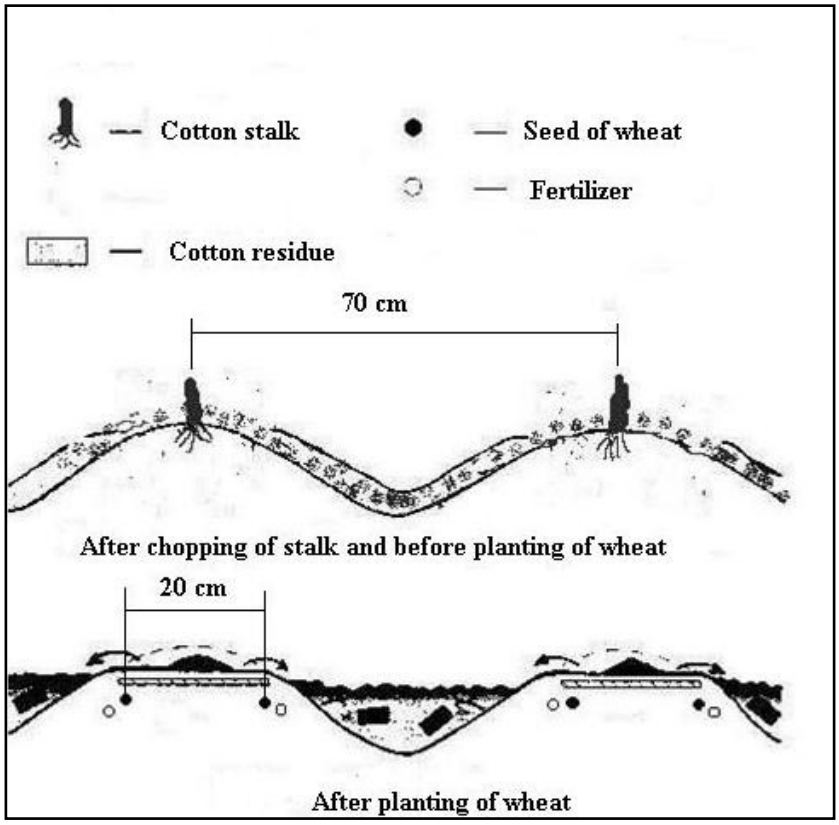

Figure 3. Schematic of no-till planting of wheat on ridge after cotton harvest.

pre-crop wheat was harvested by combine with straw chopper and blower for transporting the straw to trailer before planting wheat and lentil following wheat (Fig. 3). The no-till planter manufactured by Ozdoken Agricultural Machinery Ltd was used to plant wheat and lentil following wheat or lentil (Fig. 4). This planter with 210 cm working width and 1750 kg weight was equipped with 40 cm diameter smooth single disc openers. In no-till ridge planting method of wheat following cotton,

Figure 4. The Ozdoken no-till planter modified for no-till planting of wheat on ridge.

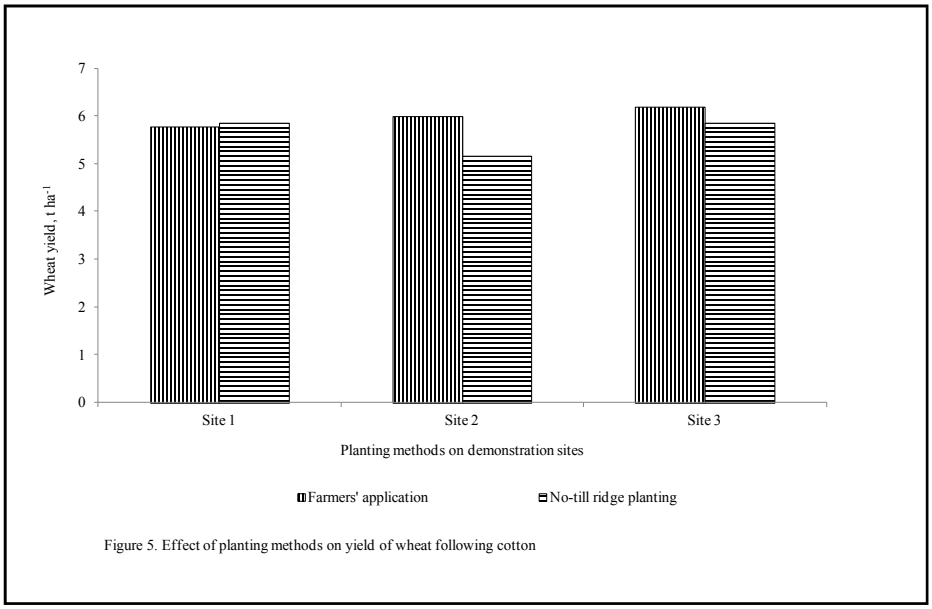

Figure 5. Effect of planting methods on yield of wheat following cotton.

two rows of wheat seed was planted on the top of ridge by using the modified Ozdoken no-till planter. The space between ridges was 70 cm. The space between each row on ridge was 15 cm (Figure 5). Farmers' planting applications included the planting process with conventional planter following cultivator and mouldboard plough after wheat and lentil harvest. The farmers' application for planting wheat after cotton was broadcast planting method. In this method, the seed was broadcasted on field without any previous stalk chopping and/or tillage and covered by cultivator.

Sarıcanak-98, a winter wheat cultivar widely used in the region, was planted at seed rate of 100 kg ha-1 for no-till ridge planting after cotton and 200 kg ha-1 for no-till planting method after wheat and lentil. In no-till ridge planting system, the lower seed rate was used to provide the amount of seed in a row and to keep plant to plant distance within a row similar to other planting/seeding systems/ treatments. The seed rate for farmer's application was 220 kg ha-1 after wheat and lentil and 300 kg ha-1 after cotton.

A compound fertilizer (20-20-0; % N-P2O5-K2O) to supply 80 kg N plus 80 kg P2O5 ha-1 was applied as basal fertilizer at planting, and 80 kg N ha-1 as ammonium nitrate (33% N) was applied at first node stage for each crop. After emergence of the crop and before tillering, grass and broadleaf weeds were controlled by herbicide. The irrigation was applied to flowering and grain-filling stage.

For no-till planting lentil following wheat, Çağıl lentil variety was planted at 100 kg ha-1. The seed rate was 180 kg ha-1 in farmer's application. No fertilizer and irrigation was applied; fertilizer is not normally applied to lentil crops in this region. After emergence of the crop and before tillering, grass weeds were controlled by herbicide.

Grain yield was measured by harvesting the full demonstration area, using combine harvester.

Results and discussion

Functional observations

Penetration of the openers of no-till ridge planter was very good due to soft soil conditions. The openers were not plugged by residues because the pre-crop wheat and lentil was harvested by combine with straw chopper. The planter modified to plant two rows of wheat on top of ridges appeared to have a good performance and was not plugged by cotton residues. The soil and residue flow among openers was very good. The seeding depth observations showed that seeds were placed to the target depths and covered with soil. Weed density and field mice pest in wheat production following wheat were higher in no-till planting than in farmers' application while there was no significant difference between no-till ridge planting and farmers' application in wheat production following cotton.

Grain Yield

The grain yield results are the demonstration plots and indicate trends only and have not been scientifically analyzed because they are not from replicated trial. Figure 5 illustrates the yield performance of wheat following cotton for no-till ridge planting and farmers' application at three demonstration sites. While grain yield of wheat was higher in no-till ridge planting than in farmers' application at site 1, no-till ridge planting resulted in lower yield than farmers' application at site 2 and site 3. The difference between demonstration sites might be resulted from the water availability in the soil profile due to irrigation applied at growing stage. Hobbs et al. (1998), Reeves et al. (1999), Sayre and Hobbs (2004), Govaerts et al. (2005) and Gürsoy et al (2010) stated that permanent raised beds can be an excellent option for wheat and offer potential benefits in terms of both productivity and costs. But, they suggested that subjects such as irrigation, seed rate, fertilization in no-till ridge planting should be researched. The no-till planting in wheat production following lentil resulted in slightly higher grain yield than farmers' application, but wheat yield following wheat was lower in the no-till planting than farmers' application (Fig. 6 and Fig. 7). The lentil yield following wheat was higher in no-till planting (1.50 t ha-1) than in farmers' application (1.10 t ha-1) (Fig 8.). The results of the studies about no-till wheat planting are not consistent due to different experimental conditions because

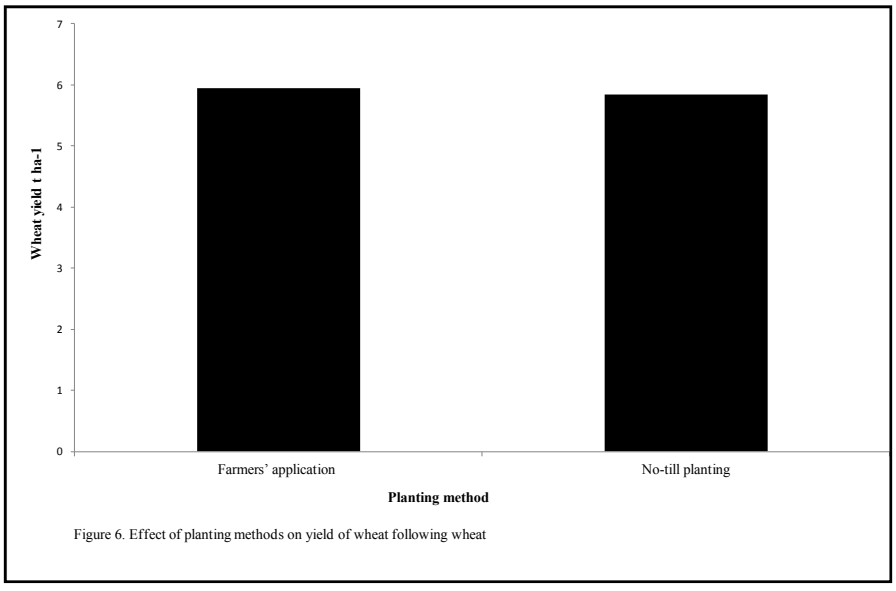

Figure 6. Effect of planting methods on yield of wheat following wheat.

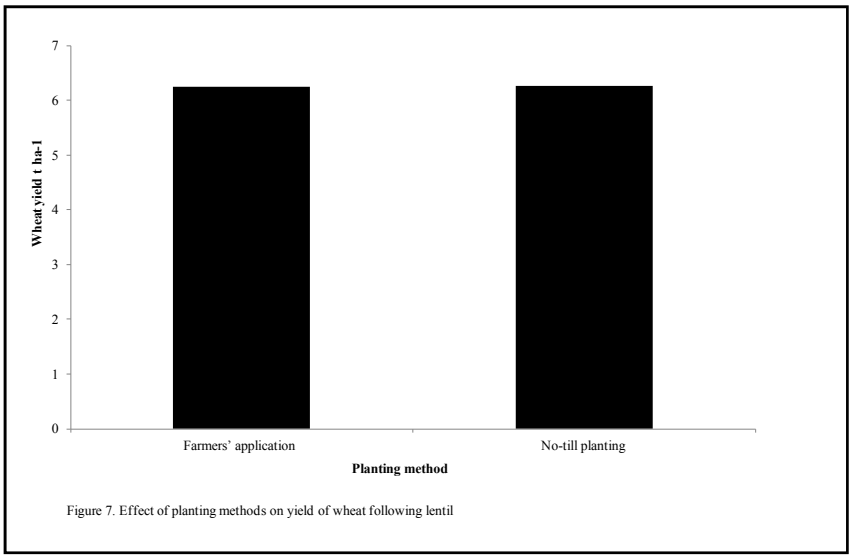

Figure 7. Effect of planting methods on yield of wheat following lentil.

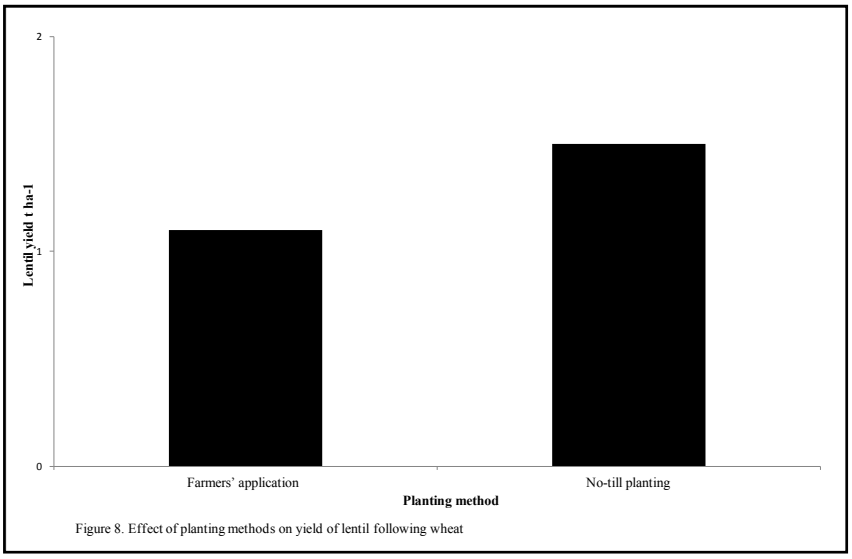

Figure 8. Effect of planting methods on yield of lentil following .

the performance of no-till planting is dependent on number of interacting factors, including soil-climatic conditions, weed control level, residue management, cultural practices and drill performance (Prasad and Power 1991; Dawelbeit and Babiker 1997; Gemtos et al. 1998; Carefoot and Janzen 1997). The yield performance in no-till planting and farmers' application at demonstration sites might be affected by soil conditions and pre-crop management.

Conclusions

Weed density and field mice pest in wheat production following wheat were higher in no-till planting than in farmers' application while there was no significant difference between no-till ridge planting and farmers' application in wheat production following cotton. The yield performance of wheat following cotton for no-till ridge planting and farmers' application was not consistent at three demonstration sites. While the no-till planting in wheat production following lentil resulted in slightly higher grain yield than farmers' application, the wheat yield following wheat was lower in the no-till planting than in farmers' application. The no-till planting resulted in higher yield in lentil production following wheat than in farmers' application.

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Possibilities of Using the Four-factorial Inventory of the Climate of Innovation in the Czech Agricultural Sector

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Anotace

Pro zvýšení konkurenceschopnosti evropského modelu zemědělství je nutné vytvářet inovační prostředí v oblasti zemědělské prvovýroby a v následném zpracovatelském průmyslu. Míra inovací ve zpracovatelském průmyslu z velké části ovlivňuje konkurenceschopnost podniků na trhu. The team climate inventory (TCI-38) je specifický nástroj pro měření důležitých aspektů inovačně zaměřeného týmového pracovního prostředí. Cílem článku je ověření možnosti použití nástroje TCI-38 v České republice a jeho následné možnosti použití v zemědělském sektoru. Na základě explorativní a konfirmativní faktorové analýzy je v článku popsána faktorová struktura TCI-38 v České republice. Explorativní faktorovou analýzou byly vstupní proměnné redukovány na 5 faktorů: (1) Týmová vize, (2) Podpora inovací, (3) Bezpečná spolupráce, (4) Orientace na úkoly, (5) Komunikace, které popisují 79,46 % rozdílnosti ve výchozím souboru. Výsledky rozdílnosti ve výchozím souboru a koeficienty reliability extrahovaných faktorů ukazují, že TCI-38 je stabilní nástroj pro měření inovačního klimatu týmového pracovního prostředí v České republice.

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Klíčová slova

Agrární sektor, inovace, týmová vize, podpora inovací, bezpečná spolupráce, orientace na úkol, komunikace.

Abstract

To increase the competitiveness of the European model of agriculture, an environment of innovation must be created in the field of primary agricultural production and in the subsequent processing industries. The level of innovation in the processing industry greatly influences the competitiveness of businesses on the market. The team climate inventory (TCI-38) is a specific tool for measuring the important aspects of an innovation-focused team work environment. The aim of the article is to verify the possibilities of use of the TCI-38 tool in the Czech Republic. The TCI-38 factor structure in the Czech Republic is described in the article on the basis of exploratory and confirming factor analysis. Through exploratory factor analysis, the input variables were reduced to 5 factors: (1) Team vision, (2) Support for Innovations, (3) Participation Safety, (4) Task Orientation, (5) Communication, which accounted for 79.46 % of the total variance. The results Rotation Sums of Squared Loading and reliability coefficients of extracted factors show that TCI-38 is a stable tool for measuring the climate for innovation in the team work environment in the Czech Republic.

The article originated as a part of the Internal Grant Agency (IGA) of the Czech University of Life Sciences in Prague, Registration Number 201111140064.

Key words

Agricultural Sector, Innovation, Team Vision, Support for Innovations, Participation Safety, Task Orientation, Communication.

Introduction

In order for a Agribusiness to be competitive on the global markets, it needs employees who actively resolve issues, seek new opportunities and continuously improve their working environment.

Companies that satisfy themselves with employees that only do what they are told lose their competitive edge (Frese and Fay 2001). The organization climate is affected by a number of internal and external factors, which indirectly create the innovative climate of the businesses (Isaksen and Lauer, 1999). The connection of innovation, which is widely accepted as the primary driving force of sustainable growth in a business (Christensen and Raynor 2003) and the ability to create new thoughts, which is considered as the starting point of innovation (Shalley and Perry-Smith 2001) shape the space for the creation of competitive advantages and maintenance of continuous growth of the business. In this connection it is necessary to focus our attention on the factors that create a pro-innovation work environment.

The aim of the research is to validate, on the basis of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) the model of a Team Climate Inventory (TCI-38) (Anderson and West 1998) in the Czech Republic.

Material and Methods

Agricultural sector and innovation

Small and medium-sized enterprises in Agribusiness are more focused on incremental innovation. Proposed to radical innovation, they are also engaged more in product and process innovations in packaging than, position and paradigm innovations. In terms of innovation characteristics these innovations are affected by many factors, the most important are the commitment to encouraging new ideas, and cultivating innovative employees (Beregheh, Rozlez, Sambrook, Davies, 2012).

Anderson and West (1998) describe TCI-38 as a tool for measuring important aspects of an innovation-focused team work environment. In connection with further researches TCI-38 is described as the Team Climate For Innovation (Tseng 2009; Lu 2011)

TCI-38 (Anderson and West 1998) was assembled on the basis of extrapolative and confirmatory analysis from the original version TCI-116 (West 1990) through research on different subjects. The original version was reduced from 116 variables to 38 variables, from which a four-factor version (38 questions) was put together with an interval of internal consistency of Alfa 0,84 – 0,94 (Anderson and West 1998): (1) Team Visions – how clearly are they defined, shared, attainable and evaluated team goals and visions (2) Support for innovations – how team members perceive the other members of the team and the team leader in the area of support of new ideas (3) Participation safety – to what extent does the team cooperate in the area of proposing new ideas (4) Task orientation – to what extent does the team consider task fulfillment as an important part of team performance in light of a joint mission.

TCI-38 was subsequently validated in Italy (Ragazzoni, Baiardi, Zotti, Neil Anderson, M. West 2002), Greece (Chatzi and Nikolaou 2008), Norway (Mathisen et al. 2004) and China (Sun 2011).

The original version of TCI-38 (Anderson and West 1998) was independently translated by the author of the article and a translation agency. Differences were subsequently consulted with a native speaker. Data for validation of the model were obtained on the basis of contacting 486 medium-sized businesses (European Commission, 2006 electronic form of contact to e-mail addresses of the companies listed in the catalog www.firmy.cz. A request form with instructions on completing a survey was distributed to the companies, where on the basis of numbers assigned in the request the first survey was completed by the team leader (restricted, by request, to the area of research, development and introduction of new products and services in the company) and subsequently by team members chosen by the team leader as competent for the completion of the survey (on the basis of criteria of direct cooperation with the leader and participation in the team for more than 6 months) at the domain www.inovace2011.cz. From 1.10.2011 – 1.12.2011 the survey was completed by 112 businesses (return rate 23.01 %). The survey was completed by 86 team leaders and 254 team members (average number of completions per team was 2,95 employees). EFA was used for lowering the large number of variables to a smaller number, a more manageable number of factors (Hair et al., 2006). SPSS 18 software was used for statistical processing. For measuring the level of team climate factors arising from the TCI-38 model, the five-point Likert scale was used: (1) Team vision – 11 variables (2) Support of innovations - 12 variables (3) Participation safety – 7 variables (4) Task orientation – 8 variables. Factors were reduced in the SPSS 18 program on the basis of EFA – the Varimax rotation method – orthogonal rotation of the original factors. The number of factors was selected on the basis of a graph method, using a sutin graph. The structure of the factors was verified on the basis of CFA in the SPSS AMOS 19 program. For evaluation of factor load of individual factor variables and the overall acceptability of the model, the following indices were used: Goodness-of-Fit Index, Root Mean Square Error of Approximation, Normed Fit Index, Tucker-Lewis Index, Comparative Fit

Index	Setpoint	Source
GFI	>0,9	Garson, 2006
RMSEA	<0,08	Garson, 2006
NFI	>0,9	Garson, 2006
TLI	>0,9	Garson, 2006
CFI	>0,9	Garson, 2006
IFI	>0,9	Garson, 2006
CMID/DF	<3	Hair at al, 2006

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 1: Fit Indices.

Factor	Rotation Sums of Squared Loadings		
	Celkové	% variabilita	Kumulativní součet %
Factor 1 (FA1)	7,908	20,809	20,809
Factor 2 (FA2)	7,399	19,471	40,280
Factor 3 (FA3)	6,284	16,537	56,817
Factor 4 (FA4)	5,269	13,865	70,683
Factor 5 (FA5)	3,337	8,781	79,463

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 2: Rotation Sums of Squared Loadings.

Index, Incremental Fix Index, and Normed Chi-square; Table 1: Fit Indices. For confirmation of discriminatory validity of the model, correlation coefficients between individual factors with a critical value of 0,85 (Kline, 2010) were monitored.

Internal consistency of factors was evaluated by Cronbach's alpha reliability coefficients based on the following criteria:: "_ > .95 – Too high, _ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor, and_ < .5 – Unacceptable" (George and Mallery, 2003)

Results and discussion

EFA was used for validation of TCI-38 (Anderson and West 1998). Variables entering TCI-38 that were evaluated as "excellent" for use of EFA (Lackey a Nancy 2003) were examined on the basis of the Kaiser-Meyer-Olkinova test (0,963). A sample of 254 respondents is sufficient, in light of the number of input variables, for the use of factor analysis (Hutcheson and Sofroniou 1999; Garson 2008).

Through explorative factor analysis, the original 38 variables were reduced to 5 independent factors witch accounted for 79.46 % of total variance of the TCI-38 construct (Table 2: Rotation Sums of Squared Loadings).

Through exploratory factor analysis, the original 38 variables were reduced to 5 independent factors: (1) FA1 explains 20.81 % of the total variability of the set of variables. It is characterized by weights (0,532 – 0,932) and is composed of 11 variables. This factor, in analogy with the tested version of TCI-38 (Anderson and West 1998) can be interpreted as team vision. (2) FA2 explains 19.47 % of the total variability of the set of variables. The load of this factor is expressed in values (0,560 – 0,796) and it is composed of 9 variables. This factor, in analogy with the tested version of TCI-38, can be interpreted as Task Orientation. (3) FA3 explains 16.54 % of the total variability of the set of variables. The load of this factor is expressed in values (0,576 – 0,810) and it is composed of 7 variables. This factor, in analogy with the tested version of TCI-38, can be interpreted as Support for Innovation. (4) FA4 explains 13.87 % of the total variability of the set of variables. The load of this factor is expressed in values (0,728 – 0,805). This factor, in analogy with the tested version of TCI-38, can be interpreted as safe cooperation. (5) FA5 explains 8.78 % of the total variability of the set of variables. The weights of this factor are high in values (0,740 – 0,834). This factor is composed of variables of 1 variable from the factor of task orientation (from the original version of TCI-38) and 3 variables of the factor support of innovations (in the original version of TCI-38). On the basis of interpretation of variables (example of position:

Variable	FACTOR					Variable	FACTOR				
	FA1	FA2	FA3	FA4	FA5		FA1	FA2	FA3	FA4	FA5
29	0,932					3			0,810		
21	0,881					1			0,777		
24	0,873					12			0,763		
27	0,861					6			0,739		
25	0,841					10			0,728		
22	0,836					17			0,585	0,472	
28	0,725					14		0,559	0,576		
23	0,710					32				0,805	
30	0,707					34				0,790	
26	0,690					33				0,789	
31	0,532			0,482		35				0,786	
2		0,796				36				0,776	
18		0,737				38				0,761	
19		0,707				37				0,728	
5		0,678				11					0,834
16		0,658				20					0,785
8		0,651				15					0,780
13		0,615				4					0,740
7		0,579	0,452								
9		0,560	0,508								

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 3: Rotated Factor Loading.

	Original	CZ EFA	Cronbach's Alfa	Results	CZ CFA	Cronbach's Alfa	Results
Team Vision	11	11	0,958	Too high	5	0,936	Excellent
Support for Innovation	12	7	0,959	Too high	6	0,939	Excellent
Participation Safety	7	7	0,943	Excellent	6	0,926	Excellent
Task Orientation	8	9	0,972	Too high	8	0,947	Excellent
Communication		4	0,857	Good	4	0,857	Good
Sum	38	38			29		

Source: Processing of authors based on data from research in 2012 (see chapter methods)

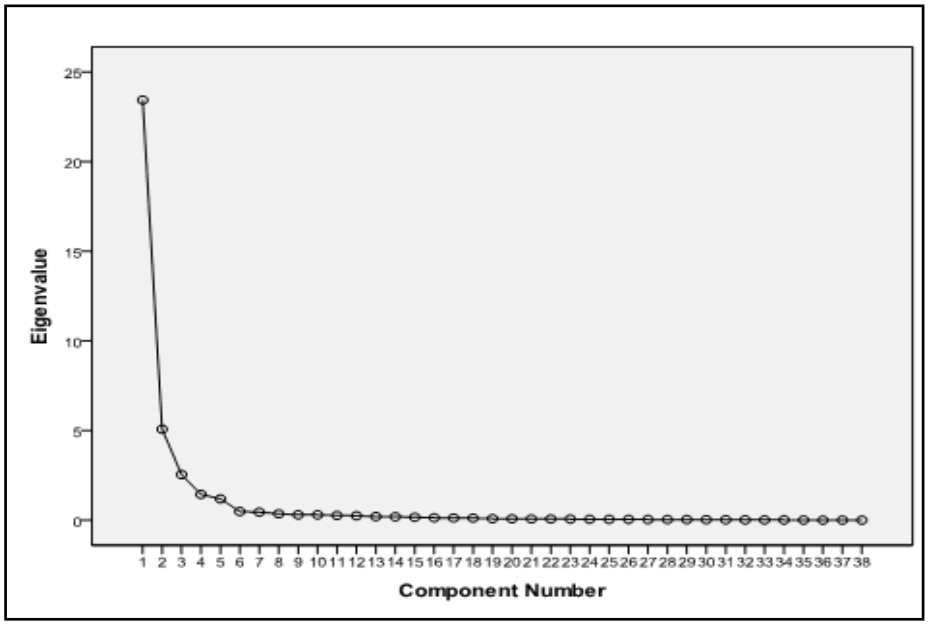
Table 4: Reliability coefficients.

"team members speak with each other formally and informally" and "mutual communication is frequent within the team") the factor, in analogy with other research (Ragazzoni, Baiardi, Zotti, Neil Anderson, M. West 2002; Chatzi, Nikolaou 2008; Mathisen et al. 2004; Sun 2011), was interpreted as Communication.

Coefficients of Cronbach's Alfa are over 0,85 for all factors, which indicates a high level of internal consistency of individual factors.

The effect of the share of factors on the overall description of differentiation is expressed by graph 1.

CFA was performed in the SPSS AMOS 19 program. The process of balancing the model was based on recommended methodology (Hair et al., 1998). The basic structure of the model was constructed on the basis of results of exploratory factor analysis – see table 2: Rotation Sums of Squared Loadings. For evaluation of factor load of individual factor variables and the overall acceptability of the



Source: Processing of authors based on data from research in 2012 (see chapter methods)

Graph 1 : Sutin graph of factor distribution.

Index	The value of the model	Setpoint	Acceptability	Source
GFI	0,903	>0,9	Ano	Garson, 2006
RMSEA	0,026	<0,08	Ano	Garson, 2006
NFI	0,955	>0,9	Ano	Garson, 2006
TLI	0,992	>0,9	Ano	Garson, 2006
CFI	0,993	>0,9	Ano	Garson, 2006
IFI	0,993	>0,9	Ano	Garson, 2006
CMID/DF	1,174	<3	Ano	Hair at al., 2006

Source: Own processing

Table 5: Fit Indices of model.

model, the following indices were used: Goodness-of-Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Tucker-Lewis Index(TLI), Comparative Fit Index (CFI), Incremental Fix Index (IFI), and Normed Chi-square. To confirm the discrimination validity of the model, the correlation coefficients between individual factors cannot exceed the value of 0,85 (Kline, 2010).

Table 5 shows the acceptability of the model in connection with modification for achievement of its acceptability. On the basis of covariance matrix, 9 variables were removed from the construct. 29 variables remained in the model with high factor weights in the range of 0,712 – 0,977. All R2 values are above 0.5, which indicates reliability of variables. Correlation coefficients between factors are in the range of 0,285 – 0,803, which supports the discriminatory validity of the model (Table 7: Correlations between factors).

Exploratory factor analysis was used to reduce the original 38 variables to 5 independent factors, which describe 79,46 % of the total variance of the TCI-38 construct. In contrast to the original model TCI-38, a new factor, “communication”, was discovered, with a reliability coefficient of 0,857, which arose through extrapolation of 3 variables from the original factor “support of innovations” and 1 variable from the original factor “task orientation”. Through confirmatory factor analysis the model was balanced on the basis of modifying indicators in the SPSS Amos 19 program (covariance matrix) with 29 variables, without changes in the number of extracted factors.

	Factor loading	C.R.	P	R2
Team vision				
Conviction of usefulness of goals for the general public	0,921	f.p.		0,85
Conviction of the respondent of the usefulness of the goals	0,966	30,152	***	0,93
Level of team agreement with the goals	0,87	21,897	***	0,76
Agreement of respondent with the goals of the team	0,872	22,28	***	0,76
Comprehensibility of the goal	0,733	15,255	***	0,54
Task orientation				
Clear criteria to achieve excellence as a team	0,925	f.p.		0,86
Team orientation to high performance	0,736	15,94	***	0,54
Sharing of knowledge to achieve high performance	0,956	30,924	***	0,91
Capability of critical evaluation of weak aspects	0,977	34,35	***	0,95
Knowledge of goal	0,974	33,683	***	0,95
Regular monitoring of own performance	0,988	36,136	***	0,98
Support in the form of providing of constructive feedback	0,807	18,969	***	0,65
Cooperation in application of new thoughts	0,866	22,312	***	0,75
Participation safety				
High level of knowledge sharing	0,944	f.p.		0,89
Unified level of knowledge sharing	0,862	22,7	***	0,74
Mutual knowledge of work issues	0,84	20,862	***	0,71
Understanding and acceptance	0,907	26,098	***	0,82
Acceptance of minority opinion	0,717	14,52	***	0,52
Synergy in knowledge sharing	0,97	19,988	***	0,94
Support for innovation				
Development of new ideas	0,933	f.p.		0,87
Assistance in developing new ideas	0,715	14,135	***	0,51
Openness to ideas and ability to react to change	0,739	16,03	***	0,55
Continuous searching for new solutions	0,71	14,942	***	0,5
Time availability for development of new ideas	0,954	31,691	***	0,91
Support of team members for new ideas	0,982	36,254	***	0,96
Communication				
Frequent mutual communication	0,793	f.p.		0,63
Frequency of formal and informal contact	0,904	15,313	***	0,82
Regular contact	0,706	11,728	***	0,5
Team unity during contact with others	0,714	11,98	***	0,51

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 6: Results of confirmatory factor analysis.

Reduction of variables as a result of balancing of the model did not change the content significance of the factors (1) Team Vision – how clearly it is defined, shared, and attainable and the team goals and visions evaluated. Most associated with this factor is "Conviction of the respondent regarding the usefulness of the goals" (R2= 0,93). (2) Support of innovations – how the team members perceive the other members of the team and the team leader in the area of support of new ideas. Most associated with this factor is "Time availability for development of new ideas" (R2= 0,91), "Support of team members in regard to new ideas" (R2= 0,96). (3) Safe cooperation – to what extent does the team cooperate in the area of innovation and how secure do the team members feel in the area of

Factor		Factor	Correlations between factors
Team Vision	<-->	Task orientation	0,486
Team Vision	<-->	Participation Safety	0,403
Team Vision	<-->	Support for Innovation	0,439
Team Vision	<-->	Communication	0,285
Task orientation	<-->	Participation Safety	0,796
Task orientation	<-->	Support for Innovation	0,788
Task orientation	<-->	Communication	0,409
Participation Safety	<-->	Support for Innovation	0,803
Participation Safety	<-->	Communication	0,505
Support for Innovation	<-->	Communication	0,524

*TCI-38 - Original version of TCI-38; CZ EFA - Structure of factors after Exploratory Factor Analysis; CZ CFA - Structure of factors after Confirmatory Factor Analysis

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 7: Correlations between factors.

Factor	TCI-38	CZ EFA	CZ CFA
Team Vision	11	11	5
Support for Innovation	12	7	6
Participation Safety	7	7	6
Task orientation	8	9	8
Communication	-	4	4
SUM	38	38	29

Source: Processing of authors based on data from research in 2012 (see chapter methods)

Table 8: Structure of factors prior to and after EFA and CFA.

proposing new ideas. This factor is most associated with "Synergy in knowledge sharing" (R2= 0,94). (4) Task orientation – to what extent does the team consider fulfillment of tasks an important part in relation to team performance. Most associated with this factor is "The ability to critically evaluate weak aspects"(R2 = 0,95), "Knowledge of goal" (R2 = 0,95), "Regular monitoring of own performance" (R2= 0,98). (5) Communication– to what extent does formal and informal contact between team members take place. This factor is most associated with the "Frequency of formal and informal contact " (R2 = 0,82). Following exploratory factor analysis the factors "Team vision", "Support of innovations", "Task orientation" achieved a reliability coefficient greater than 0,95, which, as stated by Streiner (2003), indicates redundant values in a latent factor. As a result of confirmatory factor analysis, the value of these reliability coefficients decreases to values between 0,90 – 0,95, which according to Streiner (2003) corresponds to the evaluation "Excellent". Through optimization of reliability values, a reduction in the number of variables in latent factors took place on the basis Fit Indices in the Amos 19 program.

The model can be considered as valid on the basis of GFI, RMSEA, NFI, TLI, CFI and CMID/DF indexes. In light of the previous validation tool, TCI-38 in Italy, Greece, Norway and China, comparison of the number and structure of factors in these nations can be the subject of further research.

Conclusion

On the basis of the results of exploratory and confirmatory factor analysis, the four-factor version of TCI-38 (Anderson and West 1998) can be considered as a stable tool for the measurement of team climate for innovation in the Czech Republic. The 4-factor version was expanded by a fifth factor "Communication" and the number of variables reduced to 29. The 4-factor version of TCI-38 (Anderson and West 1998) was validated through performance of explorative factor analysis, where the original 38 variables were reduced to 5 independent factors which describe 79,46 % of the differentiation in the starting set without change in

the number of variables. Four original factors: (1) Team Vision, (2) Support of innovations, (3) Safe cooperation and (4) Task orientation were preserved and on the basis of the results of explorative factor analysis, a fifth factor, "Communication", was extracted. Through confirmatory factor analysis, the model was modified to the form of 29 variables, without change in latent factors.

Following Beregheh, Rozlez, Sambrook, Davies (2012), who emphasize the needs to promote new ideas and create a climate for innovation environment for employees in the field of agricultural sector (especially the food sector), it is possible to recommend - based on the validation of TCI-38 in the Czech Republic - modified version of the TCI-29 in Czech agricultural sector to increase the competitiveness of farms on the market.

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Cloven-hoofed animals spatial activity evaluation methods in Doupov Mountains in the Czech Republic

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Anotace

Řešení projektu „Sběr a interpretace pozičních dat"je zaměřeno na využití pozičních dat (informace o pohybujícím se objektu) pro vědeckovýzkumnou a pedagogickou činnost v různých oblastech (životní prostředí, logistika apod.). Záměrem je vytvořit a v reálných podmínkách ověřit universální model pro sběr a následnou prezentaci dat získaných o sledovaném objektu prostřednictvím GPS (Global Positioning System).

V článku jsou popsány možné způsoby zpracování a vizualizace dat o pohybech jelena siky v Doupovských horách, které slouží k vyhodnocení jeho prostorové aktivity. Datovou základnu pro analýzu a zpracování tvoří rozsáhlé soubory dat získané na základě spolupráce Fakulty lesnické a dřevařské ČZU v Praze s Vojenskými lesy a statky ČR, s.p.

Klíčová slova

Telemetrické sledování, GPS, GSM, jelen sika (Cervus nippon), polygon, quick hull, heat map.

Abstract

The focus of the project „Collection and interpretation of positional data" is placed on the use of positional data (or the information about a moving object) in the scientific research and educational activities in various fields such as environmental science, logistics, spatial data infrastructure, information management, and others. The objective of this effort is to create an universal model for collection and presentation of moving objects data retrieved through GPS (Global Positioning System), and to verify the model in practice.

Several different approaches to process and visualize data about sika deer (Cervus nippon) spatial movements in Doupov Mountains are described in the paper. The data base is represented with large data files created through the cooperation of the Faculty of Forestry and Wood Sciences at the Czech University of Life Sciences in Prague and the Military Forests and Estates of the Czech Republic, a state-owned enterprise.

Pieces of knowledge introduced in this paper resulted from solution of an institutional research intention. Internal grant agency of the Faculty of Economics and Management, Czech University of Life Sciences in Prague, grant no. 20121043, „Sběr a interpretace pozičních dat".

The results of the cloven-hoofed animals spatial activity evaluation methods will be available for Research Program titled "Economy of the Czech Agriculture Resources and Their Efficient Use within the Framework of the Multifunctional Agri-food Systems" of the Czech Ministry of Education, Youth and Sports number VZ MSM 6046070906.

Key words

Telemetric observation, GPS, GSM, sika deer (Cervus nippon), polygon, quickhull, heat map.

Introduction

Due to the growing amount of damages caused by cloven-hoofed animals in forests and agricultural places and due to rise of new species such as sika deer (Cervus nippon), there is a need to inspect spatial activities of cloven-hoofed animals. The information about daily and seasonal movements of different species of cloven-hoofed mammals is a vital part of complex knowledge of their biology. Without knowing the spatial activity of these species, there is rarely any estimation of the evolution of their numbers owing to local migration in the given season of the year. Especially, the

continuous growth of the area of sika deer presence in the Czech Republic (Anděra, Červený, 2010), the knowledge in biology, ecology and home ranges of sika deer populations is very insufficient in spite of the influence on the local red deer (Cervus elaphus) population. However, the information about sika deer from its original areas are very well known (Igota et al. 2004, Takatsuki 2009).

The first, the oldest and obviously the most used way of identification of cloven-hoofed animals is by fitting of caught animals with an ear tag. The data that are retrieved comes from random observations, repeated captures of animals, or occasional shooting of marked individuals. Therefore, it is needed to mark a large number of animals so that "there is a chance to get some information back". The second most used method is a telemetric observation. The accuracy of the method is dependent on the number of observations and the method is quite time consuming (Klitsch, Holešinský, 2012). The third, and currently the fast developing method is to label the animal with a GPS collar (Global Positioning System) (Löttker 2010). The collar stores positional data and transmits it through GSM (Global System for Mobile Communications) for processing without a physical presence in the terrain. The data are stored in tabular form, and provide date, time (UTC), geocentric coordinates (ECEF), latitude and longitude according to the WGS 84, and satellite spatial reference system used for location calculation. In the collar, there is a sensor of mortality, activity data recording and automatic release mechanism when the collar is damaged.

Current approaches to spatial data evaluation are most frequently based on data transformation into some proprietary geographic information software (GIS) (Halbich, Vostrovský 2012), (Klitsch, Holešinský, 2012) where the data processing is conducted. The size of local regions of animals is settled by the method Kernel Home Range. However, GIS is not used for data presentation.

There are three places where the method of animal observation via GPS and GSM can be found in the Czech Republic. The first, a common Czech-German project for observations of deer, roe deer and Eurasian lynx in national parks Bavaria Forest and Bohemian Forest (Telemetry team, 2012). In the beginning of 2012, the project has been stopped in the Czech Republic and only the German part has been operating. The second place is a national park Bohemian Switzerland where the red deer is observed (Klitsch, Holešinský, 2012). Since 2009, there is a telemetric observation of sika deer in Doupov Mountains and since 2010 the observation has been extended to red deer (Macháček et al., 2012). The research is done in the Hradiště area that is located on the military training ground.

The area is maintained by the state-owned company Military Forests and Estates of the Czech Republic, Karlovy Vary division. Hradiště area is of 35,435 hectares and represents one of the most consistent area in the Czech Republic.

Figure 1. Sika deer with GPS collar.

The data collected with cooperation of Military Forests and Estates of the Czech Republic and the Faculty of Forest and Wooden Sciences at the Czech University of Life Sciences by observations in the region of Doupov Mountains were used as a fundamental data base for analysis and design of on-line evaluation and presentation of spatial activities of cloven-hoofed animals.

Material and methods

The main objective of proposed solution is to visualize collected spatial data that were retrieved by observation of cloven-hoofed animals and to enable their use for scientific research and pedagogical purposes and to popularize research results. As a result an application available on-line through WWW was developed. Main projected functions of the application are such as:

- Display mode: public and personalized access
- Projection of animal position in given period (time period and daytime)
- Visualization of home range and motion path in given time period
- Calculation of home range and length of motion path in given time period
- Display of additional textual information about position (such as temperature, or altitude)

Based on introductory analysis the positional data were obtained by observation of cloven-hoofed animals and then stored in MySQL 5 database server. Next, the data were cleared of erroneous figures. Web application was run on Apache web server. The application core was programmed in web programming language PHP 5 (Hypertext Preprocessor) with the use of Nette Framework 2.

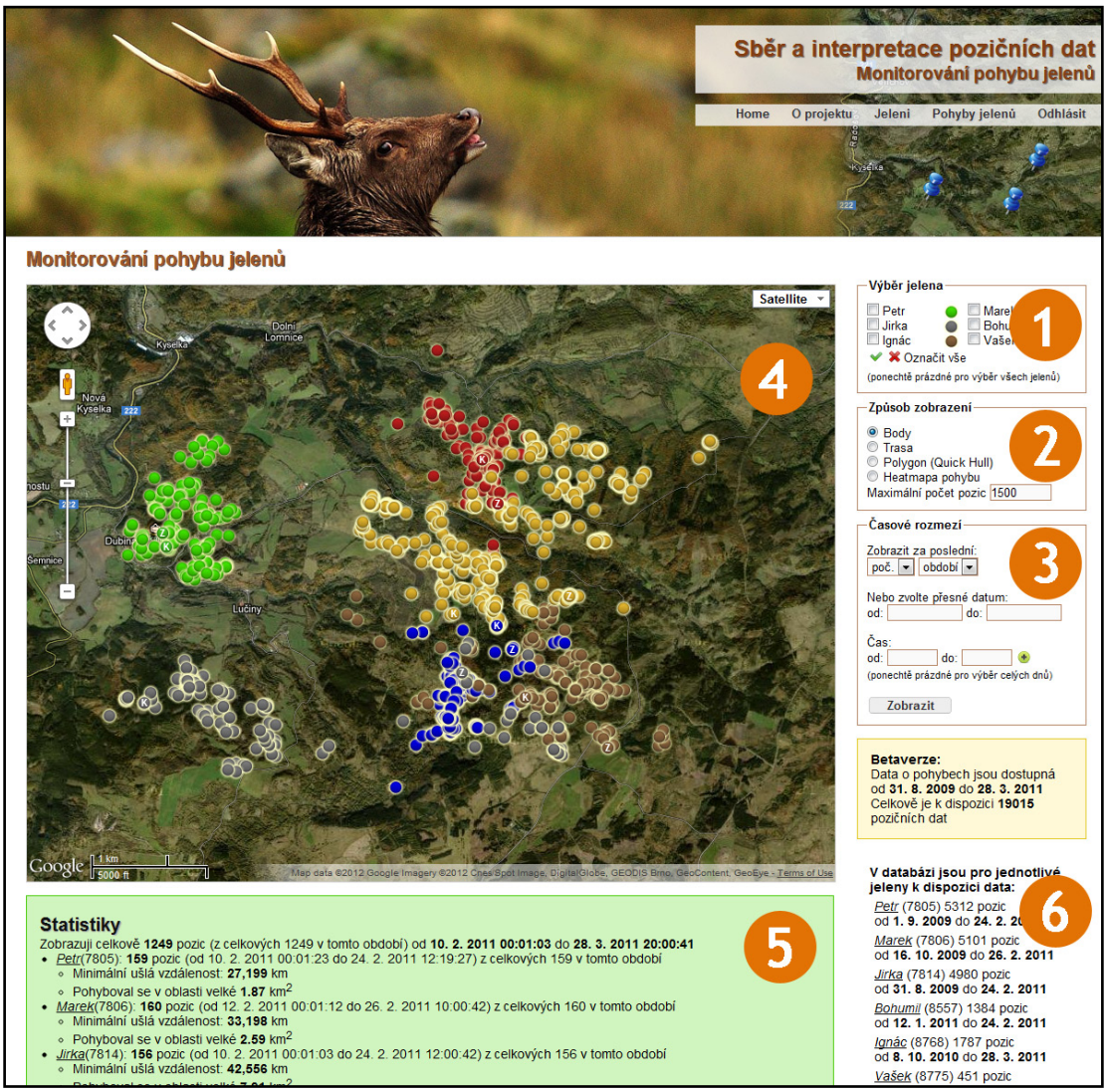

Figure 2. Layout of functions in application window.

The visualization of information about movements was done by means of Google Maps from Google Inc. The communication with Google Maps was maintained through Google Maps JavaScript API V3. The visualization was created with JavaScript framework JQuery.

Users can access the data through common web browsers, and further effort will be put on development of mobile access.

The web interface has basic menu and two other main functions: selection part where the parameters of data selection could be set, and output part where search results are presented – both in visual and statistic way (see the Figure 2). Combination of both functions in the selection part enables us to watch the presence of animals in different time periods and life conditions.

Description of selection part of application:

1 — Deer selection: one or more animals could be selected.

2 — Type of presentation: can be displayed as points of presence, motion path and home range in the form of polygon or motion heat map.

3 — Time period: can be selected as last day, week, month or year, or as a particular period within dates. In both cases the daytime can be specified.

Description of output part of application:

4 — Display of selection in Google Maps where each animal is depicted with different colour - see the colour scheme in „Deer selection“ (1).

5 — Statistic of selected figures – there is the information about the number of points of presence, the length of motion path and size of home range within the selected time period.

6 — Information about all animals – period of observation, total number of measured positions within a time period.

Display of points of presence

The default display of deer position is as points of presence that represent particular positions of animals. By clicking on points other information can be obtained such as time of measurement, temperature and coordinates. GPS collar records the position each thirty minutes. If the data are of a good quality, especially the measured figures are accurate as to the number of located satellites they are stored in the database. The data in database are then requested with selections.

The position data are two dimensional and they are processed by JavaScript code with connection to Google Maps API.

With regard to the response time of the system and different internet connection speed of users, the maximum number of displayed points was limited to 1500. If the limit is exhausted, which could be caused by selection of longer time period or by selection of multiple animals, the points that are over the limit are omitted. In detail, each point at position x is processed with modulo function (that produces the remainder of division of two numbers) such as: number of record MOD each record at position x is equal or not equal (it depends on how many records are over limit) to 0. In final turn, there are displayed up to 1500 records picked up equally

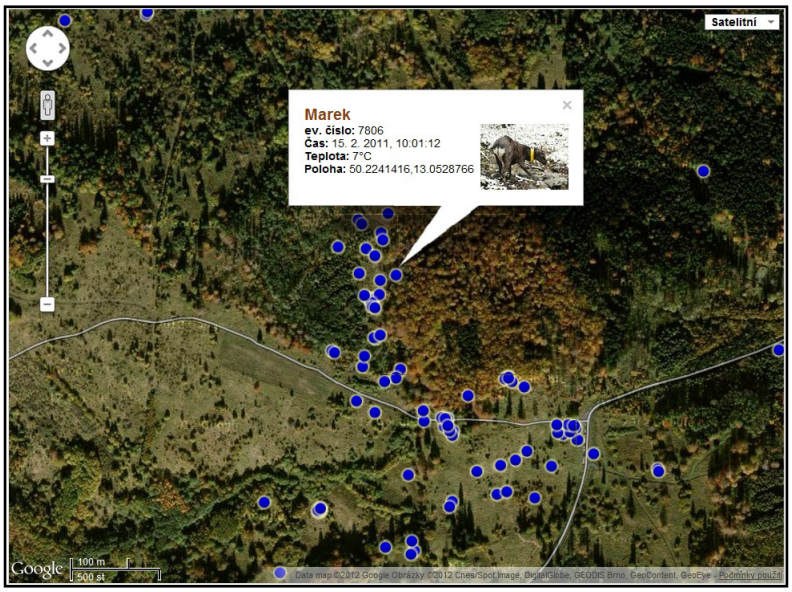

Figure 3. Display of points of presence.

from the series of points.

Theoretical number of recorded positions is 1440, respectively 1488 per month, but in practice, the number of stored positions is approximately a half of it due to the clearance of data. The information about the number of stored positions is displayed in the right bottom corner (see 6).

Motion path

Next function is to display the motion path of selected animal. There are lines connecting the individual point of presence forming so-called PolyLines which are projected through Google Maps API. In the middle of each line, there is an arrow presenting the direction of motion of the object. The start of path is depicted with letter Z and the end of path is depicted with letter K. The coordinates of arrows are calculated as an expected value of two neighbouring coordinates according to the formula (it is the same for both width and length):

$$LATITUDE = L2 - \frac{L2 - L1}{2}$$

L1 – first point latitude

L2 – second point latitude

The angle of correct projection of direction is counted with function arctg, respectively atan2() which is a PHP function.

Minimal passed distance is calculated according to the formula:

$$\$a = \sin\left(\frac{\$dlat}{2}\right)^2 + \cos(\$lat2) * \cos(\$lat2) * \sin\left(\frac{\$dlng}{2}\right)^2$$

$$distance = 2 * \text{atan2}\left(\sqrt{\$a}, \sqrt{1 - \$a}\right)$$

$dlat and *$dlng* – variance between two neighbouring coordinates

$lat1 and *$lat2* – coordinates of latitude,

atan2 – PHP function that gives arctg of two variables.

The value is multiplied by the semi-diameter of Earth (6372,797 km) to get the total distance. Results are available in the application window „Statistisc of selected figures“ (5).

Size of home range – the polygon

One of the most important parameter in observation of spatial activity of cloven-hoofed animals is a definition of home range. The quickhull algorithm (Barber et al. 1996) was utilized for the calculation.

The quickhull algorithm is based on divide and conquer approach (Li and Klette, 2011). The convex hull is constructed of two parts, the upper part called upper hull and the lower part called lower hull.

Upper hull is above the join of two points *q1*; *q3* MBR with extreme coordinates *x, q1 = min(xi), q3 = max(xi),* lower hull is under the join of *q1; q3.*

Above each hull line *a;b* we look for the farest

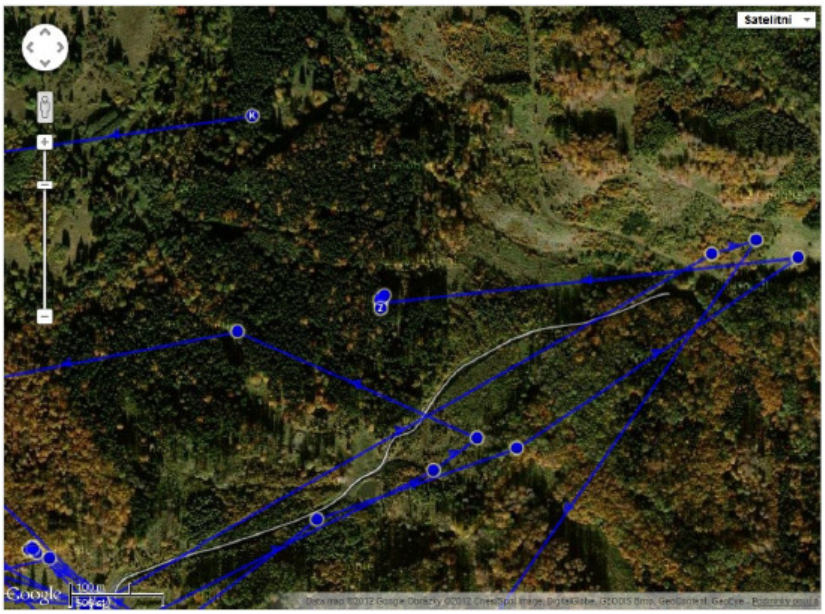

Figure 4. Display of path motion.

point *c* lying right to the line that will become a new point joining the convex hull where each line that was found is disintegrated into two new lines.

Both parts of convex hull are processed separately, and resulting convex hull is a compilation of both parts. When creating a convex hull the algorithm does not operate with all points in the input set, but only with points that are near to convex hull. Despite the quadratic evaluation of the worst case, the good speed of algorithm is ensured by that.

The algorithm utilizes a couple of recursive calls of procedure Quickhull for both newly formed lines *ac, cb* out of original line *ab* (Bayer, 2012).

The size of the polygon (according to the quickhull) where the object was moving is calculated with the

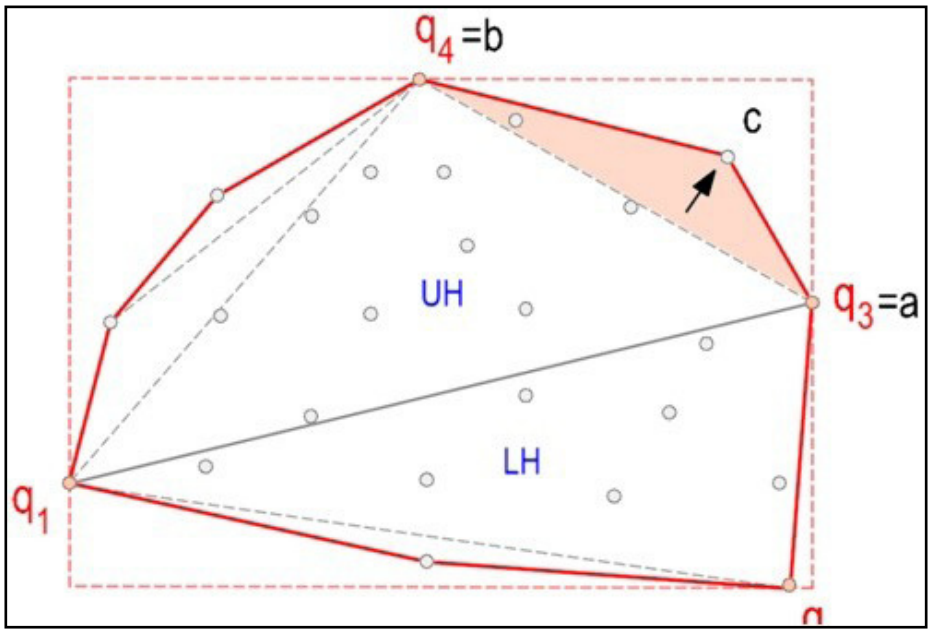

Figure 5. Quick hull construction (Bayer 2012)..

Figure 6. Display of home areas in form of polygons (quick hull).

function Geometry for Google Maps API.

Density of occurance in home range – heat map

The presence of an animal in its home range is not uniform. The heat maps were used to present graphically the points of presence with various density of occurrance (Wilkinson, 2008). The whole interest area is divided into matrices in which points are gradually added. When a new datapoint is added to the heat map‘s store, the store is checking if there is an index for the new data point, if not, it creates one and then checks whether there is a new maximum or not. If there is a new maximum count, the store initiates a global redraw by cleaning the heat map and then redrawing each data point.

In order to get a comprehensible display of home range, the treshold of maximum values display could be set. In our case the treshold value was set to 2. On the same way, the radius of drawn points was set to 15 pixels. The opacity of the heat map was set to 60 %. In the beginning, there is only monochromatic painting that is then repainted with colours. Red colour represents the highest rate of occurrance, yello is lower, while turqouise and blue represent the lowest occurrance of an animal.

Conclusions

There is an on-line access to sika deer observation data in Doupov mountains at the address http://jeleni.agris.cz. The observed deers are monitored with GPS collars that transmitt location data through GSM. The data are purified and stored into the database.

The above mentioned application enables to select data and project them into the map. It could be selected by animals and by time period. Results can be presented in various forms: points of presence, motion path and home ranges depicted as a polygon in the map (quickhull) or as a heat map that represent the density of occurrance. The size

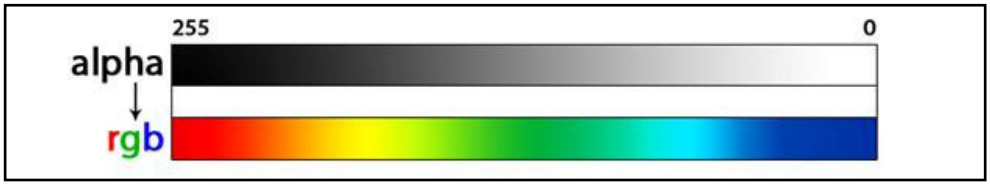

Figure 7. Colour spectrum of density of occurrance as heat maps.

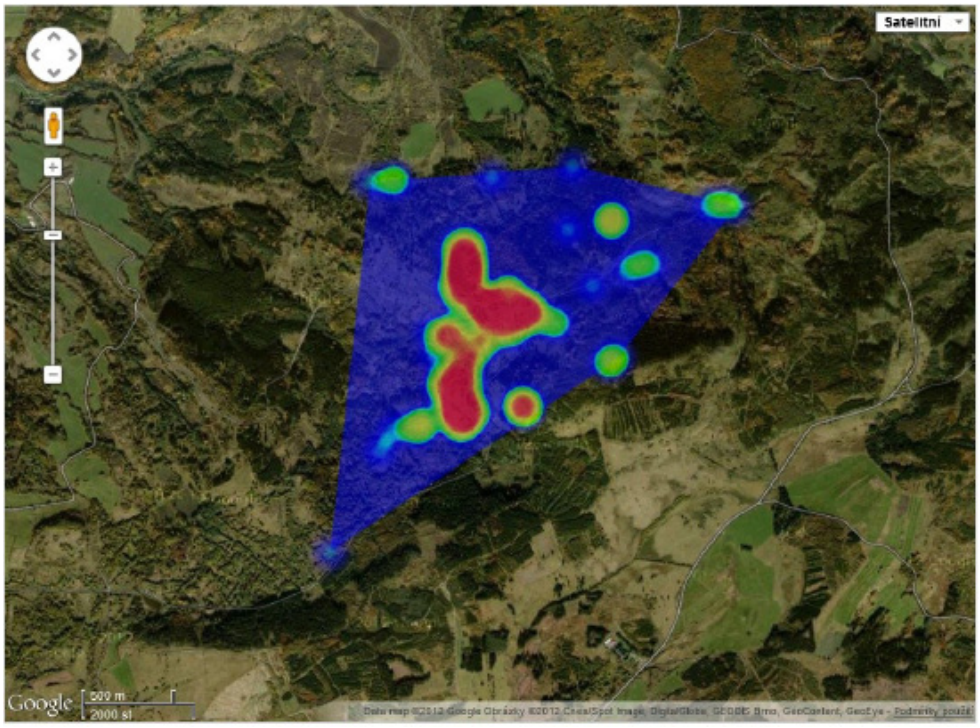

Figure 8. Display of home areas as heat maps.

of polygon and the length of path are summarized with basic statistic characteristics.

The application is designed for employment of retrieved data of deer observation in scientific research and pedagogical activities. Several functions of application will be publicly released to foster the promotion of scientific research in this field.

Other planned activities tend to enable real-time deer observation data collection and their publication on mobile devices.

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Pieces of knowledge introduced in this paper resulted from solution of an institutional research intention. Internal grant agency of the Faculty of Economics and Management, Czech University of Life Sciences in Prague, grant no. 20121043, „Sběr a interpretace pozičních dat“.

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Precise Irrigation Process Support by Using a Computer Based Algorithm of Heuristics

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Abstract

Optimization of production processes are required to provide companies with a competitive advantage. In the production industry this optimization is already under control and optimization of complex end-optimal models has been proposed. Using these model processes in agricultural production is inappropriate because they calculate exactly a process without the influence of random variables and factors. At the present time is usual to develop specific processes operating under ideal conditions. Their disadvantage is that real data from them vary considerably. Therefore, there is a need to develop simple methods and tools which can optimize these processes.

Key words

Irrigation system, queuing theory, precise irrigation, heuristic algorithms.

Introduction

Every process manipulates with a specific object according to exact rules, methods and models. Objects enter to each operation are described by set of physical values, which reflect their current status and their links to other objects and to the environment. Change the input data to the required output data provides an action member. At this point it is important to decide how to achieve the required properties of the final output. Decision making is part of process management control and is determined by a sequence of steps leading from verification of the problem to choosing an optimal variant of the solution. Process optimization involves defining an algorithm for the calculation of ideal output values.

Material and methods

About 70% of global human water withdrawal from rivers, reservoirs, and aquifers is for irrigation of agricultural land, and about one third of global food production relies on irrigation water. Irrigation systems, however, are usually rather ineffective; much of the withdrawn water is lost before it reaches the plants that require the water for optimal growth. The efficiency of irrigation often is lower than half of the optimum (depending e.g. on climate and irrigation system) [1]. From this point of view, simulation models of optimal capacity of irrigation system may have strong effects on the irrigation efficiency. For the simulation modelling is necessary to save the huge amount of data in relational databases and the conventional concept of extraction is required. An analysis of this information is needed for effective decision making in process operation. The algorithm sequence is fixed and depends on a limited number of technological values. These methods are not effective for the precise irrigation process. The application of irrigation water by spraying, as the most widely used method of the artificial delivery of water to crops, requires the operator to have high professional standards. Unlike the commonly applied agro-technical methods, which are one-off, irrigation is split, so it must be repeated over time in the relatively long irrigation season.

The irrigation system remains the weakest part of soil management. Ignoring water regimes of soil and various crops from the beginning to the end of vegetation is large obstacle to economic and ecological irrigation. Research in the irrigation sector has accumulated enough theoretical and practical knowledge and needs only to look for ways and methods as soon as possible to get it into irrigation practice [2].

Whereas the process of reproduction in agriculture is under the influence of many factors that are stochastic, building medium- and large-scale irrigation is not efficient and exactly possible using

traditional methods, without using appropriate mathematical tools, simulation methods of solution and, of course, without the use of modern IC technologies. Simulating methods of operational analysis are effective tools suitable for the analysis and optimization of controlling complex processes and systems for irrigation systems.

The model of irrigation process using queuing theory

The process of irrigation management is relatively complex and has stimulated the development of major changes. A **simulation model** of the irrigation service is suitable for the operational management of irrigation management in terms of appropriate irrigation technology deployment and use in the irrigation process.

Since the model works with a large number of random variables, computer processing is necessary. Analytical solutions of the queuing theory models are from a mathematical point of view very difficult and it is necessary to make some simplifications. Therefore, with the current performance of computing systems the task is much easier solved using heuristic methods. For this purpose it is necessary to establish a simulation model of the system and ensure a sufficient number of times that we have achieved real results [3].

Queuing theory and its exploitation in the control of irrigation

Queuing theory (QT) deals with the study of systems where the process of handling between the „customers“ and „operator“ are created [6], [7], [8], [9], [10], [11]. These two concepts must be understood in the general scope. Resources requirements enter the system at a fixed time or at random times. In the present case, the requirements enter at random intervals. Upon entering the service system the requirement is immediately served if one channel is free. Otherwise, the requirement may be lost. The mechanism of operation is the way how units are selected from the waiting queue for a channel of service. We distinguish two types of service [4]:

a) a system without priority - processing according to specific criteria

b) a system with priority – system FIFO, requirements are processing in the order they enter in the system.

In the case of the irrigation system, the queuing system consists of service channels, which serve the requirements of current plants to supply additional irrigation. If the existing channels are not able to immediately serve the incoming requirements, they leave the system without serving, or are in the waiting queue, where they are selected according to criteria given previously. This priority is necessary in the event that water demand is appearing for those crops which are economically important or non-delivery of irrigation causing great economic damage.

Stochastic elements in the case of irrigation system are:

- the input stream of requirements,
- the time longitude of the requirements service.

The input stream of requirements

The input stream of requirements is a random process in continuous time, but with discontinuous requirements. The main majority of queuing models describe the input stream by a Poisson distribution. The probability that the providing system access k requirements for the time interval t is described by the Poisson distribution given by [5]:

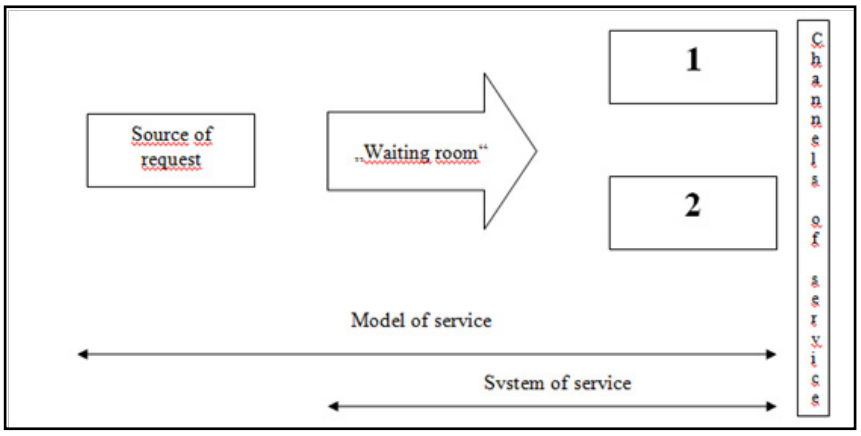

Fig. 1: The scheme of system of queuing theory

$$P_k(t) = \frac{(\lambda \cdot t)^k}{k!} \cdot e^{-\lambda \cdot t} \quad (1)$$

where λ represents the inputs, the number of inputs per unit of time.

In terms of applications in queuing theory, it is essential that the intervals between inputs are exponentially distributed. In terms of the model's practical application are important characteristics of independence, stationary and ordinary, which determine the conditions under which one is able to use the model with the Poisson distribution.

The time longitude of the requirements service

The time operator is the second important parameter in the queuing system, which determines their capacity. There are several factors influencing the service time and therefore it is needed to consider it as an exponentially divided variant with a distribution function [5]:

$$F(t) = 1 - e^{-\frac{t}{t_0}} \quad (2)$$

where t_0 is a mean time of service.

Exponential distribution of the time operator assumes that the majority of the operator is realized for a short time. The time longitude of the requirements service depends on several factors. Most interesting cases arise if the time of service depends on a long waiting queue.

The channels structure

This includes a number of channels and their mutual arrangement. In the base models is assumed parallel involvement of channels with one waiting queue. In the complex one is considered with the serial connection of channels, where each has its own waiting queue, or even with a multistage system of service and at each stage work several parallel channels.

Indicators of efficiency

There are relative or absolute values that characterize the degree to which the system performs the envisaged tasks. From the point of view of their content, they can be divided into parameters characterizing service quality and parameters characterizing the channel exploitation. Crucial elements of queuing appear:

- The input stream of requirements, its intensity, i.e. the average number of requests for service per unit time or the average length of the interval between two requirements.
- The channels of services, which carry out service features, their number and the average time needed for handling one request.
- Waiting queue and its restrictions.

The function of the queuing system is given by the mutual interaction of these three elements and can be expected from their parameters to be derivate global characteristics of the queuing system, called **indicators of efficiency** of queuing service. The choice of features first of all depends on the type of system and has to give a picture of the quality of service and the degree of utilization of queuing the system. This is a numeric type characteristic and the probability of mean values.

The number of channels of services ***n***, the density of the input stream of requirements λ, the mean service time for one requirement by one single channel t_{ob} and the mean waiting time for service $t_č$, are the quantitative characteristics of the queuing process. If these values are known, it is possible to mathematically describe the process of queuing and thus predict the progress of this process in the future.

These procedures are used in modelling the irrigation system together with mathematical models of irrigation systems, where the queuing theory is using for developing of analytical solution of model of irrigation system. There are also designed algorithms of irrigation systems for each model.

Results and discussion

This paper deals with the possibility of creating functional methods of process control of artificial irrigation using modern computing technology. The proposed solution is based on current existing processes and models [5] and adds new knowledge. The aim is not to change or modify the currently used procedures and processes that have been verified by practice, but to help them optimize the new capabilities that enable these processes to optimize and increase the efficiencies of operations using modern information technologies. This area of investigation is complex, involving a large number of aggregated methods and procedures.

This work is specialized in creating optimized processing flow of input requirements with priority, where it focuses on the evaluation of priorities and the inclusion of requirements in the waiting queue. Whole process of statistical output are analysed and results are compared with other irrigation methods. All information and the history of operations are

recorded and used for further processing. The aim is to continually refine and enhance the productivity of irrigation on the processed information from databases.

Modelling of processes in agricultural production requires the use of sophisticated tools. Processes and materials have highly stochastic and dynamic characters.

For the purposes of creating functional models of irrigation management it is necessary to record the status of soil and environment. States are divided into the following groups:

1. Parameters and variables bound to the current state of plants, respectively a set of plants of a particular sector.
2. Parameters and variables describing the environmental status of a particular sector.
3. Parameters and global variables.
4. Parameters and variables bound to the irrigation process.

Each of these groups determines the set of physical parameters describing the current status. The process of precise irrigation requires the efficient management of irrigation, and the following parameters to be measured:

- the current temperature in the sector,
- the current soil moisture in the measured area.

Based on this information the priority requirements may be assessed and thereby added to the waiting room to be served by the channel of service.

The result of the algorithm determines the effective value priorities and requirements of its proper order in the waiting order.

Ways of defined problem solution

The essence of the solution is an effective repository of collected data, which provides the necessary information relevant to the evaluation of the algorithm. The second part is the actual algorithm based on an heuristic analysis of available data indicating the value of priority requirements. There are several groups of algorithms corresponding to the fundamental questions of queuing theory:

- algorithm for determining priorities and front enlistment,
- algorithm for front update depending on the application data,
- algorithm for specification of channel of service,
- algorithm for filtering input data.

In this project, the algorithm of requirements priority determination is optimised. Similar procedures can be applied to other parts of the decision making process in determining the dose of moisture for plants.

The solution is to provide relevant information to determine the optimal operating sequence of the operations performed. The effectiveness of the proposed solutions will be judged on the basis of comparisons carried out experimentally and by comparing the measurements of values in real terms.

Database storage of analyzed Data

The standardized storage of the obtained data is a relational database. Because describing reality in complex simulation models based on relational databases is difficult and not effective, a technology of hybrid object-relational database system is used. The main advantage is the arrangement of data structure, precise modelling of processes of irrigation and quick access to hierarchical data. We are implementing Object properties such as object inheritance, time links and object links between objects are implemented. These properties give more possibilities of quick access to relevant data the possibility to lookup data from different angles of view. Another site is using Data Sets, which are represented as effective segments of the entire data model. This allows the evaluation of data in the logic of a database engine; it suppresses need of evaluation on side of application logic.

The determination of priorities of requests in QT requires the following data structures:

- Classification and definition of cultural crops
  - Basic properties
  - Moisture and temperature requests during vegetation
  - Economic importance of crops (like coefficient of economic rentability)
  - Moisture resistance
- Definition of measured sectors
  - Basic information
  - Position and allocation of seed plan
  - Yield history and irrigation history
- Input application data
  - Measured data form sectors

- Global parameters and conditions
- Time stamps (last irrigation time stamp etc.)

Procedure of data analysis

Each described structure is part of algorithm evaluation. Application data from measured sectors are then are posted to the database with a time link. Information is imported to the system by a TXT type file, which is generated by physical sensors. The procedure of analysis is as follows:

1. Identification of file change LOG – by date and time of last edit
2. Verification of import file – check the correct file structure. If indicated error, file is deleted.
3. Import filter – checks values in range of minimal and maximal values
4. Request generation and values posting to database application logic
5. Run of evaluation algorithm
6. Posting of result value to the „waiting room“ front
7. Export to external format

Algorithm of evaluation

Evaluation of the created request in the system passes several steps. First is defined an instance of request with appropriate properties. Then is request running test procedures, which results are stored in instance of request. Values were determined in an interval from 1 to 100. After finishing all tests is the whole request verified and finally is called the evaluation method, which summarizes all results and returns values of priority. Priority is in interval 1 to 100 too (100 id highest priority). After that, request object is sent do the front enlistment, where on base of priority value is object written to the front and calls method of export file update.

For an example of a test, is the irrigation urgency determination test of dedicated sector. We are testing date and time of request generation against date and time of last executed request in the dedicated sector. The value of result is calculated according to result table.

$$H_{12} = \frac{\Delta T_Q}{T_D} * R \qquad (3)$$

where H_{12} is coefficient of time,

ΔT_Q is DateDiff between current and last irrigation request,

T_D is optimal irrigation interval determined by average of last 24 DateDiff`s.

R is a coefficient of moisture resistance

Export format is a XML file containing actual front of requests in system. XML file is updated immediately after order change (open by XML parser, update, save). This XML type file can be starting point for next analysis, or can be distributed and printed as final result in HTML code web page. That provides needed information about status and priority of irrigation in terrain.

Conclusion

The definitive effect of process optimization is getting in importance, depending on the size of irrigated area in the number of sectors and the number of technical resources. In small agricultural units we do not expect a visible effect of applying this method of process optimization.

The expected trend in the near future is a significant turnover in irrigation studies, as possibility how to solve the current problems. Some intensification tools have achieved a roof effect and therefore producers are looking for sub-options.

***H* value**	**Output Result of Test**
< 0,7	0
0,7 – 0,9	Cumulative 1-20 step by 0,01
0,9 - 1	Cumulative 20-40 step by 0,005
1-1,1	Cumulative 40-60 step by 0,005
1,1 – 1,2	Cumulative 60-70 step by 0,01
1,2 – 1,3	Cumulative 70-80 step by 0,01
1,3 – 1,5	Cumulative 80-99 step by 0,01
> 1,5	100

Table 1 Result table of H12 coefficient.

The wide cause of this state is extreme environment behaviour, which cannot guarantee an adequate supply of moisture during the vegetation period.

Finally, it calls for socio-political pressure to support the idea of organic Agriculture, to which irrigation also belongs.

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Development of Agricultural Trade of Visegrad Group Countries in Relation to EU and Third Countries

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Anotace

Navzdory kontinuálně rostoucí hodnotě agrárního obchodu České republiky, Maďarska, Slovenska a Polska, agrární obchod v případě všech zemí Visegradské skupiny představuje pouze marginální část celkového zbožového obchodu. Agrární obchod jednotlivých analyzovaných zemí je jak z hlediska komoditní, tak i teritoriální struktury velmi výrazně koncentrovaný. Převážná většina agrárního obchodu – jak exportu, tak i importu – je realizována ve vztahu k zemím EU. Tyto země participují na agrárním obchodě jednotlivých zemí skupiny V4 z více než 80 %. Pakliže se zaměříme na vlastní cíl příspěvku kterým bylo identifikovat komparativní výhody agrárního obchodu zemí V4 v oblasti komoditní a teritoriální struktury a to jak ve vztahu ke globálnímu trhu, tak i ve vztahu k zemím EU27, lze uvést následující. Agrární obchod ČR, SR a Maďarska jako celek nedisponuje komparativními výhodami jak na trhu globálním, tak ani na vnitřním trhu zemí EU. Polsko jakožto jediný zástupce zemí V4 však komparativními výhodami v oblasti agrárního obchodu disponuje a to jak ve vztahu k vnitřnímu trhu zemí EU, tak i ve vztahu k trhu globálnímu (k trhu třetích zemí). Zaměříme-li se na teritorium zemí EU27, které představuje hlavního obchodního partnera všech analyzovaných zemí, a to jak z hlediska exportů, tak i z hlediska importů, lze konstatovat, že ačkoliv ČR, SR a Maďarsko nedisponují komparativními výhodami v oblasti agrární obchodu k EU jako celku, na úrovni bilaterálních vztahů s jednotlivými členskými zeměmi EU jsou schopny komparativních výhod dosáhnout.

Klíčová slova

Agrární obchod, celkový obchod, podíl, Visegradská skupina, export, import, trh, svět, Evropská unie, konkurenceschopnost, postavení, struktura, komodity, teritoria, trend, vývoj.

Abstract

Despite the continually growing value of agricultural trade of the Czech Republic, Hungary, Slovakia and Poland, agricultural trade in the case of all of the countries of the Visegrad group represents only a marginal part of the total merchandise trade. The agricultural trade of the individual analyzed countries is, both in terms of the commodity structure as well as the territorial structure, very distinctly concentrated. The overwhelming majority of agricultural trade – export as well as import – je conducted in relation to EU countries. These countries participate in agricultural trade of individual countries of the V4 group with a share of over 80%. If we focus on the actual objective of the article, which was to identify the comparative advantages of agricultural trade of the V4 countries in the area of commodity structure and territorial structure, both in relation to the global market, as well as in relation to EU27, the following may be stated. The agricultural trade of the Czech Republic, Slovakia and Hungary as a whole does not have comparative advantages either on the global market or on the internal market of the EU countries. However, Poland as the only representative of the V4 countries has comparative advantages in the field of agricultural trade, in relation to both the internal market of the EU countries, as well as in relation to the global market (to the market of third countries). If we focus on the territory of the EU27 countries, which represents the main trading partner of all of the analyzed countries, both in terms of exports as well as in terms of imports, it may be stated that despite the fact that the Czech Republic, Slovakia and Hungary do not have comparative advantages in the area of agricultural trade in regard to the EU as a whole, they are able to achieve comparative advantages at the level of bilateral relationships with individual member countries of the EU.

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Key words

Agricultural trade, total trade, share, Visegrad group, export, import, market, world, European Union, competitiveness, position, structure, commodities, territories, trend, development.

Introduction

In the current world, the agricultural sector represents one of the fundamental pillars of the global economy (Coleman, Grant, 2004). Agricultural trade itself together with agricultural production represent the key factors stabilizing the development of society anywhere in the world (Aksoy, Beghin, 2004). For such reason, agricultural production and trade in agricultural and food production thus become a part of the strategic planning of all economies in the world. The European Union and its policy distinctly support agriculture in the individual member states. The agricultural sector is the subject of a whole range of subsidies coming from supranational as well as national and regional sources. The objective of such subsidies is to carry out the objectives associated with the existence of the Common Agricultural Policy of the EU countries. Such policy is further also supported by a whole range of other EU activities. A significant factor affecting development on the EU agricultural market is the existence of the EU Common Commercial Policy, which, in the context of the single market of the EU countries, represents a sort of shield protecting the EU internal market from uncontrolled imports of goods from abroad (Svatoš, 2008). Under the EU interpretation, the agricultural market represents a specific mechanism that affects all of the individual member countries of the EU. The core of such market is represented by the old member countries of the European Union (EU15), which together represent the predominant volume of agricultural production of the EU countries (Aksoy, Ng, 2010). The dominance of such countries over the new member countries of the EU (EU12) can be demonstrated, for example, through the share of the EU15 countries in the total agricultural trade of the EU27 countries (the share in the total value of exports regardless of whether it is internal or external trade), which ranges around a 90% level. Nevertheless, although new member countries participate in the agricultural production and trade much less significantly as compared to the old member countries, it may be stated that entry into the EU was, at least in terms of the development of the value of agricultural trade, significantly beneficial for them (Pokrivčák, Drabík, 2008) – while in the years 2004 – 2010 agricultural trade of the EU15 countries increased its value by approximately 60%, the value of agricultural trade of EU12 countries increased by more than 160%. The year-on-year growth of the value of effected exports is, in the case of the EU12 countries, more than double as compared to the EU15 countries, and, at the same time, changes in the structure of export are also occurring, where it can be clearly seen that in the case of the majority of the new members of the EU, aggregations with a higher rate of added value are starting to come to the foreground within export, which positively affects not only the resulting balance of agro-trade, but also the structure of the agro-complex of individual countries. However, it is necessary to emphasize that the majority of agricultural trade in the case of EU12 as well as EU15 countries is carried out within the internal market of the EU27 (Bussière et al., 2008). The share of the value of exports conducted within the internal market in the years 2004 - 2010 rose in the case of EU12 countries from approximately 70% to more than 80%, and in the case of EU15 countries the share of exports carried out within the EU27 market remains stable at a level of approximately 80%. In this regard, it is important to also mention that the value of executed contracts is growing both in regard to the internal market of the EU countries, as well as in relation to the external market – whereby both in the case of the new as well as in the case of the old member countries, the generator of growth in the value of agricultural trade is the internal market of the EU. A specific characteristic that sets the old and new EU member countries apart from each other is the process of the restructuring of the agricultural market. While the old member countries have already gone through the restructuring process long ago, such process is not even close to being finished in the case of the new member countries (Smutka, Belova, 2011). The above thus shows that the agricultural sector, and in general the trade of the new member countries, were very significantly affected by entry into the EU (Bojnec, Ferto, 2009).

The article in question focuses on the issues of the development of agricultural trade the selected segment in countries that have recently joined the EU and how their agricultural sector, and, in general, agricultural trade, were affected by the process itself associated with accession to the EU, and further, how their agricultural sector, or trade in agricultural production, was affected by membership in the EU itself. In this regard, the

article focuses on the development of agricultural trade of four central European countries that are joined by a common history and strong economic and political ties. The individual countries of today's Visegrad group (Czech Republic, Slovakia, Poland and Hungary) – hereinafter referred to as the V4 countries – have, within the past years, undergone stormy development, which has very significantly affected the structure of their economies including the agricultural sector and trade in agricultural products (Lukas, Mladek, 2006). Immediately after the break-up of the so-called eastern bloc, the Council for Mutual Economic Assistance, and the Soviet Union, a very significant economic decline occurred in the case of all of the analyzed countries, which was related to the collapse of the former socialist system and primarily its market.

The agricultural sector suffered very significant losses in the period of the transition from a centrally planned economy to a market economy (Bartosova et al., 2008). Reforms pertaining to the restructuring of the national economy very significantly affected the scope and position of the agricultural sector within the economies of the individual countries (primarily, there was a reduction in the volume of animal production and a decline in the number of workers in the agricultural sector). Such developments resulted in a decline in the level of self-sufficiency of the individual countries in regard to supplying their own markets. That was reflected primarily in the case of the Czech Republic and Slovakia (Basek, Kraus, 2009; Hambálková, 2008). Agricultural trade was also affected by a number of changes that occurred within such period. The changes pertained to both exports as well as imports. Immediately after the collapse of the market of the countries of the Council for Mutual Economic Assistance, fundamental changes occurred, entirely logically, not only within the territorial structure of the agricultural trade, but, in time, the commodity structure of agricultural trade also started to transform. The individual countries of today's Visegrad group opened their markets up more to imports of a whole range of products primarily from countries outside of the former eastern bloc. Further, there was also a significant restructuring of the territorial structure of agricultural export, whereby such countries gradually reoriented their trade flows from the former eastern bloc countries to European Union member countries and, in time, also to countries that were candidates for EU membership (Bojnec, Ferto, 2009).

In May of 2004, the countries of the V4 group became full-fledged members of the EU. Entry into the EU meant very significant changes in the area of agro-trade for the individual countries. The Czech Republic, Slovakia, Hungary and Poland became a part of the single market of the EU countries and all barriers limiting the movement of goods among such countries and EU15 countries up until that time came down. Additionally, the barriers affecting agricultural trade among such countries themselves and further new EU member countries, which simultaneously expanded the EU, also came down (Svatoš, 2010). Thus, although barriers between individual EU members (in this case including the V4 countries) were eliminated in May of 2004, agricultural trade between EU countries and non-EU-member countries remained limited by existing barriers to trade caused by the existence of Common Commercial Policy and Common Agricultural Policy of the EU countries (Drabík, Bártová, 2008). Such fact affected the trade of the V4 countries with regions lying outside of the market of the EU countries.

The text in question focuses on the issues of the development of agricultural foreign trade of the Visegrad group countries (Czech Republic, Hungary, Poland and Slovakia – hereinafter also referred to as the V4) with the goal of identifying its comparative advantages in the field of commodity structure and territorial structure, both in relation to the global market (the market of third countries lying outside of the EU), as well as in relation to EU27 countries – in this regard.

Materials and methods

In terms of the methodological issues, the analysis focuses on development of agricultural trade in relation to the EU27 countries and non-EU countries ("Third countries"). Further, it is also important to mention that in analytical terms, the entire text is (if the data allowed for it) compiled from the viewpoint of the development of agricultural trade and other variables relating thereto within the scope of time including the period of the years 2000 - 2010.

In terms of the uniformity of the data source, the UN COMTRADE database was selected as the central source of data. The selected database enables the monitoring of the development of merchandise trade (including its agricultural and food sections) according to the Standard International Trade Classification (SITC). The selected nomenclature enables the classification of merchandise trade into ten basic commodity classes (individual classes subsequently contain thousands of individual items representing the final structure of merchandise trade). For the purposes of the conducted analysis, the processed data are on the agricultural trade level

(sum of SITC aggregations 0,1 and 4), trade in fuels and mineral resources (sum of SITC aggregations 2 and 3), and, further, trade in processed industrial products (sum of SITC aggregations 5, 6, 7 and 8). In view of the fact that the main objective of the article in question is primarily the analysis of the competitiveness of agricultural trade of the individual V4 countries, it is divided up into 15 aggregations for the purposes of a more detailed analysis of agricultural trade. The following Tables 1 and 2 provides a brief overview of SITC nomenclature used for the analysis.

The actual data obtained from the above-mentioned database are processed in terms of the development of the actual value of the effected exchange (in current prices in American dollars USD). The analysis itself focuses on the issues of agricultural trade of the V4 countries in relation to agricultural trade in the world and in EU countries. It is conducted by way of the utilization of basic statistical characteristics, such as the basic index, chain index and geometric mean. A great portion of the analysis is also conducted by way of indices, the objective of which is the characterization of the comparative advantages of V4 agricultural export (the work utilizes modified Ballas indices RCA, and the Lafaye index is also used). The Ballasa index provides a simple overview of the comparative advantage distribution (e.g., Proudman and Redding, 2000; Hinloopen and Marrewijk, 2001).

Revealed comparative advantage index (RCA1 – global/regional level)

$$RCA1 = (Xij/Xnj)/(Xit/Xnt)$$

where:

- X represents exports
- i represents the analyzed country
- j represents the analyzed sector of the economy (sector of industry or commodity)
- n represents the group of countries or world
- t represents the sum of all sectors of the economy or the sum of all commodities or the sum of all branches

SITC (code)	Agregation
0	Food and live animals
1	Beverages and tobacco
2	Crude materials, inedible, except fuels
3	Mineral fuels, lubricants and related materials
4	Animal and vegetable oils, fats and waxes
5	Chemicals and related products, n.e.s.
6	Manufactured goods classified chiefly by material
7	Machinery and transport equipment
8	Miscellaneous manufactured articles
9	Commodities and transactions not classified elsewhere in the SITC

Source: UN COMTRADE, 2012

Table 1 SITC – Basic classification of merchandise trade.

S3-00	LIVE ANIMALS	S3-08	ANIMAL FEED STUFF
S3-01	MEAT, MEAT PREPARATIONS	S3-09	MISC.EDIBLE PRODUCTS ETC
S3-02	DAIRY PRODUCTS,BIRD EGGS	S3-11	BEVERAGES
S3-03	FISH,CRUSTACEANS,MOLLUSC	S3-12	TOBACCO,TOBACCO MANUFACT
S3-04	CEREALS,CEREAL PREPRTNS.	S3-41	ANIMAL OILS AND FATS
S3-05	VEGETABLES AND FRUIT	S3-42	FIXED VEG. FATS AND OILS
S3-06	SUGAR,SUGR.PREPTNS,HONEY	S3-43	ANIMAL,VEG.FATS,OILS,NES
S3-07	COFFEE,TEA,COCOA,SPICES		

Source: UN COMTRADE, 2012

Table 2 List of aggregations representing commodity structure of agricultural trade.

The RCA1 index analyzes the exporting of commodity "j" in the case of country "i" in proportion to the total exports of the given country and the corresponding total exports of the analyzed group of countries or of the whole world (Hinloopen, Marrewijk, 2001). A comparative advantage is then proven if the RCA1 index value is greater than 1. If, however, the result of the calculated index is less than 1, it may be asserted that the given country has a competitive disadvantage in the case of the given commodity or group of commodities (Qineti, Rajcaniova, Matejkova, 2009). The bilateral comparative advantage of total agrarian trade also individual items of the Czech, Hungarian, Polish and Slovakian agrarian export with respect to selected countries is analysed by means of the Lafay index. Apart from export flows, the Lafay index (hereinafter only the LFI index) also takes into account import flows. As opposed to the standard RCA index, its advantage is its ability to take into account the intersectoral trade and also re-export. In this respect, its information value is stronger as compared to the traditional index of the obvious comparative advantage (Balassa, 1965). It is suitable to utilize this index in the cases when a relationship between two business partners is analysed. The advantage of the LFI index as compared to the RCA index is also its ability to include any distortions caused by macroeconomic fluctuations (Fidrmuc et al., 1999). The LFI index enables to analyse the position of every specific product within the foreign trade structure of every specific analysed country or a group of countries (Zaghini, 2003). The LFI index for the given "i" country and for every "j" analysed product or group of products is defined in the following formula:

$$LFI^i_j = 100 * [((x^i_j - m^i_j) / (x^i_j + m^i_j)) - (\sum^N_{j=1}(x^i_j - m^i_j)) / (\sum^N_{j=1}(x^i_j + m^i_j))] * ((x^i_j + m^i_j) / (\sum^N_{j=1}(x^i_j + m^i_j))$$

x^i_j and m^i_j represent exports and imports of "j" product realized by "i" country or a group of countries with respect to the rest of the world or with respect to a selected business partner (partner country). "N" is the number of analysed items (Lafay, 1992). The positive value of the LFI index indicates existence of a comparative advantage within the analysed traded aggregation or a group of aggregations in question. The higher is the resulting value of the index, the higher is the level of specialization of the country in question as regards trade with the given item or a group of items representing agrarian and food trade in this case. And vice versa, the negative value of the LFI index signals that specialization and hence comparative advantages are lacking (Zaghini, 2005).

Results and discussion

General characteristics of global merchandise and agricultural trade with a focus on EU countries

World merchandise trade in the years 2000 – 2010 increased very significantly in value and volume. A contributing factor in the growth in the value of world trade was also a relatively high growth of GDP primarily within the second half of the 1990's, which continued on a global scale until 2008, when the growth of the world economy was stopped by the global crisis, which had the greatest impact primarily on highly developed regions of the world, including Europe and the European Union. The process of liberalization of world trade has also contributed to the growth of world trade primarily within the last two decades (Potter, Tilzey, 2007). Liberalization within the Uruguay round of GATT opened up a very significant space for the development of global merchandise trade – including agricultural trade. Thus, since the 1990's (other than certain fluctuations, e.g. in 2001 and 2009), global trade has constantly been increasing in value. This has been occurring within all of the monitored segments of merchandise trade. Just in the years 2000 – 2010, the value of merchandise trade in the world increased from approximately USD 6 billion to more than USD 10 billion (however, it must be noted that the growth in the value was significantly accelerated by a decline in the rate of the USD within the monitored decade). Nevertheless, if we consider the growth in the volume of trade, it may be stated that in the course of the monitored period the actual volume of global trade increased by approximately 50% - which represents a very significant increase in terms of a relatively short time period. Merchandise trade of EU countries within the monitored period also increased very significantly. Just in the years 2000 – 2010, it increased from USD 1.5 billion to more than USD 3 billion, whereby it reached its peak in 2008, when its value ranged at about the level of USD 3.8 billion (details pertaining to the development of merchandise trade of the EU countries and total world trade can be found in Table 3). The said table further also shows development in the area of the commodity structure of world and Union merchandise trade.

In terms of value, agricultural trade represents the least significant component of world and Union merchandise trade. In world trade (without Union intra-trade), agricultural trade has a share of approximately 7%. The share in Union trade is approximately 10%. If we focus on the dynamics

In bil. USD													
World	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2000-2004**	**2005-2008**
Agricultural prod.	401.6	416.7	442.9	512.2	585.9	638.2	709	850.4	1023.2	913.9	1007.6	2359.2	3220.9
Fuels and Raw mat.	814.2	746.9	754.5	917.3	1197.9	1559.7	1985.9	2151.7	3043.9	1969.5	2493.6	4430.8	8741.2
Processed prod.	4926.6	4776.9	5046.5	5842.3	7053.1	7772.5	8956.2	10259.4	11268.4	9050.3	10758	27645.4	38256.5
EU27	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2000-2004**	**2005-2008**
Agricultural prod.	131.3	137.6	151.3	185	212.8	228.9	249.5	299.5	350.2	312.6	322.3	818	1128.1
Fuels and Raw mat.	103.4	96.4	100.8	124.3	160.3	194.7	237	262.5	333.7	209.3	274.3	585.1	1027.8
Processed prod.	1326.4	1342.9	1442	1732.1	2081.8	2196.7	2498.8	2908.2	3108.3	2393.5	2607.1	7925.2	10712
Inter annual growth rate (chain index)													
World	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2000-2004**	**2005-2008**
Agricultural prod.		1.038	1.063	1.156	1.144	1.089	1.111	1.199	1.203	0.893	1.103	1.099	1.15
Fuels and Raw mat.		0.917	1.01	1.216	1.306	1.302	1.273	1.083	1.415	0.647	1.266	1.101	1.263
Processed prod.		0.97	1.056	1.158	1.207	1.102	1.152	1.146	1.098	0.803	1.189	1.094	1.124
EU27	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2000-2004**	**2005-2008**
Agricultural prod.		1.048	1.1	1.223	1.15	1.076	1.09	1.2	1.169	0.893	1.031	1.128	1.133
Fuels and Raw mat.		0.932	1.046	1.232	1.29	1.215	1.217	1.107	1.271	0.627	1.31	1.116	1.201
Processed prod.		1.012	1.074	1.201	1.202	1.055	1.138	1.164	1.069	0.77	1.089	1.119	1.105

Source: Comtrade, own processing, 2012

Table 3 Development of global trade in the years 2000 – 2010.

in the area of the development of global and Union agricultural trade, it may be stated that agricultural trade of EU countries shows lesser dynamic of growth as compared to the development of global agricultural trade. In view of the fact that agricultural trade of EU countries is based primarily on processed food products, the global economic crisis in recent years has had a more significant impact on it than on the global foodstuffs market – that pertains primarily to the year 2010, when the value of the global foodstuffs market grew by approximately 10%, while the value of Union trade in agricultural production only grew by 3%. In this regard, it is appropriate to further state that the crisis in the area of merchandise trade as well as agricultural trade had a much more significant impact on EU15 countries as compared to the new member countries – even though such countries also experienced a whole range of problems associated with the global economic crisis.

Development and structure of merchandise trade of the Visegrad group countries with a focus on agricultural trade

The countries of the Visegrad group are representatives of the new member countries of the EU. A general characteristic of such countries is their very significant orientation toward foreign trade, which is primarily significant in the case of the Czech Republic and Slovakia, as well as in the case of Hungary. Poland also likewise significantly engages in foreign trade activities, but nevertheless, the share of foreign trade in the Polish GDP is significantly lower in comparison with the share of foreign trade in the GDP of the Czech Republic, Slovakia and Hungary. If we analyze the commodity structure of merchandise trade of the V4 countries, we find that it is dominated (both in the case of export – Table 4, as well as in the case of import – Table 5) by trade in processed industrial products. Further, it is also important to state that

Export		bil. USD	2000	2002	2004	2005	2006	2007	2008	2009	2010	Inter annual growth rate – average value
CR	EU27	Agriculture	0.86	1.19	1.89	2.58	2.88	3.98	5.08	4.45	4.51	1.18
CR	EU27	Fuels and Raw mat.	1.79	2.95	3.42	3.91	4.68	5.95	7.75	6.53	8.12	1.163
CR	EU27	Processed products	22.31	33.62	51.84	60.43	72.4	92.88	108.3	82.51	95.11	1.156
SR	EU27	Agriculture	0.32	0.43	0.89	1.29	1.56	2.05	2.24	2.3	2.39	1.223
SR	EU27	Fuels and Raw mat.	1.17	1.26	2.52	2.74	3.15	3.76	4.97	3.71	4.69	1.149
SR	EU27	Processed products	9.17	11.25	20.75	23.73	31.47	44.48	52.59	41.6	46.82	1.177
Hungary	EU27	Agriculture	1.32	1.6	2.52	2.65	2.97	4.67	5.68	4.89	5.25	1.148
Hungary	EU27	Fuels and Raw mat.	0.9	0.95	1.68	2.09	2.1	2.9	3.68	2.53	3.51	1.146
Hungary	EU27	Processed products	20.94	26.15	41.87	43.59	53.57	61.12	68.11	53.41	59.38	1.11
Poland	EU27	Agriculture	1.6	2.03	4.52	6.33	7.94	10.44	13.07	12.04	13.27	1.236
Poland	EU27	Fuels and Raw mat.	2.2	2.68	5.29	5.74	6.44	7.4	9.31	5.63	8.61	1.146
Poland	EU27	Processed products	21.53	28.12	49.47	56.37	70.77	89.89	108.7	88.91	102.12	1.168
CR	World	Agriculture	1.11	1.4	2.18	2.99	3.25	4.37	5.53	4.84	4.94	1.161
CR	World	Fuels and Raw mat.	1.91	3.14	3.63	4.19	4.96	6.28	8.13	6.94	8.69	1.164
CR	World	Processed products	26.03	39.72	59.96	71.02	86.93	110.25	132.43	101.1	118.51	1.164
SR	World	Agriculture	0.37	0.49	0.98	1.41	1.69	2.15	2.37	2.39	2.49	1.21
SR	World	Fuels and Raw mat.	1.22	1.31	2.59	2.82	3.3	3.89	5.19	3.85	4.84	1.148
SR	World	Processed products	10.3	12.67	24.29	27.63	36.69	52.01	62.64	49.31	56.67	1.186
Hungary	World	Agriculture	1.96	2.35	3.41	3.63	4.02	5.72	7.12	5.89	6.5	1.127
Hungary	World	Fuels and Raw mat.	1.02	1.12	2.08	2.7	2.87	4.14	5.33	3.46	4.5	1.16
Hungary	World	Processed products	25.12	30.86	49.98	55.94	67.17	84.73	95.76	73.22	83.7	1.128
Hungary	World	Total trade	28.09	34.34	55.47	62.27	74.06	94.59	108.21	82.57	94.69	1.129
Poland	World	Agriculture	2.43	3.03	6.11	8.36	10.12	12.95	16.13	14.96	16.79	1.213
Poland	World	Fuels and Raw mat.	2.48	3.02	5.94	6.5	7.34	8.34	11.01	6.66	10.07	1.15
Poland	World	Processed products	26.05	34.21	61.73	74.52	92.13	117.49	144.72	115.03	130.21	1.175

Source: Comtrade, own processing, 2012

Table 4 Development of value and structure of foreign trade (export) of Visegrad group countries in the years 2000 – 2010.

the actual territorial structure of merchandise trade of the V4 countries is distinctly oriented toward EU27 countries. Another interesting finding that pertains to the development of merchandise trade of the Visegrad group countries is also the fact that the average year-on-year rate of growth of merchandise trade of the V4 countries significantly exceeds both the average year-on-year rate of growth of the world merchandise trade, as well as the average year-on-year rate of growth of merchandise trade of EU countries. Thus, that also shows a significant increase in the value of effected trading operations in the years 2000 – 2010, when, in the case of exports, there was an increase in value from USD 100 billion to almost 500 billion USD (in the year 2008). In the case of goods imports, the value increased from USD 125 billion to approximately 530 billion (in the year 2008). It is also appropriate to mention that in terms of merchandise trade – the V4 group leaders are undoubtedly Poland and the Czech Republic.

In relation to the position of agricultural trade of the Visegrad group countries within the overall merchandise trade, it may be stated that likewise as in the case of the global and European market, agricultural trade represents only a supplement to merchandise trade. In the case of goods exports and imports, agricultural products have approximately a 7% or 6.2 % share in the total value (data for the year 2010). In this regard, it is important to state that the value of both agricultural exports as well as imports of the V4 countries is dynamically increasing. Just in the years 2000-2010, the value of agricultural export of the V4 countries increased from USD 6 billion to more than USD 30 billion, and in the case of agricultural import, there was an increase in the traded value from USD 6 billion to 28 billion. In terms of their own development of agricultural trade, the V4 countries achieve, other than certain exceptions, a positive balance of agricultural trade. Nevertheless, it is appropriate to state that currently, such positive balance is fully to the debit of the agricultural trade of Poland and Hungary, while the agricultural trade of the Czech Republic and Slovakia regularly finishes in negative values. A further significant characteristic of

Import		bil. USD	2000	2002	2004	2005	2006	2007	2008	2009	2010	Inter annual growth rate – average value
CR	EU27	Agriculture	1.12	1.55	2.59	3.27	3.93	5.04	5.98	5.65	5.64	1.175
CR	EU27	Fuels and Raw mat.	1.45	3.17	2.8	3.18	3.71	4.81	6.1	4.55	5.18	1.136
CR	EU27	Processed products	21.31	29.33	42.87	48.26	57.66	72.76	81.67	58.23	65.45	1.119
SR	EU27	Agriculture	0.59	0.73	1.07	1.56	1.7	2.26	3.03	2.63	2.82	1.169
SR	EU27	Fuels and Raw mat.	0.51	0.73	1.43	1.51	1.79	2.06	2.92	2.27	3.22	1.202
SR	EU27	Processed products	7.81	10.75	17.75	18.45	23.07	29.87	37.1	25.07	28.11	1.137
Hungary	EU27	Agriculture	0.55	0.78	2.02	2.44	2.73	3.45	4.29	3.72	3.82	1.214
Hungary	EU27	Fuels and Raw mat.	0.84	1.03	1.72	2.17	2.66	2.82	3.86	2.97	3.36	1.149
Hungary	EU27	Processed products	19.72	22.46	40.35	38.87	48.91	53.68	59.17	40.02	44.57	1.085
Poland	EU27	Agriculture	1.81	2.04	3.2	3.92	4.59	6.72	9.57	8.03	8.86	1.172
Poland	EU27	Fuels and Raw mat.	1.66	1.58	2.83	3.61	4.46	6.62	8.88	5.72	6.18	1.14
Poland	EU27	Processed products	29.82	34.29	54.62	57.87	69.69	90.1	109.08	76.58	87.6	1.114
CR	World	Agriculture	1.56	2.02	3.27	3.99	4.65	5.99	7.1	6.55	6.65	1.156
CR	World	Fuels and Raw mat.	4.13	7.96	6.47	7.17	10.9	12.03	18.45	11.88	15.19	1.139
CR	World	Processed products	26.55	38.25	56.97	65.37	77.87	98.8	116.28	86.41	103.85	1.146
SR	World	Agriculture	0.71	0.89	1.47	2.05	2.24	3.13	3.97	3.76	3.97	1.188
SR	World	Fuels and Raw mat.	2.73	2.83	4.78	5.69	7.37	8.05	11.36	7.86	10.55	1.145
SR	World	Processed products	9.33	12.91	23.21	26.49	35.15	48.03	57.28	43.53	49.86	1.182
Hungary	World	Agriculture	0.92	1.17	2.29	2.67	2.97	3.79	4.7	4	4.12	1.162
Hungary	World	Fuels and Raw mat.	2.13	3.41	5.34	7.6	6.79	10.15	10.69	6.78	10.74	1.176
Hungary	World	Processed products	29.03	33.03	52.62	55.65	67.22	80.72	93.39	66.49	72.5	1.096
Poland	World	Agriculture	2.86	3.21	4.95	6.13	7.27	10.07	13.6	11.58	13.08	1.164
Poland	World	Fuels and Raw mat.	6.91	6.64	11.11	14.55	16.78	21.16	30.18	18.02	24.18	1.133
Poland	World	Processed products	38.36	44.41	72.1	80.87	101.59	132.94	166.7	119.96	136.87	1.136

Source: Comtrade, own processing, 2012

Table 5 Development of value and structure of foreign trade (import) of Visegrad group countries in the years 2000 – 2010.

agricultural trade of the V4 countries is its distinct orientation toward the market of EU countries – whereby a significant portion of the effected exports as well as imports goes through EU12 countries. An important role in this regard is also played by the actual trade effected between the individual V4 member countries amongst themselves (see the text below).

A specific characteristic of merchandise trade of the V4 countries is the competitiveness of effected goods transactions, both in relation to the market of the EU27 countries, as well as in relation to the market of third countries. In this regard, it is appropriate to emphasize that currently, in terms of the development of the value of effected trade flows, the important thing is primarily the ability to retain comparative advantages in relation to the EU27 market , which represents the main outlet for exports originating from V4 countries. The following Table 6 provides information on the development of values of the RCA1 index in the case of individual goods categories traded by the individual V4 countries. The data shows that comparative advantages are being maintained on a long-term basis by all of the monitored countries primarily in the case of trade in processed industrial products, both in relation to the EU market, as well as in relation to the market of third countries. Trade in fuels and mineral resources is, as a whole, uncompetitive on a long-term basis, both in relation to EU countries, as well as in relation to third countries. As regards agricultural trade, there we can state that agricultural trade of the V4 countries is currently uncompetitive, both in relation to the EU market, as well as in relation to the market of third countries. Nevertheless, in the case of Poland, the situation is the opposite. Polish agricultural trade, unlike agricultural trade of the Czech Republic, Slovakia and Hungary, is capable of achieving comparative advantages, and, importantly – it is also capable of amplifying them.

In relation to the development of values of the RCA1 index, it is appropriate to also mention the development of the competitiveness of Hungarian agro-trade, which, unlike that of Poland, has had a tendency to stagnate within recent years. Hungary – at one time the number one agricultural exporter within the monitored region – has been

Export		RCA1	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CR	EU27	Agriculture	0.41	0.37	0.35	0.35	0.38	0.44	0.43	0.45	0.45	0.44	0.42
CR	EU27	Fuels and Raw mat.	1.08	1.07	1.31	1.01	0.92	0.79	0.74	0.77	0.73	0.97	0.88
CR	EU27	Processed products	1.05	1.06	1.05	1.07	1.07	1.08	1.08	1.08	1.09	1.07	1.08
SR	EU27	Agriculture	0.36	0.37	0.37	0.33	0.42	0.53	0.52	0.47	0.41	0.45	0.44
SR	EU27	Fuels and Raw mat.	1.66	1.72	1.64	1.40	1.60	1.33	1.10	0.99	0.94	1.09	1.02
SR	EU27	Processed products	1.01	1.01	1.02	1.04	1.01	1.02	1.04	1.06	1.07	1.06	1.07
Hungary	EU27	Agriculture	0.68	0.72	0.62	0.63	0.63	0.63	0.61	0.79	0.79	0.75	0.77
Hungary	EU27	Fuels and Raw mat.	0.59	0.58	0.56	0.54	0.56	0.58	0.45	0.56	0.54	0.58	0.60
HUngary	EU27	Processed products	1.06	1.06	1.07	1.07	1.07	1.08	1.09	1.06	1.07	1.07	1.07
Poland	EU27	Agriculture	0.75	0.72	0.69	0.72	0.88	1.06	1.12	1.12	1.08	1.05	1.06
Poland	EU27	Fuels and Raw mat.	1.31	1.47	1.37	1.24	1.37	1.13	0.95	0.91	0.81	0.74	0.81
Poland	EU27	Processed products	1.00	0.99	1.01	1.01	0.98	0.98	0.99	1.00	1.01	1.02	1.01
CR	Third	Agriculture	1.04	0.79	0.50	0.70	0.57	0.65	0.46	0.38	0.31	0.30	0.28
CR	Third	Fuels and Raw mat.	0.19	0.19	0.20	0.17	0.15	0.13	0.09	0.09	0.06	0.11	0.12
CR	Third	Processed products	1.16	1.17	1.18	1.18	1.21	1.24	1.28	1.28	1.37	1.30	1.30
SR	Third	Agriculture	0.69	0.65	0.61	0.46	0.42	0.53	0.44	0.23	0.21	0.17	0.16
SR	Third	Fuels and Raw mat.	0.26	0.28	0.23	0.17	0.12	0.11	0.13	0.09	0.09	0.09	0.07
SR	Third	Processed products	1.18	1.16	1.16	1.21	1.23	1.26	1.27	1.29	1.37	1.32	1.32
Hungary	Third	Agriculture	2.20	2.08	2.08	1.83	1.62	1.26	1.28	0.72	0.80	0.69	0.76
Hungary	Third	Fuels and Raw mat.	0.16	0.15	0.21	0.22	0.26	0.24	0.25	0.25	0.23	0.22	0.19
HUngary	Third	Processed products	1.08	1.08	1.06	1.09	1.11	1.17	1.18	1.21	1.27	1.24	1.24
Poland	Third	Agriculture	2.49	2.24	2.10	2.26	1.87	1.74	1.68	1.44	1.29	1.46	1.72
Poland	Third	Fuels and Raw mat.	0.32	0.34	0.32	0.26	0.28	0.20	0.18	0.16	0.18	0.18	0.22
Poland	Third	Processed products	1.02	1.02	1.04	1.04	1.08	1.14	1.17	1.18	1.25	1.18	1.15

Source: Comtrade, own processing, 2012

Table 6 Competitiveness of commodity structure of merchandise trade of V4 countries in relation to the EU market and to the global market.

significantly declining within recent years. That pertains primarily to the dynamics of growth of Hungarian agricultural export, which continues to decline. However, the decline in the dynamics of growth of agricultural export is not the main problem of Hungary – the main problem is the continually growing rate of growth of agricultural imports – which gradually leads to a decline in the significance of agricultural trade as a source of a positive trade balance.

Agricultural trade of the V4 countries in relation to partners from EU countries – status as of 2010

Tables 7 and 8, as mentioned further in the text, provide a detailed overview of the development of the territorial structure of agricultural trade of the individual V4 countries in relation to the individual member countries of the European Union. The table shows that although the individual V4 countries effect trade operations in agricultural and food goods in relation to all other member countries – their territorial structure of agricultural trade is significantly limited and greatly concentrated. The great concentration of agricultural trade in relation to individual EU countries is evidenced by the following findings shown by the table. In the case of the Czech Republic, the most significant partners are: Germany, Slovakia, Austria, Hungary, Italy, Poland and Romania (these countries participate in the total agricultural export and import with a share of 74.2% or 56.1% respectively). In the case of Slovakia, the most significant partners are: Czech Republic, Austria, Germany, Hungary, Italy and Poland (these countries participate in the agricultural export and import with a share of 85.6% or 59% respectively). In the case of Hungary and Poland, the territorial concentration on a limited number of EU countries is not as prominent as is the case for the Czech Republic and Slovakia, but, nevertheless, a narrow orientation toward several key members of the EU territory is more than clear. In the case of Hungary, the most significant partners are: Germany, Italy, Romania, Slovakia, Austria, Poland and the Czech Republic (these countries participate in the agricultural export and import with a share of 60% or 66% respectively). In the case of Hungary, the most significant partners are: Germany, Italy, Romania, Slovakia, Austria, Poland

mil. USD		CR	Hungary	Poland	Slovakia	V4	mil. USD	CR	Hungary	Poland	SR	V4
Import	Austria	298,2	361.5	175.5	91.1	926.3	Export	299.9	476.7	262.8	165	1204.5
Import	Belgium	216,8	96.1	335	41	688.9	Export	81.4	117.4	383	25.3	607.1
Import	Bulgaria	19,6	15.1	59.9	9.4	104	Export	30	102.2	137.7	54.5	324.4
Import	Cyprus	2	11.7	8.7	1.1	23.5	Export	1.8	15	12.3	7.6	36.7
Import	Czech	0	212.1	440.9	928.2	1581.1	Export	0	258.3	1070.4	684.4	2013.2
Import	Denmark	86,5	45.6	632.4	16	780.5	Export	34.7	32.9	358	2.3	427.9
Import	Estonia	4	0.7	7.5	1	13.1	Export	5.6	18	90	1.5	115.1
Import	Finland	10,4	1.7	55.5	3.3	70.9	Export	18.4	16.9	133.9	10.2	179.5
Import	France	250,5	150.2	501.6	72.8	975	Export	126.4	222.3	1040.4	21.6	1410.7
Import	Germany	1535	915.1	2814.2	411.3	5675.5	Export	880.9	709.6	3600.1	97.9	5288.6
Import	Greece	67,6	29.8	126.1	21	244.5	Export	12.7	92.9	127	3.2	235.8
Import	Hungary	265,2	0	250	330.4	845.6	Export	216.1	0	610.7	672.4	1499.2
Import	Ireland	49,8	35.8	99.9	17	202.5	Export	21.7	6.7	123.4	1.4	153.1
Import	Italy	390,4	195.7	614.1	112.1	1312.3	Export	356.6	662.9	988.1	111.5	2119.2
Import	Latvia	4,4	0.7	35.8	5.7	46.6	Export	9.6	14.5	176.2	1.6	201.9
Import	Lithuania	9,9	10.6	130.1	1.3	151.9	Export	27.2	37.2	379.1	6.5	450
Import	Luxembourg	1,2	4.7	1.8	1.4	9.2	Export	1.8	1.9	4.9	0	8.6
Import	Malta	0	0.2	0	0	0.3	Export	0.8	2.1	6.7	0	9.6
Import	Netherlands	386,2	421.3	971.8	112.4	1891.7	Export	82	212.9	958.4	40.6	1293.9
Import	Poland	1007,5	568.1	0	444.2	2019.8	Export	480.6	265.5	0	272.5	1018.6
Import	Portugal	38,4	13.5	31	2.1	84.9	Export	5.8	10.7	55.7	2.3	74.5
Import	Romania	28,2	147.5	46.4	21.8	243.9	Export	87.1	902	305.2	127	1421.5
Import	Slovakia	499,9	325.6	245.1	35.8	1106.4	Export	1431.5	624.3	515.9	0	2571.8
Import	Slovenia	6,4	97.5	4.5	5.3	113.6	Export	45.1	142.6	91.6	13.4	292.7
Import	Spain	343,8	80.6	754	104.2	1282.7	Export	41.9	64.3	331.8	28.2	466.3
Import	Sweden	32	9	123.1	10.4	174.5	Export	54.6	49.3	289.8	8.1	401.7
Import	UK	83,9	74	393.2	17.2	568.3	Export	157.7	188.5	1214.2	32.1	1592.5
Import	EU15	3790,8	2434.6	7629.2	1033.2	14887.8	Export	2176.5	2865.9	9871.5	549.8	15463.7
Import	EU12	1847,2	1389.9	1228.9	1784	6249.9	Export	2335.4	2381.6	3395.9	1841.5	9954.5
Import	Visegrad 4	1772,6	1105.8	936	1738.5	5552.9	Export	2128.2	1148.1	2197	1629.3	7102.7

Source: Comtrade, own processing, 2012

Table 7 Territorial structure of agricultural trade of the V4 countries in relation to EU countries.

and the Czech Republic (these countries participate in the agricultural export and import with a share of 60% or 66% respectively). And, finally, the most significant Polish trading partners from the territory of the EU countries are: Germany, Czech Republic, France, Italy, Hungary, Great Britain, Netherlands and Slovakia (these countries participate in the agricultural export and import with a share of 60% or 48% respectively). The data further shows that the individual V4 countries are mutual significant business partners to each other. In the case of the Czech Republic, the countries of the V4 are currently participating with a share of approximately 43.1% in the total agricultural exports and 26.6% of imports. In the case of Slovakia, the share of V4 countries represents approximately 65.5% for export and approximately 42.9% for agricultural import. Further, the V4 countries also participate in agricultural exports and imports of Hungary with a share of approximately 17.7%, or 26.9% respectively. Only in the case of Poland is the share of V4 countries in the actual agricultural export (13.1%) and import (7.2%) marginal, for reasons of its significantly higher production as compared to the other countries. The production of Poland significantly exceeds the absorbing capacities of the market of the V4 countries. The reason for the low share of V4 countries in Polish imports is the fact that, in relation to Poland, the V4 countries do not have such significant comparative advantages as it is the other way around.

The following Table 9 provides an overview of the distribution of the comparative advantages in the case of the agricultural trade of the individual monitored countries. As was stated above – with the exception of Poland – agricultural trade as a whole does not currently have comparative

mil. USD		CR	Hungary	Poland	Slovakia	V4	mil. USD	CR	Hungary	Poland	SR	V4
Share in import							Share in export					
Import	Austria	4.50%	8.80%	1.30%	2.30%	3.30%	Export	6.10%	7.30%	1.60%	6.60%	3.90%
Import	Belgium	3.30%	2.30%	2.60%	1.00%	2.50%	Export	1.60%	1.80%	2.30%	1.00%	2.00%
Import	Bulgaria	0.30%	0.40%	0.50%	0.20%	0.40%	Export	0.60%	1.60%	0.80%	2.20%	1.10%
Import	Cyprus	0.00%	0.30%	0.10%	0.00%	0.10%	Export	0.00%	0.20%	0.10%	0.30%	0.10%
Import	Czech	0.00%	5.20%	3.40%	23.40%	5.70%	Export	0.00%	4.00%	6.40%	27.50%	6.60%
Import	Denmark	1.30%	1.10%	4.80%	0.40%	2.80%	Export	0.70%	0.50%	2.10%	0.10%	1.40%
Import	Estonia	0.10%	0.00%	0.10%	0.00%	0.00%	Export	0.10%	0.30%	0.50%	0.10%	0.40%
Import	Finland	0.20%	0.00%	0.40%	0.10%	0.30%	Export	0.40%	0.30%	0.80%	0.40%	0.60%
Import	France	3.80%	3.60%	3.80%	1.80%	3.50%	Export	2.60%	3.40%	6.20%	0.90%	4.60%
Import	Germany	23.10%	22.20%	21.50%	10.40%	20.40%	Export	17.80%	10.90%	21.40%	3.90%	17.20%
Import	Greece	1.00%	0.70%	1.00%	0.50%	0.90%	Export	0.30%	1.40%	0.80%	0.10%	0.80%
Import	Hungary	4.00%	0.00%	1.90%	8.30%	3.00%	Export	4.40%	0.00%	3.60%	27.00%	4.90%
Import	Ireland	0.70%	0.90%	0.80%	0.40%	0.70%	Export	0.40%	0.10%	0.70%	0.10%	0.50%
Import	Italy	5.90%	4.80%	4.70%	2.80%	4.70%	Export	7.20%	10.20%	5.90%	4.50%	6.90%
Import	Latvia	0.10%	0.00%	0.30%	0.10%	0.20%	Export	0.20%	0.20%	1.00%	0.10%	0.70%
Import	Lithuania	0.10%	0.30%	1.00%	0.00%	0.50%	Export	0.60%	0.60%	2.30%	0.30%	1.50%
Import	Luxembourg	0.00%	0.10%	0.00%	0.00%	0.00%	Export	0.00%	0.00%	0.00%	0.00%	0.00%
Import	Malta	0.00%	0.00%	0.00%	0.00%	0.00%	Export	0.00%	0.00%	0.00%	0.00%	0.00%
Import	Netherlands	5.80%	10.20%	7.40%	2.80%	6.80%	Export	1.70%	3.30%	5.70%	1.60%	4.20%
Import	Poland	15.10%	13.80%	0.00%	11.20%	7.30%	Export	9.70%	4.10%	0.00%	11.00%	3.30%
Import	Portugal	0.60%	0.30%	0.20%	0.10%	0.30%	Export	0.10%	0.20%	0.30%	0.10%	0.20%
Import	Romania	0.40%	3.60%	0.40%	0.50%	0.90%	Export	1.80%	13.90%	1.80%	5.10%	4.60%
Import	Slovakia	7.50%	7.90%	1.90%	0.90%	4.00%	Export	29.00%	9.60%	3.10%	0.00%	8.40%
Import	Slovenia	0.10%	2.40%	0.00%	0.10%	0.40%	Export	0.90%	2.20%	0.50%	0.50%	1.00%
Import	Spain	5.20%	2.00%	5.80%	2.60%	4.60%	Export	0.80%	1.00%	2.00%	1.10%	1.50%
Import	Sweden	0.50%	0.20%	0.90%	0.30%	0.60%	Export	1.10%	0.80%	1.70%	0.30%	1.30%
Import	UK	1.30%	1.80%	3.00%	0.40%	2.00%	Export	3.20%	2.90%	7.20%	1.30%	5.20%
Import	EU15	57.00%	59.10%	58.30%	26.00%	53.50%	Export	44.10%	44.10%	58.80%	22.10%	50.30%
Import	EU12	27.80%	33.80%	9.40%	45.00%	22.50%	Export	47.30%	36.60%	20.20%	74.00%	32.40%
Import	Visegrad 4	26.60%	26.90%	7.20%	43.80%	20.00%	Export	43.10%	17.70%	13.10%	65.50%	23.10%

Source: Comtrade, own processing, 2012

Table 8 Territorial structure of agricultural trade of the V4 countries in relation to EU countries.

advantages in relation to the market of the EU27 countries in the case of any other country of the V4 group. Nevertheless, this contradicts the fact that agricultural trade, including exports effected by V4 countries in relation to the market of EU countries, is continually increasing in its own value. Such development is evidence of the fact that the individual countries, although they do not achieve comparative advantages in relation to the EU27 as a whole – do achieve at least partial comparative advantages both on the territorial structure level, as well as on the commodity structure level – as will be further demonstrated in the text.

In relation to the member countries of the EU, the Czech Republic achieves comparative advantages in the case of trade with Slovakia, Slovenia, Romania, Malta and Luxembourg. In the case of Slovakia, the situation is similarly poor. Slovakia achieves comparative advantages in agricultural trade only in relation to Bulgaria, Finland, Romania and Slovenia. Generally, it may be stated that the Czech Republic and Slovakia are, in relation to the distribution of comparative advantages of agricultural trade as a whole among the EU member countries, in the worst position of all of the monitored V4 countries. Hungary and Poland are in the opposite position. Hungary achieves comparative advantages in relation to Austria, Belgium, Bulgaria, Cyprus, Estonia, Finland, Italy, Lithuania, Latvia, Malta, Romania, Slovakia, Slovenia and Great Britain. Poland retains comparative advantages in relation to Austria, Belgium, Bulgaria, Czech Republic, Estonia,

LFI 2010	CR	Hungary	Poland	Slovakia	V4
Austria	-1.2	1.7	1.4	-0.7	-0.1
Belgium	-3.5	1.3	1.1	-1.7	-0.7
Bulgaria	-2.2	1.8	3.9	1.9	0.8
Cyprus	-1.4	11.2	-5.1	-0.5	-1.9
Czech	N/A	0	2.2	-3	-0.3
Denmark	-4.1	-2.1	-8.5	-2.5	-6.4
Estonia	-1.4	4.7	2.5	-0.6	2.1
Finland	0	2.5	4.2	1.4	2.4
France	-2.1	-0.1	1.5	-1.2	-0.3
Germany	-1.4	-0.7	0.7	-1.6	-0.6
Greece	-16.3	-2.8	-9.8	-7.1	-9
Hungary	-1.3	N/A	2.7	-1.3	1.4
Ireland	1	-3.1	5.5	-2.7	2.4
Italy	-1.2	3.6	2.1	-0.9	1.1
Latvia	-2	1	1.7	-6.5	0
Lithuania	-0.2	0.4	4.2	-0.2	2.7
Luxembourg	0.3	-1.1	1.1	-1.2	0.2
Malta	1.7	5.2	11	N/A	5.9
Netherlands	-4.1	-2.6	-0.6	-5.7	-2.7
Poland	-3.5	-4.7	N/A	-5.1	-4.2
Portugal	-4.3	-2.8	1	-0.3	-1.6
Romania	0.8	4.5	4.9	2.8	4
Slovakia	2.4	1.3	2.9	N/A	2.3
Slovenia	2.6	1.3	7.9	0.3	2.9
Spain	-7	-2.5	-6.8	-5.8	-6.5
Sweden	-0.1	2.1	1.2	-0.8	0.6
United Kingdom	-0.4	-0.4	1.6	-0.1	0.4
EU15	-1.9	-0.2	0.5	-1.6	-0.7
EU12	-0.4	0.7	3.2	-2	0.5
Visegrad 4	-0.4	-1	2.5	-2.3	-0.2

Source: Comtrade, own processing, 2012

Table 9 Comparative advantages of agricultural trade of the V4 countries in relation to EU.

Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Latvia, Luxembourg, Malta, Portugal, Romania, Slovenia, Slovakia, Sweden and Great Britain. The general finding is then that in relation to the market of the V4 countries, has comparative advantages are had primarily by Poland – which significantly dominates the entire market.

Conclusions

On the basis of the above findings, it is shown that agricultural trade in the case of all of the countries of the Visegrad group represents only a marginal part of the total merchandise trade. Further, in regard to the agricultural trade of the individual analyzed countries, it may be stated that the commodity structure as well as the territorial structure is very significantly concentrated. The predominant majority of agricultural trade – export as well as import – is carried out in regard to EU countries. Such countries participate in the agricultural trade of the individual countries of the V4 group at a rate of over 80%. Third countries represent only a marginal market in regard to the sale of agricultural products from the V4 countries, and their position is slightly more significant in relation to agricultural imports primarily of tropical and subtropical products going onto the markets of the V4 countries. In regard to the territorial structure of the agricultural trade of the V4 countries, it may generally be stated that it is relatively stable in time. Nevertheless, entry into the EU in 2004 had a significant impact on its current form. Within agricultural trade, orientation toward the market of EU countries has asserted itself more, whereby there was an increase in trade primarily in relation to new EU member countries, which, in the area of agricultural trade, only liberalized mutual agricultural and food trade to a limited extent prior to

entry into the EU. However, after entry into the EU, they had to eliminate all barriers to mutual trade at one time – while in relation to the EU15 countries, the process of eliminating mutual barriers to trade was gradual and had already been commenced in the period of the signing of association treaties in the 1990's. In relation to third countries, the entry of the V4 countries into the EU meant a significant change. Trade with such countries after entry into the EU stopped being affected by bilateral treaties entered into between the individual V4 countries and their partners; after the entry of the V4 countries into the EU, agricultural trade between the V4 countries and third countries began to be governed by the rules based on the Common Commercial Policy and Common Agricultural Policy of the EU countries. This then subsequently led to a decline in the significance of third countries in terms of the forming of the territorial structure of agricultural trade. In relation to the development of agricultural trade with third countries, entry into the EU affected primarily the Czech Republic and Slovakia - and also Hungary to a limited extent, and Poland the least. In relation to the development of the commodity structure of agricultural trade, it may be stated that the volume and value of trade effected within the majority of goods aggregations is growing on a long-term basis in the case of all of the V4 group countries. Nevertheless, it is appropriate to state that the most dynamic growth in terms of the development of the value of effected trade in terms of the development of the value of effected trade in recent years was seen in the case of Poland. Czech and Slovak agricultural trade also showed considerable growth in terms of effected trade; however – only in the case of Poland was the growth in the dynamicity of exports so substantial that the resulting balance of Polish agricultural trade moved from negative values to positive values. A specific country in terms of the development of the commodity structure and the value of agricultural trade is Hungary. At the beginning of the monitored period, it was the only country of the V4 group with a positive balance in agricultural trade. Nevertheless, structural problems of the Hungarian economy also led to significant problems in the area of the development of the agricultural sector and agricultural trade – when a significant decline in the dynamicity of growth in the value of agricultural exports occurred – primarily in the field of highly processed products with a higher level of added value and, further, there was also a significant increase in imports primarily of cheap agricultural and food products characterized by a low quality level. The result of such development is the gradual reduction in the field of the development of a positive balance of the Hungarian agro-trade and a decline in the importance of the agricultural sector – or agricultural trade – as a significant source of the positive trade balance of Hungarian merchandise trade.

If we focus on the actual objective of the article, which was to identify the comparative advantages of agricultural trade of the V4 countries in the area of commodity structure and territorial structure, both in relation to the global market, as well as in relation to the EU27 countries, the following may be stated. Agricultural trade of the Czech Republic, Slovakia and Hungary as a whole does not have comparative advantages either on the global market or on the internal market of the EU countries. However, Poland as the only representative of the V4 countries does have comparative advantages in the field of agricultural trade, both in relation to the internal market of the EU countries, as well as in relation to the global market (to the market of third countries). If we focus on the territory of the EU27 countries, which represents the main trade partner of all of the analyzed countries, both in terms of exports, as well as in terms of imports, it may be stated that although the Czech Republic, Slovakia and Hungary do not have comparative advantages in the area of agricultural trade in regard to the EU as a whole, they are capable of achieving comparative advantages at the level of bilateral relations with individual EU member countries. In terms of bilateral business competition, Poland and Hungary are of course in the best position. On the other hand, the Czech Republic and Slovakia are in the worst positions.

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Information Support of Regions and Possibilities of Its Further Development

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Anotace

Příspěvek prezentuje výsledky výzkumu podpory rozvoje informačních a komunikačních technologií (ICT) v regionech ČR zaměřené především na problematiku mapování kulturního dědictví spolu s aktivitami v oblasti cestovního ruchu a s nimi spojené podnikatelské aktivity (ubytování, stravování, apod.). Na příkladu řešení webového portálu „Poznej Pošumaví – turistický průvodce po Pošumaví“ je demonstrován možný přístup, který integruje výhody klasických informačních zdrojů s internetovou aplikací, která navíc poskytuje přehledný mapový výstup. Realizace projektu je prováděna ve spolupráci s vybraným místním partnerem, kterým je zde LAG Pošumaví. Uvedené řešení je možné případně dále dle potřeby rozšířit, ale také chápat jako univerzální, tedy s širokým využitím v dalších oblastech informační podpory regionů.

Klíčová slova

Zavádění informačních a komunikačních technologií, vysokorychlostní internet, cestovní ruch, regionální rozvoj, webový portál.

Abstract

The paper presents the results of information and communication technologies (ICT) research support in the Czech Republic regions, focused mainly on the problems of mapping cultural heritage together with activities in the area of tourism and business activities connected with it (accommodation, food etc). One possible approach is demonstrated on the example of web portal “Get to know Posumavi – a tourist guide to Posumavi”. This approach integrates the advantages of standard information sources with the Internet application. Moreover, this application provides a clear topographical output. The project is being prepared in co-operation with a chosen local partner, in our case the Posumavi local action group. The under-mentioned solution can be further extended if need be, but we can also understand it as a general-purpose solution which means it can be widely used in other areas of the information support of regions.

The knowledge and data presented in the paper were obtained as a result of the Research Program titled “Economy of the Czech Agriculture Resources and Their Efficient Use within the Framework of the Multifunctional Agri-food Systems” of the Czech Ministry of Education, Youth and Sports number VZ MSM 6046070906.

Key words

ICT adoption, broadband, tourism, regional development, web portal.

Introduction

Information on regional level is currently produced, offered and provided by a number of sources and information channels, from the simplest forms such as leaflets and other printed materials to the Internet information sources. The quality of these materials obviously differs and it depends to a large extent on the concept and support on the regional level (regions, counties, villages and towns, cultural sights etc.) There exist various approaches and concepts which are often incompatible or contradictory. In some cases they are not even interconnected or all embracing. This concerns a number of areas including: tourism, the support of business activities more or less connected with tourism and the promotion of local cultural heritage.

Among subjects that can play a relatively important role in this area are Local Action Groups – LAGs). A lot of LAGs are really dynamic subjects supporting the development of various activities in their region. The Department of Information Technologies (the Faculty of Economics and Management, the Czech

University of Life Sciences) cooperates in the long term for example with the Posumavi LAG.

The Posumavi local action group is a voluntary association of towns, rural micro-regions, business people and nonprofit organizations who operate in southwestern Bohemia. It primarily focuses its activities on the regional development by means of collecting financial means from various sources and by coordinating individual subjects' activities which are in progress in the given area. Among areas with wide support are the surveying of cultural heritage and activities in the sphere of tourism and business activities linked to it. A number of activities are connected to the development of information and communication technologies and its use in the regional environment where the cooperation with the Department of Information Technologies (DIT) is being used.

As far as foreign literature is concerned, some relevant and interesting impetus is emphasized in, for example, [3]. Even though it covers the regional environment in Australia, the principles are general ones:

"...highlighting the need for destination stakeholders to foster a cooperative and strategic approach and ensure consistent design and delivery of a destination brand and image which is supported by tactical advertising and promotional strategies, effective visitor information services, and events to support the destination brand and image to target appropriate visitor markets."

The problems of integrated information systems are being solved not only in our regional conditions. The construction of integrated information systems is relevant for example to the environment of China and other Asian countries - see [6]. Regional tourism and web applications are being solved in the conditions of Australia [2], New Zealand [1, 4] or Europe [5]. General recommendations and evaluations are described for example in [7].

On the contrary, our official documents don't deal with the above mentioned problems at all (if we ignore several and only partially general phrases) - see for example [8]. The main initiative has always rested with various regional subjects.

Objectives and methods

Since 2011 DIT has been - in cooperation with local partner the Posumavi LAG – working on the solution of concept and implementation of web pages (portal) "Get to know Posumavi – a tourist guide to Posumavi" project (for the homepage of this portal see picture 1).

Note: the global intention and solution results are shown in the pictures (screens) of the portal testing solution - English or Czech version.

The task of the solution is to improve tourism potential in the area concerned (the area of the Posumavi LAG in our case) via modern software solution combined with topographical and other sources. The solution as a whole tries to integrate the problems of tourism by a unified approach in several partial views which classify the objects into five basic groups. At the same time it aims to use already existing information sources or to support their wider circulation. Furthermore, a clear topographical output is presented and information search by a number of criteria is supported. In this way, a complex information system is created which - after the input of data - maps the offer of the given area for tourists and potential visitors. The users are therefore able to familiarize themselves with the area and read a lot of information (or print it for their later needs) in advance.

The tourist guide introduces the particular, from the tourists' point of view very interesting site from several defined partial views which can generally be applied to the given area of interest (Accommodation, Food, Villages and Towns, Activities, Attractions). The above mentioned division belongs (together with the topographical output, search and contacts information) to the basic offer of the portal functions (see picture 1].

The above mentioned views enable to classify the objects of the region by the most important activities or attributes concerning the global focus on tourism and business support in that particular region. Every object is allowed to have one activity (attribute) and several follow-up ones.

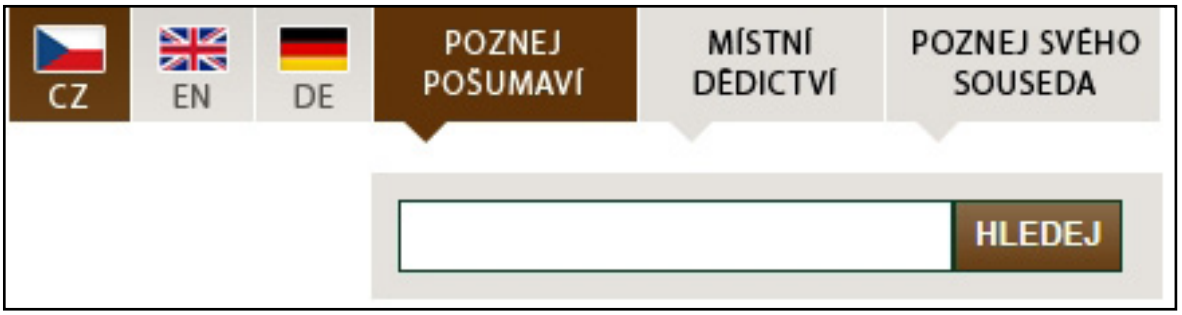
Accommodation – objects primarily with standard accommodation services. Various categories and special offers, often linked to the region. The possibility of catering and other activities.

Food – objects offering food. Standard services of providing meals or special offers according to the special characteristics of the region (e.g. regional specialities and foodstuff).

Villages and towns – the introduction and promotion of sites in the given area. Furthermore, it draws attention to the villages and towns of the region and to the most interesting sights (from the tourists' point of view).

Activities – the introduction and promotion of various activities available in the region. Classification in an independent category allows simpler orientation in the area's offer.

Picture 1. Homepage of the portal (English version) - application testing.



Picture 2. The change of language versions, the integration of other web portals and search.

Attractions – an independent category to make available and promote cultural sights, natural sights and national parks, interesting places etc.

Because of the proximity of our borders with Germany and the potential of foreign tourists the solution is carried out as multilingual (Czech, German, English).

Portal "Get to Know Posumavi" makes accessible other interesting web projects run by the LAG as well: explicitly "Local Heritage" and "Get to Know your Neighbour". This is put into practice by options in the top right-hand corner of the web presentation, next to the options enabling to change portal's language versions. Visitors to web presentation are in this way able to switch over to other applications which were originally prepared as separate solutions and which by their content belong to this particular topic and area and create an important supplement to the information value of the whole system. The change of language versions, search and integration of other web portals are shown in picture 2.

The web presentation offers (within the frame of individual views of all listed objects) information on three levels: Basic information – Details – Special information leaflet. All of them can be seen

on the web, printed and used as a basic guide to trips around Posumavi. The scheme of the provided information individual levels is shown in picture 3. Detailed examples of output are shown in pictures 5 to 7. Here it is demonstrated on the Skanzen Chanovice object.

Basic information – primary information about the object concerned. It comprises short descriptive information and a picture of the object. Furthermore, it enables to open details (switch to details about the object) and download or display the information leaflet in .pdf format.

Details – comprise basic information completed with information about contacts (www, e-mail addresses, phone numbers, addresses, GPS coordinates, etc.) and a picture gallery. And it enables to download or display the information leaflet in .pdf format as well.

Special information leaflet – one page detailed colour information leaflet about the given object with colour photographs. It represents the official publicity printed material which is primarily available in the paper form of high quality but with the intension of the electronic version's simultaneous creation.

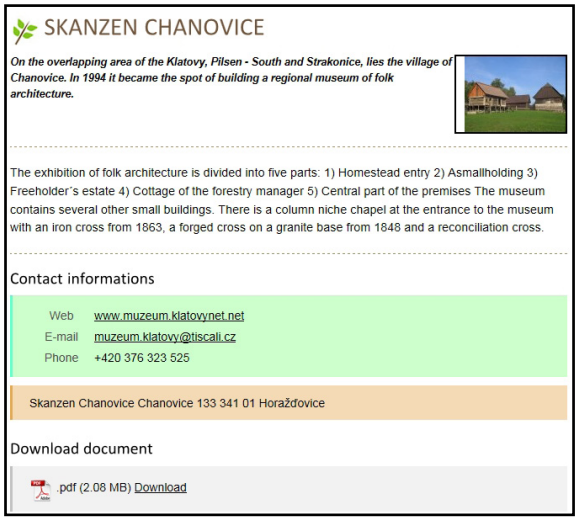
Picture 3. The overview of output levels.

Picture 4. The overview of various kinds of leaflets – colour frames according to the categories of objects (Accommodation, Food, Villages and Towns, Activities, Attractions).

The integration of information leaflets into web presentation is indeed a very interesting functionality. Even though the leaflets are primarily created as a paper information printed material to be distributed within information places, their electronic form in a file form (.pdf) on the web represents their additional important use. The leaflets are in accordance with partial views (objects' categories) distinguished by colours – colour frames: Accommodation (blue), Food (orange), Villages and Towns (yellow), Activities (red), Attractions (green). For overall overview see picture 4.

The location of objects in the topographic output represents another important functionality of the system. The topographic output differentiates the individual categories of objects via the system of icons assigned to individual categories (see picture 8). In this way a high clarity of the graphic (topographic) output is achieved. A lot of attention is devoted to the accuracy of objects' location on the map which is clearly visible in the detailed pictures from satellite maps.

Picture 5. The Attractions view – Basic Information (the Skanzen Chanovice example).



Picture 6. The Attractions view – Details (the Skanzen Chanovice example).

Solution technology (of solution)

Web application "Get to know Pošumaví" is based on and subsequently uses SW components which the research workers' workplace regularly uses for a number of other projects which have topographic outputs as their part. The basis of above mentioned software solution is an officially recognized output (software type according to valid methodology of RVVI Czech Republic) called MPRD 1.0 (Map Portal for Regional Development 1.0). The portal runs on the Apache 2.0 server, uses PHP version 5.3.11 a database MySQL 5.1.62. The application is written by means of PHP web framework Nette (version Nette 2.0-dev released on 2011-03-10 – alpha), and a database layer from Nette is being used. For work with topographical outputs API (Application Programming Interface) - Google maps API version 2 is used. The more detailed description of the portal's software solution isn't presented here; it can be found, for example, in other publications of the authors - see [9], [10].

As distinct from other solutions (Ecofarms, Biogas stations) – due to a smaller number of objects – some functions of the general MPRD solution aren't used here, such as accumulated display or the filtration of views by individual objects' categories. Nevertheless, if need be, the filtration of objects by individual categories (views) can be installed. In case of the implementation of a large number of objects it is possible to increase the clarity by the functionality of accumulated display (of the assembled groups of objects). Thus it depends on the possible providers – which certified portal solution and what data input they will use.

Results and discussion

By the design and implementation of the "Get to Know Posumavi" project an integrated information system is created which will, after the input of data sources, map in detail the offer of the given area for tourists and possible visitors. The users will thus have a chance to get to know the given area and read a lot of information (or print it for their later needs) in advance. In this way the solution represents one of interesting possibilities how to increase the information support of the regional development.

The advantage of the entire solution is the integration of information into one whole and relatively high potential of traffic (attendance) which can be supported by a suitable system of of local partners' links and central information sources routing. Information which would be otherwise difficult to

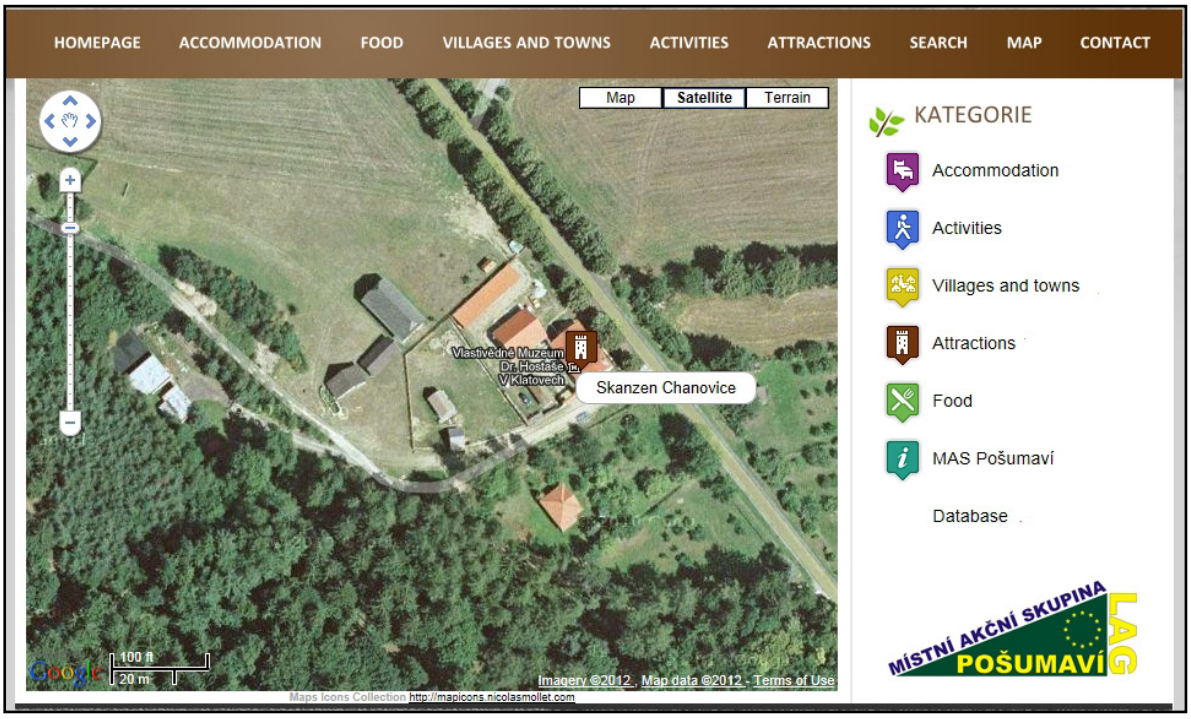
Picture 7. The Attractions view – Special information leaflet (the Skanzen Chanovice example).

obtain by other means is in this way comfortably accessible from one single source. Electronically presented here is information which would not be under normal circumstances possible to use on a large scale as it would be bound to a certain local information place or to local information sources and channels only.

The use of suggested system is neither bound to one area nor limited to the competence of LAGs or other local subjects. It can be implemented to any area.

There is nevertheless one important factor and it is the necessity to use in any case a strong local partner who has the best information about the

Picture 8. Topographical output – a global view.



Picture 9. Topographical output – a detailed view (a satellite picture).

area concerned, its sights, potential for tourism, contacts. Such a partner might participate in the organization of a lot of activities in the region so it can fundamentally contribute to the implementation of projects in practice. The most important condition for the successful implementation of the developed solution is the input of the basic set of relevant data for the system to provide the users with expected information. Then it is gradually possible to complete information and to update it subsequently.

It is necessary to understand that the final solution is general (universal) and to realize that there is a chance to modify it for other areas of interest apart from tourism and business activities. The potential use of the system is therefore rather wide.

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Wage Disparity and Inter-Occupation Specifics in Managing Czech Households' Portfolios: What is the position of agricultural workers?

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Anotace

Článek se zabývá analýzou mzdové disparity a meziprofesních rozdílů v řízení portfolií českých domácností. Výsledky jsou založeny na Heckmanově selekčním modelu a doplněny analýzou mzdové disparity. Výsledky ukazují, že mezi skupinou dělnických povolání (vč. zaměstnanců v zemědělství) a povolání střední úrovně nelze identifikovat žádné signifikantní rozdíly. Důvodem je vysoká heterogenita skupiny dělnických povolání a identifikovaná mzdová disparita mezi povoláními, resp. sektory. Zaměstnanci v zemědělství spadají do skupiny s podprůměrným příjmem a jsou charakterizováni nízkou pravděpodobností využití produktů dlouhodobého spoření, úvěrů a mají nižší platby na produkty krátkodobého spoření. Skupina zaměstnanců v zemědělství a zemědělských domácností je rovněž vysoce heterogenní. Mzdová disparity v zemědělském sektoru je významná i mezi jednotlivými regiony.

Klíčová slova

Příjmová disparita, profesní specifika, volba portfolia, Heckmanův selekční model.

Abstract

Wage disparity that exists between genders, sectors, and geographical regions, can influence household portfolio management. This study examines the impact of wage disparity and inter-occupation differences on Czech household portfolios. The model of portfolio choice was estimated using the Heckman selection model complemented by wage disparity analysis. Results show no significant differences in financial portfolios between blue-collar workers, including farm households and employees in agricultural sector, and white-collar workers. There was high heterogeneity within the group of blue-collar workers, and wage disparity among employment sectors. Employees in the agricultural sector were categorised as having a below average salary and characterised by a lower probability of utilising long-term saving products, loans and making a smaller contribution to short term saving products. Agricultural workers and farm household were a highly heterogeneous group. Finally a significant regional wage disparity in the Czech agriculture sector was observed.

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Key words

Wage disparity, Occupation specifics, Portfolio choice, Heckman selection model.

JEL: C25, D14, G11, Q12

Introduction

Wage disparity is a worldwide problem that can be found between genders (e.g. Borland (1999), Blau and Kahn (2001), Arulanpalam, Booth and Bryan (2007)), sectors and regions (e.g. Lucifora, Meurs (2006), occupations (e.g. Weeden (2002)), skilled and unskilled workers (e.g. Abdel-Rahman (2002)). Wage disparity has different consequences – economical, social, psychological etc. (e.g. Hakim (1998)). Income gap between farm households and workers in other sectors of economy is presented as one of the reasons for agricultural support. In this paper we aim at the wage disparity among sectors and regions. In particular, we focus on the position of employees in agriculture with respect to other sectors. Moreover, we link the wage disparity problem of the Czech agricultural sector with how household portfolios are managed. In other words, we show how the wage disparity and

inter-occupation differences affect the households' portfolio choice.

We will elaborate three key questions in this paper. The first question concerns the specifics of portfolio choice considering occupation and gross wage. The second question deals with the wage disparity and inter-occupation differences as factors shaping household portfolio choice. The last question concerns the situation of agricultural workers in different regions and the specifics of agricultural sector as a whole.

The next section describes the data, introduces theoretical framework and outlines the econometric procedure for analysis of consumer decision-making process, followed by section 3, which presents the results. The final section is a discussion of conclusions.

Data and Methods

1. Data

Data from 2007 was collected from OVB Allfinanz, a company which specializes in providing financial services to consumers. The data consists of information about financial products that clients used before receiving a financial consultancy service from OVB. The data also includes details regarding age, gender, wage, occupation and household composition. In total the data set contains information from 629 Czech household portfolios. Table 1 provides a summary of the data.

Financial products are grouped into four aggregate variables based on their function in the consumer portfolio: long term savings, short term savings, insurance and loans (LS, SS, IN, LO). Each financial product is represented by a binary variable and the amount of payment to that product is represented by a continuous variable. The average values of product binary variables show the ratio of consumers in the sample who have the particular financial product. The average of product continuous variables express the average payment on financial products conditional on its positive holding i.e. this is the average payment by only those consumers who have the product. Demographic and social-economic characteristics are represented by categorical variables. Their averages show the frequency of given demographic and social-economic categories within the sample. Finally a tax incentive variable provides information on the tax savings when tax-deductible payments (2000 CZK/month) are applied.

2. Theoretical framework

The model describing the decision-making process is derived in the form of a Heckman selection model:

$$FP = \alpha + \beta_1 SFP + \beta_2 OFP + \beta_3 payment\ on\ SFP + \beta_4 payment\ on\ OFP + \beta_5 Gender + \beta_6 Age + \beta_7 Household + \beta_8 Occupation + \beta_9 Salary + \beta_{10} Tax\ incentive + e \quad (1)$$

where SFP are substitute financial products (products within the same group) and OFP are the other aggregate groups of financial products i.e. long term savings, short term savings, insurance and loans.

3. Estimation procedure

Heckman's selection model (1979) treats the ownership and share decisions separately while allowing for the possibility that unobserved determinants of the two decisions are correlated. Heckman suggests a two-step procedure. In the first step the selection equation is estimated using all observations. The estimated inverse Mill's ratios $\widehat{\lambda}_{i2} = \lambda(\mathbf{x}_{i2}\delta_2)$ are used in the second step to estimate parameters $\widehat{\boldsymbol{\beta}}_1$ and $\widehat{\gamma}_1$ using OLS method on the selected sample (outcome equation):

$$P(y_{i2} = 1|\mathbf{x}_{i2}) = \Phi(\mathbf{x}_{i2}\delta_2) \quad i = 1, 2, \ldots, N \quad (2)$$

$$\widehat{\lambda}_{i2} = \lambda(\mathbf{x}_{i2}\delta_2) \quad (3)$$

$$E(y_{i1}|\mathbf{x}_{i1}, y_{i2} = 1) = \mathbf{x}_{i1}\boldsymbol{\beta}_1 + \gamma_1\lambda(\mathbf{x}_{i2}\delta_2) \quad i = 1,2,\ldots N_1 \quad (4)$$

where y_1 is observed only if Error terms (u_1, v_1) are independently and normally distributed with zero mean and constant variance, σ^2. The correlation between u_1 and u_2 is assumed to be ρ.

Heckman (1979) reported that the presence of selection bias can be viewed as an omitted variable problem within the selected sample. The Heckman two-step estimation procedure provides efficient parameter estimates when the degree of multicollinearity is low (Nawata, 1994).

Since the estimated parameters are difficult to interpret directly their first differences are used. The probability change of holding financial product is a difference between the predicted probabilities for two values of independent variable, ceteris paribus. If the variable is presented only in the outcome equation its parameters provide the information about the monthly change in payment given by the unitary change of independent variable. If the

	Variable	Mean	St. Dev.	Max.
LS	**Long-term savings**	0.548	0.498	1
PF	Pension funds	0.335	0.473	1
WLI	Whole life insurance	0.321	0.467	1
ULI	Unit-linked life insurance	0.095	0.294	1
SS	**Short-term savings**	0.668	0.471	1
BS	Building society	0.51	0.5	1
LI	Life insurance used for short-term savings	0.275	0.447	1
MF	Mutual funds	0.025	0.158	1
IN	**Insurance**	0.7	0.459	1
TLI	Term life insurance	0.051	0.22	1
CAI	Casualty insurance	0.641	0.48	1
CI	Contents insurance	0.083	0.276	1
PI	Property insurance	0.091	0.287	1
LO	**Loans**	0.159	0.366	1
HC	Lending for home purchase	0.102	0.303	1
CC	Consumer credit	0.062	0.241	1
LS payment	**Monthly payment on LS [ths. CZK]**	0.319	0.473	3.265
PF payment	Monthly payment on PF [ths.CZK]	0.101	0.215	1.5
WLI payment	Monthly payment on WLI [ths. CZK]	0.153	0.29	2.008
ULI payment	Monthly payment on ULI [ths. CZK]	0.065	0.262	3
SS payment	Monthly payment on SS [ths. CZK]	0.706	0.879	8.333
BS payment	Monthly payment on BS [ths. CZK]	0.556	0.718	4.5
LI payment	Monthly payment on LI [ths. CZK]	0.101	0.2	1.25
MF payment	Monthly payment on MF [ths.CZK]	0.056	0.503	8.333
IN payment	**Monthly payment on IN [ths. CZK]**	0.156	0.356	4.903
TLI payment	Monthly payment on TLI [ths.CZK]	0.057	0.327	4.7
CAI payment	Monthly payment on CAI [ths.CZK]	0.077	0.099	1.084
CI payment	Monthly payment on CI [ths.CZK]	0.007	0.027	0.244
PI payment	Monthly payment on PI [ths. CZK]	0.016	0.074	1.402
LO payment	**Monthly payment on LO [ths. CZK]**	0.592	1.847	16.587
HC payment	Monthly payment on HC [ths. CZK]	0.411	1.649	16.587
CC payment	Monthly payment on CC [ths. CZK]	0.184	0.856	9.4
Men	Binary variable: 0 – Women, 1 - Men	0.512	0.5	1
Age				
0-19	Consumer in the age of 0-19	0.254	0.436	1
20-29	Consumer in the age of 20-29	0.245	0.43	1
30-39	Consumer in the age of 30-39	0.283	0.451	1
40-49	Consumer in the age of 40-49	0.149	0.357	1
50-64	Consumer in the age of 50-64	0.068	0.253	1
Household				
Single	Single-person household	0.122	0.328	1
Partners	Two-persons household without children	0.089	0.285	1
One child	Household with one child	0.231	0.422	1
Children	Household with two and more children	0.558	0.497	1

Source: OVB Allfinanz and own calculations

Table 1: Descriptive statistics of variables.

	Variable	Mean	St. Dev.	Max.
Occupation				
Blue-collar	Blue-collar workers	0.28	0.449	1
White-collar	White-collar workers	0.118	0.322	1
Public sector	Employees in public sector	0.097	0.296	1
Professional	Professionals	0.079	0.271	1
Self-employed	Self-employed persons	0.037	0.188	1
Benefits	Persons receiving benefits	0.073	0.261	1
Student	Children, students	0.316	0.465	1
Wage				
0-0.5	Gross wage: 0 - 10 478 CZK/m.	0.386	0.487	1
0.5-0.75	Gross wage: 10 479 - 15 717 CZK/m.	0.145	0.352	1
0.75-1	Gross wage: 15 718 - 20 957 CZK/m.	0.186	0.389	1
1-1.5	Gross wage: 20 958 - 31 435 CZK/m.	0.191	0.393	1
1.5 +	Gross wage: 31 435 CZK/m. and more	0.092	0.29	1
Tax incentive	Tax savings for tax-deductible item: 2000 CZK/m. [ths. CZK]	0.269	0.255	1.28

Source: OVB Allfinanz and own calculations

Table 1: Descriptive statistics of variables.

variable appears in both equations (the selection and the outcome equation) the parameter in outcome equation is influenced by its presence in the selection equation. According to Sigelman and Zeng (1999) the marginal effect can be calculated as:

$$\frac{\partial E(y_{i1}|x_{i1}, y_{i2}=1)}{\partial x_k} = \beta - \delta\rho\sigma_v\lambda(\lambda - \delta' x_2) \qquad (5)$$

where β is the parameter in the outcome equation and α is the corresponding parameter in the selection equation. ρ is the correlation coefficient between the error terms in the selection and outcome equation, sigma is the error term of the outcome equation and lambda is the inverse mill's ratio.

In the case of categorical variables the calculation of marginal effects is based on Hoffman and Kassouf (2005):

$$\frac{\partial E(y_{i1}|x_{i1}, y_{i2}=1)}{\partial x_k} = \beta - \rho\sigma_v(\lambda_1 - \lambda_0) \qquad (6)$$

where λ_1 and λ_2 are the inverse mill's ratios for categorical variable equals one and zero.

The multicollinearity was tested by traditional VIF test (variance inflation factor test) (Green, 2003) and condition number test (Leung and Yu, 2000).

Results and discussion

1. Portfolio choice models

Portfolio choice models (1) were estimated for following aggregate group of products: Long-term savings (LS), Short-term savings (SS), Insurance (IN) and Loans (LO). Furthermore to explore the impact of wage-disparity and inter-occupation specifics on the portfolio choice the individual product specific models were estimated within each aggregate group.

The estimates of aggregate models are presented in Table 2. For easier interpretation the table shows first differences of explanatory variables for participation decision and marginal effects of explanatory variables for decision about monthly payment. In the first step of the Heckman selection model the first differences express the impact of explanatory variable on probability of having particular aggregate group of products in financial portfolio. The first differences were calculated as difference between two values of dependent variable for two values of explanatory variable when other variables remain fixed. The two values of explanatory variable were set as follows: for categorical variables it was zero and one, for variables representing payment on financial product it was zero and value of conditional mean, and for other continuous variables it was zero and value of unconditional mean. For easier interpretation the values were rounded up to hundreds' of CZK. In

the second step of Heckman selection model the marginal effects are calculated conditionally on the positive holding, in other words they show impact of endogenous variables on amount of payment for consumers who have at least one product from the particular aggregate group.

The heteroscedasticity was not directly tested. However, the high conformity of robust errors of the estimate with standard errors of the estimate in the first step of the Heckman procedure suggests that there is no heteroscedasticity problem within the model. Moreover, the VIF test and conditional number test did not detect the high multicolinearity among variables. Finally, the LR test in the first step and the Wald test in the second step of Heckman procedure suggest that all models except

Variable	Long-term savings		Short-term savings		Insurance	Loans	
	Participation	Payment	Participation	Payment	Payment	Participation	Payment
LS	-	-	-17.68 %***	-	-	3.16%	-
			(0.06)			(0.03)	
SS	-16.31 %**	-	-	-	-	-1.40%	-
	(0.07)					(0.03)	
IN	12.14 %**	-	4.50%	-	-	1.08%	-
	(0.06)		(0.05)			(0.02)	
LO	9.33%	-	5.50%	-	-	-	-
	(0.09)		(0.08)				
LS payment	-	-	4.26%	0.108	-0.082	-1.93%	-0.638
			(0.03)	(0.09)	(0.05)	(0.02)	(0.6)
SS payment	0.97%	0.060**	-	-	0.019	-3.65%	-0.799*
	(0.04)	(0.03)			(0.02)	(0.02)	(0.04)
IN payment	-3.20 %**	0.024	-2.15 %*	0.048	-	-0.42%	4.517***
	(0.01)	(0.07)	(0.01)	(0.15)		(0.01)	(0.97)
LO payment	-8.02%	-0.027*	-23.16 %***	-0.031	0.026**	-	-
	(0.07)	(0.01)	(0.08)	(0.05)	(0.01)		
Men	-9.44%	0.094	-8.76 %**	0.057	-0.024	3.12%	0.295
	(0.06)	(0.06)	(0.05)	(0.09)	(0.05)	(0.03)	(0.61)
Age							
20-29	-	-	-3.62%	0.429***	0.064	-	-
			(0.08)	(0.14)	(0.07)		
30-39	16.87 %**	0.063	-14.59%	0.736***	0.082	2.67%	-0.31
	(0.07)	(0.08)	(0.1)	(0.02)	(0.08)	(0.03)	(0.67)
40-49	18.58 %**	0.199**	-15.03%	0.747***	0.302***	3.96%	-1.132
	(0.09)	(0.1)	(0.11)	(0.23)	(0.09)	(0.05)	(0.93)
50-64	32.19 %***	0.419***	-6.37%	0.998***	0.098	-5.72 %**	1.762
	(0.1)	(0.11)	(0.12)	(0.23)	(0.1)	(0.03)	(2.61)
Household							
Partners	-4.75%	0.027	10.52%	-0.383**	-0.019	27.72 %***	0.461
	(0.1)	(0.1)	(0.07)	(0.18)	(0.08)	(0.08)	(1.54)
One child	0.58%	-0.155*	-3.83%	-0.429***	-0.056	9.17 %**	0.368
	(0.09)	(0.09)	(0.07)	(0.15)	(0.07)	(0.04)	(1.21)
Children	3.58%	-0.113	-9.14%	-0.626***	-0.039	-0.12%	0.83
	(0.09)	(0.09)	(0.07)	(0.15)	(0.07)	(0.03)	(1.06)

Note: results of t-test provide information about the statistical significance of parameters not their marginal effects; *** p<0.01; **p<0.05; * p<0.1; AUC (LS) = 0.889, AUC (SS) = 0.737, AUC (LO) = 0.854; SE in parenthesis.
Source: own calculations

Table 2: Portfolio choice models – aggregate product groups.

Variable	Long-term savings		Short-term savings		Insurance	Loans	
	Participation	Payment	Participation	Payment	Payment	Participation	Payment
Occupation							
Manual	7.57%	-	-14.44 %**	-	-	-0.45%	-
	(0.06)		(0.07)			(0.05)	
Public sector	-9.60%	-	-7.67%	-	-	0.46%	-
	(0.09)		(0.08)			(0.06)	
Professional	-14.16%	-	-3.43%	-	-	-8.15 %*	-
	(0.1)		(0.09)			(0.05)	
Self-employed	-20.23%	-	7.48%	-	-	-4.23%	-
	(0.14)		(0.1)			(0.07)	
Benefits	3.41%	-	-18.35 %*	-	-	18.84 %*	-
	(0.1)		(0.11)			(0.1)	
Student	-66.05 %***	-	-7.49%	-	-	-10.49 %*	-
	(0.09)		(0.13)			(0.06)	
Wage							
0 - 0.5	2.31%	0.091	-1.60%	0.215	-0.063	-8.39 %*	0.447
	(0.13)	(0.12)	(0.11)	(0.16)	(0.09)	(0.05)	(1.46)
0.5 - 0.75	-23.51 %***	0.009	-6.70%	-0.281*	-0.033	-3.85%	-0.535
	(0.08)	(0.09)	(0.07)	(0.15)	(0.07)	(0.04)	(0.94)
1 - 1.5	5.65%	0.067	-7.65%	0.066	-0.029	5.76 %**	-0.255
	(0.09)	(0.07)	(0.07)	(0.14)	(0.06)	(0.05)	(0.76)
1.5 +	7.29%	0.233**	-14.23%	0.239	0.151	24.27%	0.095
	(0.12)	(0.11)	(0.12)	(0.17)	(0.09)	(0.11)	(1.17)
Tax incentive	4.57%	0.12	2.44%	-	0.177	-2.59%	4.451*
	(0.06)	(0.2)	(0.05)		(0.16)	(0.03)	(2.53)

Note: results of t-test provide information about the statistical significance of parameters not their marginal effects; *** p<0.01; **p<0.05; * p<0.1; AUC (LS) = 0.889, AUC (SS) = 0.737, AUC (LO) = 0.854; SE in parenthesis.
Source: own calculations

Table 2: Portfolio choice models – aggregate product groups.

of the models of participation in insurance products and mutual funds and models of payment on unit-linked life insurance, property insurance and life insurance used primarily for short-term savings are significant at a 5 % level of significance. Model of life insurance used primarily for short-term savings is significant at a 10 % level of significance. The goodness of fit, measured by the size of the area below the ROC curve (AUC), is high for all models.

The results in Table 2 suggest that only some variables are significant determinants of consumer's decision about the structure of their financial portfolio. These determinants are also product specific which is given by the nature of individual financial products and their function in the portfolio.

The estimated inter-product relationships provide the information about the substitutions or complementarities of financial products. As expected the mutual significant substitution relationship was estimated between financial group of long-term savings and the group of short-term savings. The probability of utilizing of long-term saving products is lower by 16.31 % if the consumer has short-term saving product(s) in her (his) portfolio and vice versa, the utilizing of long-term saving products decreases the probability of inclusion of short-term saving products into the portfolio by 17.68 %. The mutual complementary relationship was estimated between the group of insurance product and loans. The one-way relationship exists between groups of long-term savings and insurance products, the amount of payments on loans and on long-term savings and between short-term savings and loans. The utilisation of insurance increases the probability of usage of long-term saving products by 12.14 %. The loans determine the payment on long-term savings in negative way.

The estimated relations are consistent with the expected role of financial products in the portfolio. The roles are confirmed by the effects of socio-demographic and economic variables.

Age is an important determinant of consumer's portfolio choice. We estimated that the probability of utilisation of long-term savings goes up with increasing age. Whereas the probability of inclusion of long-term savings into the portfolio is higher by 16.78 % in the group of consumer between 30 and 39 comparing to the group of consumer between 18 and 29, then in the group 40 and 49 the probability is higher by 18.58 % and in the group over 50 it is 32.19 % more than in the group of consumer between 18 and 29. Moreover, the age significantly determines the amount of payment on short-term saving products, the higher the age the higher the payment on short-term saving products. In addition, a significant relationship was estimated for insurance products and the age group between 40 and 49. The payment on insurance in this group is significantly higher comparing to other groups. Finally, the estimates show that the probability of utilisation of loan products drops significantly if the consumer is older than 50.

The household is a significant determinant especially for short-term saving products and loans. We estimated that the households with more members have a higher tendency to use loan products and a lower tendency to include the short-term saving products into their portfolio. It also holds that households consisting only of couples have a high probability to use loan products. These characteristics are consistent with our expectation about the consumer behavior and income constraints of young couples or families with children, respectively.

The estimated inter-occupation differences are pronounced only for some products. According to our expectation students have significantly lower probability of using both long-term saving products and loans. Blue-collar workers (including those from farm households and employees in agricultural sector) and persons who are in receipt of state benefits have a significantly lower probability (by 14.4 %, or 18.35 % respectively) of using short-term saving products. This can be explained by low disposable income within these groups. In addition, the professionals have a lower probability to use loans (by 8.15 %) as opposed to persons receiving state benefits who have higher probability of including loans in their portfolio (by 18.84 %).

Probability of utilisation of long-term saving products and loans and the amount of payment on short term saving products is lower for consumers with bellow average income. On the other hand, consumers with a higher than average salary have a greater tendency to use loans and pay more on long-term saving products.

Since the inter-occupation and income differences are significant characteristics of Czech household portfolios we provide a more in-depth analysis of each aggregate group.

Table 3 presents the parameter estimates for the group variable occupation and individual financial products. The group of long-term saving products consists of pension funds, whole life insurance and unit-linked life insurance. In particular the significant inter-occupation differences can be found for financial product pension funds. The employees in public service, professionals, self-employed persons as well as students have significantly lower probability of the inclusion of pension funds into their portfolio comparing to the group of white-collar workers. Moreover, the employees in public service, professionals and students have a lower tendency to use consumer credit. In addition, students have a lower probability of borrowing for home purchase. In the case of insurance products, the significant difference can be found for casualty insurance and contents insurance. The self-employed persons have significantly higher probability (by 25.56 % higher) to use casualty insurance comparing to white-collar workers. On the other hand, persons receiving state benefits have a lower probability to use contents insurance. Whereas the estimated high probability for self-employed persons can be explained by the risk aversion against a potential drop in income in the case of casualty occurrence, then the lower probability for persons taken benefits is due to the income constraints.

The interesting feature of the estimates is that the group of blue-collar workers (including farm households and employees in agricultural sector) does not distinguish significantly from the white-collar workers or does not have any special characteristics in the sample, respectively. The reason can be found in the high heterogeneity of this group, which includes high variability of income (see the discussion in the section 3.2). That is, the analysis becomes more relevant if we connect the occupation with the information about the average income in individual occupation.

Table 4 provides the parameter estimates for the group variable income and individual financial

Variable	Long-term saving products					
	Pension funds		Whole life insurance		Unit-linked life insurance	
	Participation		Participation		Participation	
	ME	SE	ME	SE	ME	SE
Occupation						
Manual	10.90%	0.08	5.70%	0.08	4.49%	0.04
Public sector	-17.39 %**	0.09	-7.74%	0.1	-3.52%	0.04
Professional	-21.94 %**	0.09	4.30%	0.11	4.85%	0.06
Self-employed	-25.90 %**	0.1	-7.86%	0.14	8.07%	0.09
Benefits	8.06%	0.12	-14.33%	0.12	4.83%	0.08
Student	-39.99 %***	0.08	-38.43 %***	0.09	-5.16%	0.04

Variable	Short-term saving products				Loans			
	Building society		Life insurance - SS		Home purchase		Consumer credit	
	Participation		Participation		Participation		Participation	
	ME	SE	ME	SE	ME	SE	ME	SE
Occupation								
Manual	-11.80%	0.08	-9.09%	0.07	-2.35%	0.05	0.17%	0.02
Public sector	-0.58%	0.09	2.28%	0.09	3.20%	0.06	-2.59 %*	0.02
Professional	-0.54%	0.1	0.90%	0.1	-6.09%	0.05	-2.68 %*	0.02
Self-employed	15.74%	0.12	17.78%	0.15	-4.15%	0.06	-2.30%	0.02
Benefits	-16.03%	0.11	3.38%	0.12	5.84%	0.09	9.02 %*	0.07
Student	-6.73%	0.15	1.82%	0.14	-9.19 %**	0.05	-	-

Variable	Insurance products							
	Term life insurance		Casualty insurance		Property insurance		Contents insurance	
	Participation		Participation		Participation		Participation	
	ME	SE	ME	SE	ME	SE	ME	SE
Occupation								
Manual	0.83%	0.03	4.57%	0.08	-2.33%	0.02	0.08%	0.02
Public sector	0.32%	0.03	14.93%	0.09	-2.67%	0.02	3.61%	0.04
Professional	1.05%	0.04	10.18%	0.1	-1.24%	0.02	5.66%	0.05
Self-employed	4.80%	0.07	25.56 %**	0.12	-1.76%	0.02	-0.80%	0.04
Benefits	6.88%	0.07	6.40%	0.12	-2.53 %*	0.02	-0.92%	0.04
Student	-1.82%	0.03	21.49%	0.14	-	-	-	-

Note: results of t-test provide information about the statistical significance of parameters not their marginal effects.

*** p<0.01; ** p<0.05; * p<0.1

Source: own calculations

Table 3: Portfolio choice models – inter-occupation differences among financial products.

products. As expected the results show that the probability of the product inclusion is higher for consumers with the income higher than the average income and vice versa.

The probability of investing in a pension funds is 8% lower for consumers with below average gross wage (10,479 - 15,717 CZK) and by 15 %, resp. 21%, higher for consumers above average gross wage in comparison to the consumer with average wage. In addition, the consumers with gross wage higher than 31,435 CZK have on average by 140 CZK higher contributions to their pension funds than consumers with an average wage. In contrast to the pension funds the participation decision in two other tax incentivised long-term savings products, whole life insurance and unit-linked life insurance, is not so strongly related to the income. However the income has a positive impact on the amount of payment on the whole life insurance when the consumers in the highest income category pay on their life insurance on average income by 261 CZK more. Income also has a positive impact on the amount of short-term savings on building

Variable	Long-term savings									
	Pension funds				Whole life insurance				Unit-linked life insurance	
	Participation		Payment		Participation		Payment		Participation	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Wage										
0 - 0.5	1.17%	0.08	0.047	0.08	15.97%	0.11	0.03	0.09	-6.57%	0.05
0.5 - 0.75	-8.07 %*	0.05	0.005	0.06	-3.39%	0.06	0.04	0.07	-6.62 %*	0.04
1 - 1.5	15.22 %***	0.06	0.006	0.05	1.72%	0.06	0.004	0.06	-1.86%	0.04
1.5 +	20.94 %**	0.11	0.140*	0.07	-6.40%	0.07	0.261***	0.09	-0.02%	0.07

Variable	Short-term savings							
	Building society				Life insurance - SS			
	Participation		Payment		Participation		Payment	
	ME	SE	ME	SE	ME	SE	ME	SE
Wage								
0 - 0.5	-8.73%	0.12	0.281	0.19	-5.98%	0.12	-0.008	0.12
0.5 - 0.75	-1.44%	0.08	-0.116	0.13	-5.97%	0.08	-0.063	0.09
1 - 1.5	-9.02%	0.07	0.306**	0.13	0.33%	0.07	0.075	0.09
1.5 +	-7.66%	0.12	0.213	0.18	-8.61%	0.10	0.064	0.13

Variable	Insurance products									
	Term life insurance				Casualty insurance				Property insurance	
	Participation		Payment		Participation		Payment		Participation	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Wage										
0 - 0.5	0.76%	0.03	-1.000**	0.44	-1.41%	0.12	-0.039	0.03	-	-
0.5 - 0.75	-1.20%	0.02	-0.345	0.42	6.79%	0.07	0.005	0.02	1.79%	0.02
1 - 1.5	0.33%	0.02	-1.046**	0.42	6.85%	0.07	0.014	0.02	0.38%	0.01
1.5 +	1.05%	0.04	0.016	0.41	-0.54%	0.11	0.000	0.03	-0.49%	0.01

Variable	Insurance products				Loans							
	Contents insurance				Home purchase				Consumer credit			
	Participation		Payment		Participation		Payment		Participation		Payment	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Wage												
0 - 0.5	-	-	-0.024	0.04	-2.57%	0.03	0.481	1.97	-	-	-	-
0.5 - 0.75	-0.29%	0.02	0.006	0.02	-1.87%	0.03	0.772	1.51	0.97%	0.02	-0.797	1.01
1 - 1.5	-2.21%	0.02	-0.003	0.02	2.48%	0.03	-1 522	1.20	2.82%	0.02	0.72	0.80
1.5 +	-1.40%	0.03	0.044*	0.02	30.45 %***	0.14	-1 691	2.03	3.41%	0.05	1 647	1.28

Note: results of t-test provide information about the statistical significance of parameters not their marginal effects. *** p<0.01; ** p<0.05; * p<0.1

Source: own calculations

Table 4: Portfolio choice models – wage differences.

society accounts. The consumers with above average income save on average by 306 CZK more than the consumers with average income. Similarly to the long-term saving products the decision in participation in life insurance used for short-term savings does not change with the income.

In relation to the loan products the consumers have a higher probability of having loan for home purchase (by 30%). As showed in table 2 there is a complementary relationship between mortgage and

the term life insurance as the term life insurance is often required for opening the mortgage. That is why the average payment on term-life insurance is lower for consumers with income below 10,479 CZK and for consumers with income between 20,958 CZK and 31,435 CZK as this income group has a lower participation in home related loan in the sample.

2. Wage disparity problem

Table 5 provides the information on the average salaries in sectors of Czech Economy. These figures together with tables 6 and 7 can be used to deduce the wage disparity problem in Czech Economy. The wage disparity problem is approached from the sector and regional point of view. Moreover, we will predominantly concentrate on the position of agricultural sector.

The lowest salaries are in the sector Accommodation and food services activities industry with the ratio to the average salary around 52 % between 2005 and 2011. As opposite, the highest level of salaries was reached in Financial and insurance activities with about 86 % over the average salary. The salaries in agricultural sector are significantly below the average salary with the ratio 71 % within 2005 and 2011. That is, the average salary in agricultural sector belongs to the group below average income with the consequences identified in previous section.

The average salary increased from 19,729 CZK in 2005 to 25,912 CZK in 2011. The variation coefficient rose as well which indicates that the

Economic Activity	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Agriculture, forestry and fishing	13 961	14 838	16 194	17 765	17 644	18 399	18 630
Mining and quarrying	17 837	18 977	20 311	22 118	22 625	23 473	24 242
Manufacturing	22 679	24 047	25 714	29 271	28 312	30 118	31 289
Electricity, gas, steam and air conditioning supply	17 362	18 490	19 852	21 564	21 968	22 828	23 621
Water supply; Sewerage, waste management and remediation activities	26 594	29 179	31 157	35 420	39 436	39 604	40 598
Industry, Total	17 703	18 749	19 750	21 461	22 049	22 729	23 081
Construction	16 808	17 885	19 036	20 948	22 022	22 352	22 636
Wholesale and retail trade; Repair of motor vehicles and motorcycles	17 058	18 238	19 821	21 341	21 358	21 683	22 480
Transportation and storage	18 188	19 262	20 663	22 369	23 000	23 090	23 352
Accommodation and food services activities	10 637	11 676	12 380	12 474	12 330	12 632	12 856
Information and communication	33 423	35 814	38 167	41 800	43 083	43 461	44 639
Financial and insurance activities	37 296	40 020	42 351	45 655	46 124	46 356	47 425
Real estate activities	17 879	19 263	20 718	20 808	20 715	20 885	21 880
Professional, scientific and technical activities	23 486	24 678	26 925	30 244	31 789	31 017	30 702
Administrative and support service activities	13 516	14 478	15 254	15 521	15 927	16 031	16 368
Public administration and defence; Compulsory social security	22 244	23 292	25 040	26 209	27 045	26 958	26 349
Education	18 787	20 040	21 251	22 119	23 429	23 030	23 718
Human health and social work activities	17 609	19 043	20 169	21 177	23 032	24 338	24 941
Arts, entertainment and recreation	16 071	16 827	17 908	18 797	19 434	19 881	19 829
Other service activities	15 450	16 497	17 612	17 990	18 340	18 568	19 594
Descriptive statistics							
Minimum	10 637	11 676	12 380	12 474	12 330	12 632	12 856
Maximum	37 296	40 020	42 351	45 655	46 124	46 356	47 425
Average	19 729	21 065	22 514	24 253	24 983	25 372	25 912
Standard Deviation	6 484	6 977	7 408	8 429	8 854	8 806	9 003

Note: full time equivalent

Source: Czech Statistical Office (http://www.czso.cz/csu/csu.nsf/engi/tab_2_pmz/$File/pmzcr030912_2.xls) and own calculations

Table 5: Average gross monthly wage in Czech Economy (in CZK).

salary differences among the sectors went up. As far as the agricultural sector is concerned we may conclude that the growth of salaries in agricultural sector kept the pace with the economy.

Table 6 shows the average salaries for the main occupation groups and their distribution. The group of blue-collar workers can be defined as: Service and sales workers, Skilled agricultural, forestry and fishery workers, Craft and related trades workers and Plant and machine operators, and assemblers. Within the group of blue-collar workers there are significant differences in salaries. Both the average and median are significantly lower in the group of Service and sales workers and Skilled agricultural, forestry and fishery workers comparing to the groups of Craft and related trades workers and Plant and machine operators, and assemblers.

Occupation		Average earnings	Earnings (in CZK) in main quantiles				
			1st decile	1st quartile	Median	3rd quartile	9th decile
Total		25 645	11 506	15 825	21 826	29 418	40 326
CZ-ISCO major groups	Armed forces occupations	26 216	16 135	19 074	24 536	30 127	38 382
	Managers	55 158	19 159	26 835	39 846	60 214	102 025
	Professionals	36 372	20 243	24 829	30 355	40 832	58 198
	Technicians and associate professionals	28 364	15 662	20 453	25 638	32 955	42 612
	Clerical support workers	22 131	12 092	16 137	20 483	26 240	32 969
	Service and sales workers	16 123	9 058	10 952	14 505	18 766	25 247
	Skilled agricultural, forestry and fishery workers	17 174	11 183	13 656	16 535	20 268	23 618
	Craft and related trades workers	21 023	11 840	15 561	20 035	25 320	31 094
	Plant and machine operators, and assemblers	20 651	12 114	15 576	19 923	24 580	30 038
	Elementary occupations	14 590	8 850	10 908	13 577	17 254	21 413

Source: Czech Statistical Office (http://vdb.czso.cz/vdbvo/tabdetail.jsp?kapitola_id=15&potvrd=Zobrazit+tabulku&go_zobraz=1&cislotab=PRA0021UU&voa=tabulka&cas_1_29=2011&str=tabdetail.jsp)

Table 6: The distribution of average salaries (2011).

Region	Average earnings	Blue-collar workers			
		Clerical support workers	Service and sales workers	Skilled agricultural, forestry and fishery workers	Craft and related trades workers
Total	25 645	16 123	17 174	21 023	20 651
Prague, the Capital City	33 546	18 302	19 750	23 459	22 290
Central Bohemian Region	25 651	15 808	17 839	23 029	22 292
South Bohemian Region	23 199	15 095	19 985	20 072	20 411
Plzeň Region	24 036	16 153	19 439	21 921	20 344
Karlovy Vary Region	21 723	16 632	16 490	20 214	19 421
Ústí nad Labem Region	23 174	14 586	15 641	20 689	21 571
Liberec Region	23 422	15 762	15 725	21 501	20 146
Hradec Králové Region	22 837	15 759	15 553	20 068	20 185
Pardubice Region	22 978	15 561	19 438	19 914	19 217
Vysočina Region	22 918	15 377	18 891	20 175	19 062
South Moravian Region	24 651	15 120	16 190	20 584	19 840
Olomouc Region	22 825	15 837	19 471	20 587	20 050
Zlín Region	22 655	15 245	17 293	20 665	20 241
Moravian-Silesian Region	24 174	15 244	16 465	21 985	22 104

Source: Czech Statistical Office (http://vdb.czso.cz/vdbvo/tabparam.jsp?voa=tabulka&cislotab=PRA0041PU_KR&&kapitola_id=15)

Table 7: Regional wage disparity – Blue-collar workers – 2011 (CZK).

The average salary in the group of Service and sales workers was 16,123 CZK in 2011 which is 37% below the total average salary. Similarly the average salary in the group of Skilled agricultural, forestry and fishery workers was 33 % below the total average salary. In contrast the average salary in groups of Craft and related trades workers and Plant and machine operators, and assemblers was about 18% below the average. This implies that the Service and sales workers and Skilled agricultural, forestry and fishery workers belong to the group with bellow average income and the groups of Craft and related trades workers and Plant and machine operators, and assemblers are in the group of average salary (as defined in the previous section).

In addition to the significant wage disparity among sectors there can be also regional wage disparity. Table 7 provides the average salaries within the main regions in the Czech Republic (NUTS3) and their distribution across the group of blue-collar workers. The figures show that there is significant regional wage disparity in the group of Skilled agricultural, forestry and fishery workers.

Conclusion

The results show that a mutual significant substitution relationship exists between long-term saving and short-term saving products. The mutual complementary relationship was estimated between insurance and loan products. The one-way relationship exists between long-term saving and insurance products, between the amounts of payments on loans and on long-term saving products and between the products of short-term saving and loans. Moreover, the presence of loans in the financial portfolio decreases the payments on long-term saving products.

The socio-demographic and economic variables provided important information about managing households' portfolios. The probability of utilisation of long-term products goes up with increasing age. Moreover, the age significantly determines the amount of payment on short-term saving products, the higher the age the higher the payment on short-term saving products. The payment on insurance products is significantly higher in the age group between 40 and 49 comparing to other groups. Finally, the estimates show that the probability of utilisation of loan products drops significantly if the consumer is older than 50 years.

The household is a significant determinant especially for short-term saving products and loans. The households with more members have a higher tendency to use loan products and a lower tendency to include the short-term saving products. Moreover, households consisting only of couples have a high probability to use loan products.

We did not find significant differences between the group of blue-collar workers (including farm households and employees in agricultural sector) and the group of white-collar workers. The reason is the high heterogeneity of the group of blue-collar worker and the identified wage disparity among sectors. That is, the inter-occupation differences as a factor determining the portfolio choice must be considered together with the level of income. Since employees in agricultural sector fit in the group of below average salary they are characterized by the lower probability of utilisation of long-term saving products and loans and they have lower payments on short term saving products.

Moreover, as far as the group of agricultural workers and farm households are concerned we have to be aware of the high heterogeneity within this group. In addition to the high variability of average salaries in agricultural sector we identified significant regional wage disparity in Czech agriculture sector. Finally, the portfolio choice can be determined by agricultural specifics which were not possible to include in the model, e.g. natural income, seasonality, specifics of farm households budget.

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