Czech University of Life Sciences Prague
Faculty of Economics and Management

agris on-line

Papers in Economics and Informatics

http://online.agris.cz

ISSN 1804-1930
I, 2009, 2

International scientific journal
Prague

Agris on-line Papers of Economics and Informatics

The international reviewed scientific journal issued by the Faculty of Economics and Management of the Czech University of Life Sciences Prague.

The journal publishes original scientific contributions from the area of economics and informatics with focus on agriculture and rural development.

Editorial office

AGRIS on-line Papers in Economics and Informatics
Information and Consulting Center of FEM CULS Prague
Kamýcká 129, 165 21 Praha 6 – Suchdol
Czech Republic
Phone: +420 224 382 050
E-mail: agrisonline(at)pef.czu.cz

Publisher

Faculty of Economics and Management
Czech University of Life Sciences Prague
Kamýcká 129, 165 21 Praha 6 – Suchdol
Czech Republic
Reg. number: 60460709

ISSN 1804-1930

I, 2009, 2
30th of December, 2009
Prague

Agris on-line
Papers in Economics and Informatics

ISSN 1804-1930

I, 2009, 2

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

World agricultural production and consumption

L. Smutka, M. Steininger, O. Miffek

Czech University of Life Sciences Prague, Faculty of Economics and management, Department of Economics

Abstract

The article deals with an analysis of the world agricultural and foodstuff production and consumption. It analyses production and consumption development during the last 45 years (1961-2006). The aim of our paper is to analyse the current growth of population and foodstuff consumption and production and on the basis of these analyses, the paper tries to analyse the past and current food production development. In general, the paper analyses which factors influenced the foodstuff demand and which factors influenced the foodstuff supply.

The study is part of a project which focuses on an analysis of the development of world agricultural production (supply) and consumption (demand) and which is undertaken by the authors within the VZ MSM 6046070906 ("Economics of resources of Czech agriculture and their efficient use in frame of multifunctional agri-food systems").

Key words

Agriculture, production, consumption, development, analyses, World.

Anotace

Článek analyzuje vývoj světové agrární produkce a spotřeby v období let 1961-2006. Cílem článku je analyzovat vývoj světové populace, produkce a spotřeby potravin v uplynulých 45 letech a na základě provedené analýzy poukázat na minulé a současné trendy v oblasti světové produkce a spotřeby agrárních produktů. V obecné rovině pak článek analyzuje obecné faktory, které ovlivňují vývoj nabídky a poptávky po agrárních produktech ve světě.

Článek je součástí projektu zaměřeného na analýzu vývoje světové nabídky a poptávky po potravinách na, kterém autoři dlouhodobě pracují v rámci VZ MSM 6046070906 („Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů").

Klíčová slova

Zemědělství, produkce, spotřeba, vývoj, analýza, svět.

Introduction

The agricultural sector is one of the most important sectors of the world economy. Although the share of agricultural sector in the total world economy is about 6.3%, we have to emphasize that the agricultural sector has a very important influence on the world human society development. The ancient Greek philosopher Xenofon, speaking about agriculture, said that: "Agriculture is the mother of all sciences. When it works well, other sciences prosper. When it is marginalized, other sciences deteriorate". We have to agree with ancient Xenofon. He was completely right when he told that the agricultural sector is one of the cornerstones of the human society.

The agricultural sector and its development supported a steady growth of the world economy. Other sectors of world economy take an advantage of a well working agrarian sector. The agrarian sector offered additional labour forces; its growing productivity enabled many people to move out of the agricultural sector and supports the development of some other sectors of world economy. In the past, the majority of the world population worked in the agricultural sector. Now, only 20% of the world population works in

agricultural business. There is a huge difference in a number of employees between developing and developed countries. In developed countries, only about 5% of the economically active population is working in the agricultural sector, while in developed countries, more than 20% of the total economically active population works in this sector.

The role of agriculture consists in a participation in a realization process of economic, political and social development which consists particularly in safeguarding the production function and rural regions.[1]

The influence of globalization processes, the New Economy and development tendencies in the world influence significantly development trends of agriculture in the world, integration groups or territories, the particular countries and regions.[2]

Nowadays, the agricultural sector plays a very important role because of a very intensive population growth. During the last 50 years, the world population increased by more than 200%. Its inter-annual growth rate reached the highest level in the history of human society development. In 1950, the world population was approximately 2.5 billion inhabitants, in 2006 it increased to more than 6.6 billion people. The average inter annual growth rate of population was about 1.7%. The following graph No.1 (together with the table No. 1) illustrates the world population development in the period 1960-2006.

Data and methods

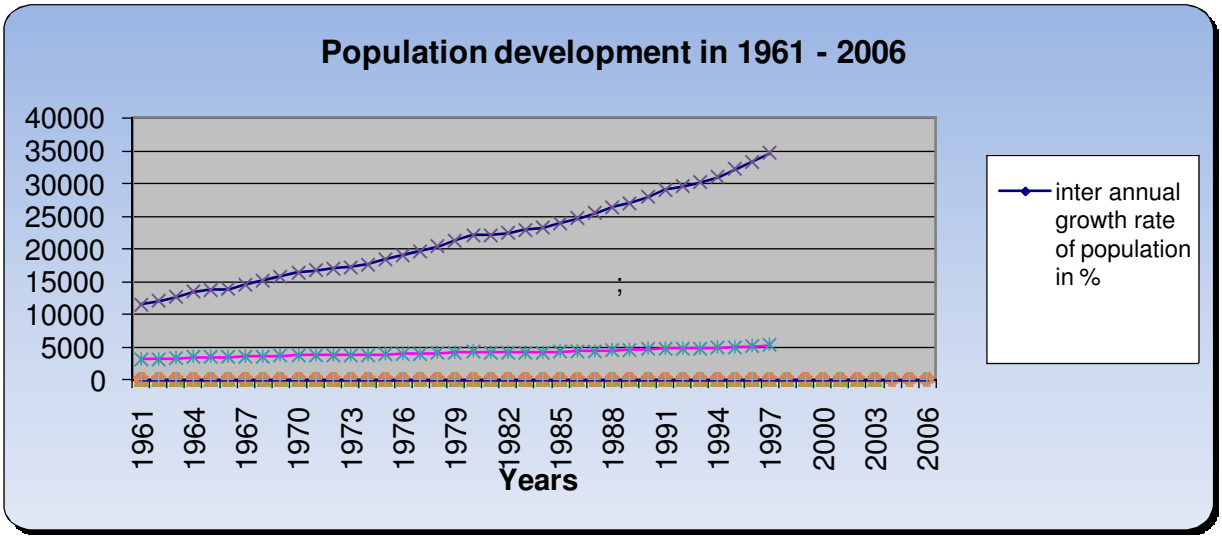
The paper analyzes the world agricultural production and consumption development in the years 1961-2006. It must be mentioned that this paper is written as a part of more extensive research undertaken by the author and the co-authors, and also that paper is undertaken within the framework of research activities which are a part of VZ MSM 6046070906 ("Economics of resources of Czech agriculture and their efficient use in frame of multifunctional agri-food systems").

The aim of our paper is to analyze the current growth of agricultural consumption and production and on the basis of these analyses, this paper attempts to analyze past and current food production and consumption development. In general, it can be stated that this paper analyses which factors influenced the foodstuff demand and which factors influenced the foodstuff supply. For the purpose of our analyses we decided to analyze an influence of the following factors on the total world agricultural production and consumption: the population growth, the available agricultural and arable land, GDP, GDP/cap, the consumption of fertilizers, and the level of technological development (number of machines and vehicles used in the agricultural sector).

The fundamental data source for needs of this paper is the Food and Agricultural Organization's database. This database includes the main data about agricultural production and its utilization (http://faostat.fao.org/site/502/default.aspx). For the purpose of data analyses we used the following methods: time series analysis, linear and non-linear regression analysis, basic and chain indices. The analyses of consumption and production are performed in metric tons. Data for an analysis of GDP development are taken from the UN Statistics Division's database. All the data about the world GDP are calculated in USD (constant prices of 1990). Data about available agricultural and arable land are taken from FAOSTAT database. Data about the world population development are taken from UN Population Division's database. The world agricultural production and consumption are analysed in the following two basic categories: plant production and consumption (cereals, fibres, fruits, nuts, oil crops, pulses, roots and tubers, rubber, fodder crops, spices, stimulants, sugar crops, tobacco and vegetables), and animal production and consumption (meat, milk, eggs and honey). For the purpose of the structural analysis of agricultural products consumption, the agricultural consumption is analysed in the following six sub-categories: feeds consumption, seeds consumption, waste, primary production consumption, processed products consumption, nonfood utilization of agricultural production..

1 SVATOŠ, M., Economics of Czech and Slovak Agriculture Integration with the EU, Prague 1999, ISBN 80-213-0497-9

2 SVATOŠ, M.: Selected trends forming European agriculture, Agric. Econ. – Czech, 54 (2008), No. 3, 93 – 101



Graph 1.

	Population (in billion inhabitants)		inter annual growth rate 1960-2006	inter annual and total growth of population 1960-2006 (in million)	Population development in 1960-2006	Share of population in total population	
	1960	2006				1960	2006
World	3.03	6.59	1.70%	77.41 / 3 561	117.45%	xxx	Xxx
Developed Countries	0.92	1.22	0.62%	6.59 / 303	33.11%	30.22%	18.50%
Developing Countries	2.12	5.37	2.05%	70.82 / 3 258	153.97%	69.78%	81.50%

Source: FAO, own processing

Table 1: World population development in 1961 – 2006.

Results and discussions

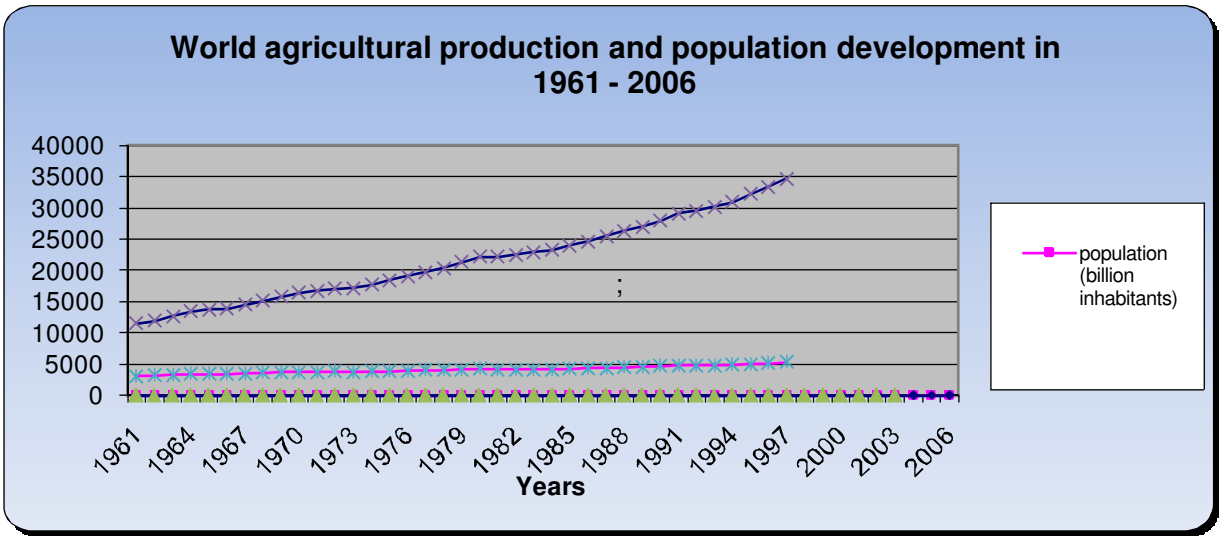
The globalization as a multidimensional process is not only a driving power but at the same time it is a resultant force of many development trends. In this sense, the formation of sustainable dimension of globalization is fundamental from the view-point of world society, economy and ecology. This aim is very considerably connected with global trends. In characterization of the global structures and definition of requirements for the needs of global coordination, it is necessary to stem from multidimensionality and mutual connection of the globalization processes and trends. Besides other decisive spheres of the global trends and the connected requirements of sustainable development there is the area of world society, the world economy and the world ecology.[3]

The population growth rate during the last 50 years was enabled by an intensive growth of agricultural production. The agricultural sector increased its production during the period 1960 – 2006 by 145% (which means that the average inter-annual growth rate of production reached the value 2.05%). It means that the growth rate of agricultural production was higher than the growth rate of world population. The following graph No. 2 illustrates the population and agricultural production growth during 1961-2006.

3 SVATOŠ, M.: Selected trends forming European agriculture, Agric. Econ. – Czech, 54 (2008), No. 3, 93 – 101

The current world agricultural production (in 2006, the volume of total agricultural production reached 8.9 billion tonnes) is represented by 88.8% crops production (7.9 billion tonnes). The share of animal production is only about 11% (approximately 1 billion tonnes). Even though, the volumes of crops and animal production constantly increase, the ratio between crops and animal production did not significantly change during the last 45 years. The world crops production increased during the analyzed period by 148% - i.e. 4.7 billion tonnes (average inter annual growth rate reached the value of 2.07%), animal production increased by 131% - i.e. 0.564 billion tonnes (average inter annual growth rate reached the value of 1.88%). The total world agricultural production increased during the analysed time period by 146% - i.e. 5.3 billion tonnes (average inter annual growth rate reached the volume of 2.05%). If we analyze the production development, we have to also analyze its structure. The main components of agricultural production are crops and the animal production. The following table No. 2 illustrates the structure of world production and its development during the last 45 years.

The world crops production consists particularly of the following commodity groups production: cereals, sugar crops, fodder crops, vegetables, oil crops, roots and tubers, fruits, pulses, fibres, stimulants, nuts, spices and so on. The animal production is represented particularly by the following commodities: milk, meat and eggs. The following commodities have the main share in the total volume of world agricultural production. The main pillars of the world agricultural production are cereals (25%), sugar crops (18.5%), fodder crops (11%), vegetables (10.2%), oil crops (8.4%), roots and tubers (8.3%), milk (7.4%), fruits (5.9%), meat (3.1%) and the share of others is about 2.35%. During the last 45 years (1961 – 2006), the world agricultural production increased significantly. The most progressive growth (about more than 200%) of production can be seen in the following commodity groups: oil crops (381%), rubber (367%), (eggs (339%), spices (315%), meat (287%), nuts (267%), and fruits (200%). It is obvious that the high growth rates are usually connected with commodities with a low share in the total production and a relatively higher price per kilogram. Conversely, commodities with a significant share in the total world production are connected with a relatively lower production growth (sugar crops - 170%, cereals - 153%, stimulants – 137%, fibres – 104%, honey -100%, milk - 90%, tobacco - 88%, roots and tubers - 62%, fodder crops – 57% and pulses – 48%).



Graph 2.

	World production (in million tonnes)		Average inter annual growth rate	Inter annual growth (in million tonnes)	Production growth 1961-2006	Production growth 1961-2006 (in million tonnes)	Share of production in total production	
	1961	2006					1961	2006
Cereals	877.8	2 221.1	2.17%	29.9	153.04%	1 343.3	24.25%	24.99%
Fibres	14.4	29.3	1.87%	0.3	104.00%	15.0	0.40%	0.33%
Fruits	176.0	526.5	2.50%	7.8	199.14%	350.5	4.86%	5.92%
Nuts	3.0	11.1	3.09%	0.2	267.54%	8.1	0.08%	0.12%
Oilcrops	154.5	743.5	3.63%	13.1	381.14%	588.9	4.27%	8.36%
Pulses	40.8	60.2	0.98%	0.4	47.48%	19.4	1.13%	0.68%
Roots, Tubers	455.4	736.7	1.15%	6.3	61.78%	281.3	12.58%	8.29%
Rubber, gums	2.1	9.9	3.54%	0.2	367.85%	7.8	0.06%	0.11%
Fodder crops	620.6	972.6	1.36%	7.8	56.72%	352.0	17.15%	10.94%
Spices	1.8	7.3	3.35%	0.1	315.40%	5.6	0.05%	0.08%
Stimulants	7.0	16.6	2.18%	0.2	137.78%	9.6	0.19%	0.19%
Sugarcrops	609.1	1 649.7	2.32%	23.1	170.83%	1 040.5	16.83%	18.56%
Tobacco	3.6	6.7	1.85%	0.1	87.85%	3.1	0.10%	0.08%
Vegetables	222.2	903.4	3.19%	15.1	306.55%	681.2	6.14%	10.16%
Eggs	15.1	66.5	3.36%	1.1	339.53%	51.4	0.42%	0.75%
Honey	0.7	1.4	1.67%	0.0	100.03%	0.7	0.02%	0.02%
Meat	70.5	272.9	3.06%	4.5	287.03%	202.4	1.95%	3.07%
Milk	344.4	653.8	1.44%	6.9	89.81%	309.4	9.52%	7.35%
Crops	3 188	7 895	2.07%	104.6	147.61%	4 706.4	88.1%	88.8%
Animal	430.8	994.6	1.88%	12.5	130.89%	563.8	11.9%	11.2%
Total	3 619	8 889	2.05%	117.1	145.62%	5 270.2	xxx	xxx

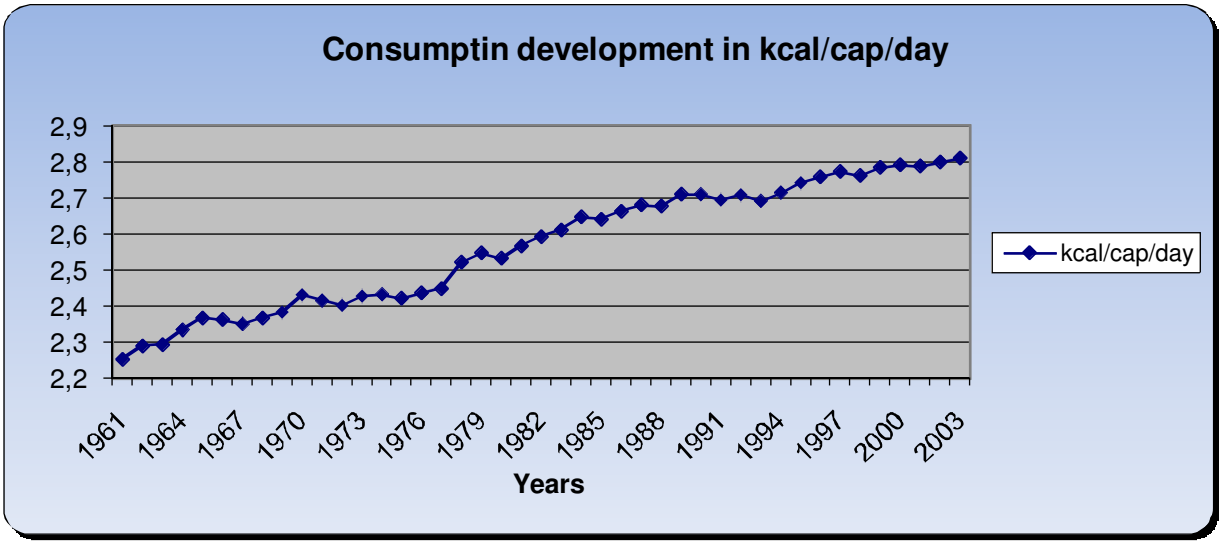
Source: FAO, own processing

Table 2: World agricultural production development.

Agricultural products consumption development

The world agricultural production is closely related to the level of agricultural consumption. During the analyzed period, the world agricultural products increased by 171%. If we analyze the world population growth – one of the main agricultural production stimuli – we can see that the population growth is the main source of agricultural products consumption growth. During the analysed period, the share of food products consumption in the total agricultural products consumption increased from 73% in 1961 to 78% at present. It is necessary to emphasize that the share of production used as a foodstuff constantly grows – and because the world agricultural production grows faster than the world population, the world food consumption per capita is slowly increases. The growth of consumption can be observed in the following graph No. 3 – which illustrates the growth of foodstuff consumption in kcal/cap/day. The graph illustrates that the world average consumption/capita/day increased its caloric value by 24%. The growth of consumption caloric value is stimulated by the following two factors: the growth of consumption volume and improvements to the quality of the consumed products (higher nutrition value in one unit of consumed products). Thanks to these developments, it is possible to see changes in the structure of world production. It is possible to see that although the world production of all analyzed commodity groups grew, the growth rate of production is higher in the case of products with high nutrition values. Nevertheless, the ratio between the shares of crops and animal production in the total world agricultural production is the same from 1961 to the present. While the share of crops production in the total consumed nutrition value is 86%, the share of animal production is only 14%.

The total world agricultural consumption is not represented only by the food and foodstuff industry consumption. A huge part of the world agricultural consumption is represented by the feeds and seeds consumption, the industrial non-food consumption (for example - bio-fuels and so on) and also a certain part of the world production is lost because of manipulation, poor storage conditions, and so on. The current share of non-food agricultural products consumption in the total agricultural products consumption is about 22% (i.e. 1.650 billion tonnes) and in spite of the fact that the quantity of consumption continuously grows, the share of non-food agricultural products consumption in total agricultural products consumption constantly decrease (in 1961 it was 27% - i.e. 0.812 billion tonnes). It is possible to see following development trends in the non-food consumption. The share of feeds and seeds consumption in the total world agricultural products consumption decreases. During the analyzed period, their share decreased from 21% to 15.5%. In spite of the fact that the share of feeds and seeds consumption in the total consumption decreases, the total quantity of agricultural products, which are produced as feeds or seeds, constantly increases. In 1961, the seeds and feeds consumption represented by 127 and 512 million tonnes respectively, at present, the seeds consumption is represented by 153 million tonnes of agricultural products and the feeds consumption is represented by 1.026 billion tonnes of agricultural products. While the share of feeds (mainly: fodder crops, cereals, starchy and tubers crops, vegetable, oil crops and sugar crops) and seeds (mainly: cereals, starchy and tubers crops, pulses and oil crops) consumption decrease, the share of agricultural production, which is used by the non-food industry, slowly increases – at present, the share of the non-food industry consumption in the total agricultural products consumption is 2.1% - 160 million tonnes (i.e. during the analyzed period, the share of agricultural consumption, which is used by non-food industry, increased by 50% - in 1961; the total production used for non-agricultural and food purposes represented 45 million tonnes). The growth of production which is consumed by the non-food industry is especially stimulated by the increasing demand for alternative energies and bio fuels.



Graph 3.

World (in hectares)	1961	2006
available arable land per capita	0.41	0.22
available agricultural land per capita	1.44	0.75
total available area per capita	4.22	1.97

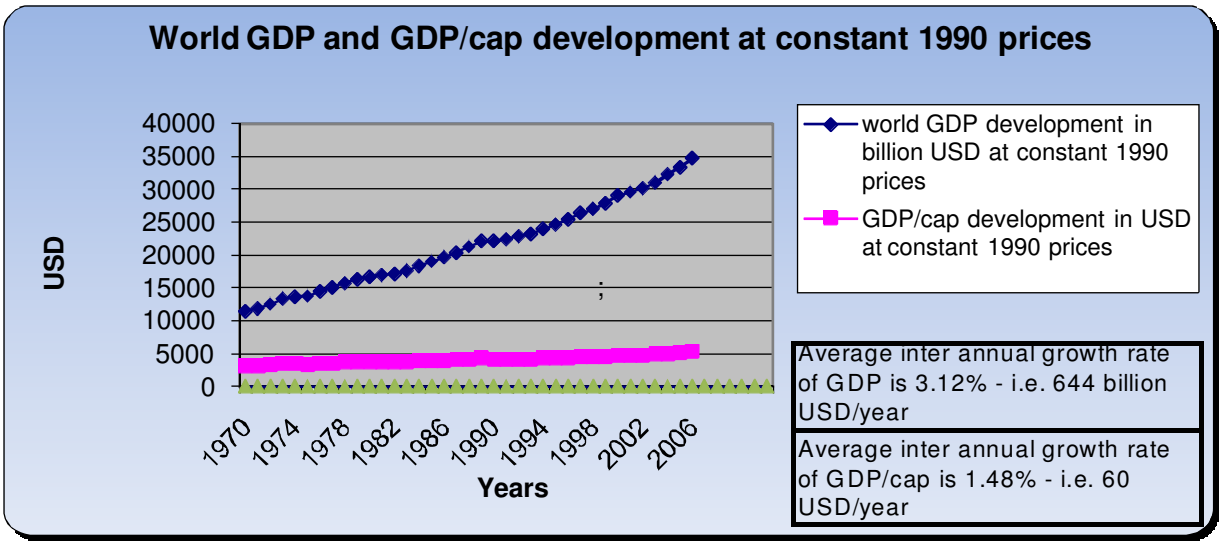
Source: FAO, own processing

Table 3: Available land/cap development in the world.

The last part of the total agricultural products consumption is represented by a waste of agricultural production. The share of waste in the total consumption is stable in the long term. During the analyzed period, the share of waste in the total consumption oscillated between 3.9 – 4.4%. The current share of waste in the total consumption is more than 4% (i.e. 311 million tonnes of world production is lost somehow). The following commodity groups have the main shares in the total waste of agricultural production: cereals (26%), sugar crops (24%), starchy roots (22%) and eggs (14%). The share of other commodity groups in the total waste is about 15%.

Factors which have been influencing world production and consumption development

The world agricultural production and consumption possibilities are influenced (limited) by the technological level of human society, an available agricultural area (which is suitable for agricultural production), yields respectively an available production per hectare development, climate conditions, the population growth, GDP and GDP/cap development, and many other factors. If we analyze the technological level of agricultural production and the level of productivity, it has to be emphasized that the character of agricultural sector changed during the last more than 40 years. The number of machines and vehicles increased during the analyzed period by more than 122% (according to FAO - the current number of machines and vehicles used in the agrarian sector reached almost 34 million pieces). Another factor which influenced the world agricultural production is the consumption or the availability of fertilizers. The current consumption of basic fertilizers (N,P,K) reached almost 161.5 million tonnes, and it is possible to expect that the consumption will permanently increase because during the years 2002 – 2005 alone, the world consumption of fertilizers increased by 10% (the current available amount of fertilizers per hectare in the world reached 32.5 kilograms). New methods and technological development increased the total agricultural sector's production rate. We can see that the world agricultural production increased by 148% and the main reason for this development trend is increasing productivity (yields or number of animals per hectare development).



Graph 4.

	1961	2006
Animals (head)	0.66	0.95
Poultry (1000 head)	0.98	3.90
Crops production (tonnes)	0.72	1.59
Animal production (tonnes)	0.10	0.20

Source: FAO, own processing

Table 4: Agricultural production per one hectare of available agricultural land.

	1961	2006	inter annual growth rate (%)	relative change	absolute change
World population (in billion inhabitants)	3.03	6.59	1.70%	117.45%	3.56
World agricultural production (in billion tonnes)	3.62	8.89	2.05%	145.62%	5.27
World agricultural consumption (cal/cap/year)	2253.77	2808.87	0.53%	24.63%	555.10
World available agricultural land (in billion hectares)	4.46	4.97	xxx	11.49%	0.51
Available agricultural land per capita in the world (hectares/cap)	1.44	0.75	xxx	-47.75%	-0.69
World GDP (in billion USD) 1970 - 2006	11 501.0	34 694.0	3.12%	201.66%	23 193.0
World GDP/cap (in USD) 1970 - 2006	3 109.0	5 262.0	1.48%	69.25%	2 153.00
Available number of machinery (in million pieces)	15.23	33.96	xxx	122.94%	18.72
Available amount of fertilizers (in million tonnes)	150.26	163.14	xxx	8.57%	12.88
World crops production (in billion tonnes)	3.19	7.89	2.07%	147.61%	4.71
World animal production (in billion tonnes)	0.43	0.99	1.88%	130.89%	0.56
Agricultural production per hectare - crops production (tonnes/hectare)	0.72	1.59	xxx	122.10%	0.87
Agricultural production per hectare - animal production (tonnes/hectare)	0.10	0.20	xxx	107.10%	0.10

Source: FAO, own processing

Table 5: Main indicators of world agricultural production and consumption development.

A very important factor is the available land area. During the analyzed period, the world agricultural area increased by 11.5%. The current agricultural area represents approximately 38% (almost 5 billion hectares) of the total land area in the world (about 13 billion hectares). The share of arable land in the total world land and agricultural area is about 10% and 28% respectively. The share of arable land has the same development trend as the share of agricultural area, both increased by approximately 10%. While the total area, which is used for agricultural activities, increases, it has to be emphasized that the total agricultural area per capita, and especially the arable land per capita, decrease significantly. During the analyzed period, the available area per capita decreased by more than 50% (in 1961, the available area per capita was about 4.22 hectares and in 2006 it was only 1.98 hectares). The same development trend can be observed in the case of arable and agricultural land development (the table No. 3).

The above mentioned development trend is connected with an intensive need to increase the effectiveness of the world agricultural production – because the population growth (the table No. 1 and the graph No.1) together with the growth of incomes and GDP growth (the graph No. 4) are connected with the growth of demand for agricultural and foodstuff products. Because the surface of the Earth is constant, the growth of population is connected with the decrease of available area per capita. Owing to this development, the agricultural sector has tot increase production and the only way to achieve it is to increase the production effectiveness. The following table No. 4 illustrates the development of agricultural production intensity (a number of animals per hectare and yields per hectare) during the last 45 years. It can be seen that the production growth is connected with the process of intensification.

While the total available agricultural and arable land in the world increased approximately only by 10%, the agricultural production per one hectare of agricultural land increased significantly. During the analyzed period, the crops production per hectare increased by 122%, the animal production increased by 107% and the number of animals and poultry per hectare increased by 42% respectively 300%. In general, it is possible to see that owing to the intensification process (the growth of yields per hectare), the total world agricultural production increased by almost 150% during the last 45 years

(the share of slowly increasing agricultural area in this production growth is only minimal).

Another stimulus for the growth of production respective to consumption is GDP growth. The graph No. 4 illustrates the total world GDP and GDP/cap development. It is possible to see that the average inter annual growth rate of world GDP's reached a value of about 3.12% (644 billion USD / year) and GDP/cap also increased by 1.48% every year.

The growth of GDP respective to GDP/cap is connected with the growth of demand for food, foodstuff product and raw materials. The economy and population growths are connected not only with the growth of food consumption, but also with growth of other sectors' demand. It is possible to see that through the permanent growth of income per capita, the individual agricultural products consumption also increased during the whole analyzed period. The food consumption/capita/year (the current value is 640.4 kg) increased during the analyzed period by 27% (i.e. 136.5 kg). The average inter-annual growth rate reached a value of about 0.58% (i.e. 3.25 kg). If we analyze the influence of population and GDP/cap growth on the total consumption (with respect to production) development, we have to highlight the following development trend. The growth of total food and foodstuff consumption (about 171% during the analyzed period) is especially stimulated by the population growth (about 113%), while the influence of growing GDP/cap (which is connected with the increasing level of individual demand for foodstuff products) was only about 58%. Nevertheless, both mentioned factors played a very important role in the development process of agricultural sector.

Conclusion

The following table No. 5 provides data describing the world agricultural production development and the development trends of those factors which influenced the world production in the most significant way.

During the last 45 years, the agricultural production and consumption significantly increased their volumes. The permanent growth of agricultural products consumption stimulated the growth of production by 150%. While the world demand (consumption) for food is especially stimulated through the population growth and the growth of individual incomes, the growth of world agricultural production (which is stimulated through the growth of demand for agricultural products) is especially achieved through the growth of production effectiveness (yields per hectare growth) and through the growth of available areas which are used for agricultural activities. Nevertheless, it is necessary to emphasize that the influence of new available areas is only minor; the main share in the total growth of production is the growth yields per hectare.

Nowadays, the world agriculture is standing at a crossroad – a very important crossroad. Agriculture is a very important part of the world economy and plays a key role in the development of human society. Agriculture is not only the source of food for a permanently growing population; it is also a very important part of sustainable development concept. It is connected with the following issues - for example: food security, market and price stability, environment protection, rural development, bio-fuel and so on.

Corresponding authors:
Ing. Luboš Smutka, Ph.D.
Czech University of Life Sciences Prague, Department of Economics
Kamycká 129, Prague- Suchdol, Czech Republic
Phone: +420224382076,e-mail: smutka@pef.czu.cz

Reference

[1] FAO, Rome, 2009, http://faostat.fao.org/site/502/default.aspx, 15.9.2009

[2] FAO, Rome, 2009, http://faostat.fao.org/site/340/default.aspx, 20.9.2009

[3] International Financial Statistics, IMF, 2008, ISSN 0020-6725

[4] OECD-FAO, 2009, http://www.oecd.org/dataoecd/48/40/37188978.pdf, 12.6.2009

[5] SVATOŠ, M., Economics of Czech and Slovak Agriculture Integration with the EU, Prague 1999, ISBN 80-213-0497-9

[6] SVATOŠ, M.: Selected trends forming European agriculture, Agric. Econ. – Czech, 54 (2008), No. 3, 93 – 101

[7] UN, New York, 2009, http://unstats.un.org/unsd/snaama/SelectionQuick.asp, 19.6.2009

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

The range and the structure of subsidies in agriculture companies reaching a different economical level

E. Svobodová, K. Vinohradský

Department of Regional and Business Economics, Faculty of Regional Development and International Studies, Mendel University of Agriculture and Forestry in Brno

Abstract

The paper deals with a range and a structure of subsidies in agricultural companies reach a different economic level and farm in different natural conditions.

The research realized within a set of 109 agricultural companies of NUTS II South-East throughout the years 2001-2003 shows that the endowment support of field economy had the same extent in the main (subsidies for 1 ha of agricultural land and for one worker), both in the group of different economic level and in the group of agricultural companies running their own business in different natural conditions during this period.

The structure of subsidies, in a view-point of their special purpose, is a bit different among the companies running businesses in less favored areas (LFA), namely in a higher share of subsidies supporting a non-production asset, ecological agriculture and beef-raising.

Key words

Agricultural companies, subsidies, economical level of companies, natural conditions.

Anotace

Práce analyzuje rozsah a strukturu dotací zemědělských podniků různé ekonomické úrovně hospodařících v různých přírodních podmínkách.

Výzkum, který se uskutečnil v rámci vybraného souboru 109 zemědělských podniků NUTS II Jihovýchod v letech 2001–2003, vedl k poznání, že dotační podpora zemědělského hospodaření byla v tomto období v podstatě stejného rozsahu (dotace na 1ha zemědělské půdy a na pracovníka) jak ve skupinách podniků rozdílné ekonomické úrovně, tak i v různých přírodních podmínkách.

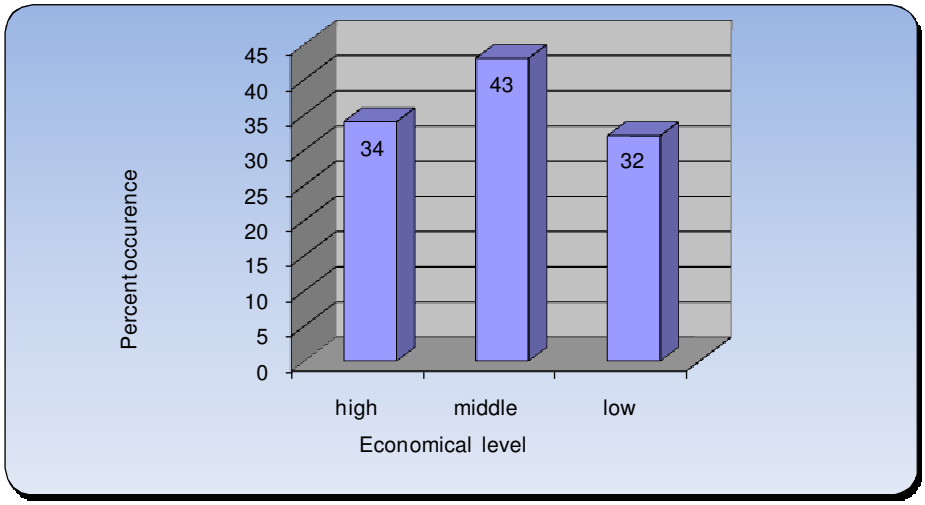
Struktura dotací z hlediska jejich účelového směrování se poněkud odlišuje v podnicích s méně příznivými přírodními podmínkami (oblasti LFA), a to vyšším podílem dotačních titulů podporujících mimo-produkční přínos, ekologické zemědělství a chov skotu.

Klíčová slova

Zemědělské podniky, dotace, ekonomická úroveň podniků, přírodní podmínky.

Introduction

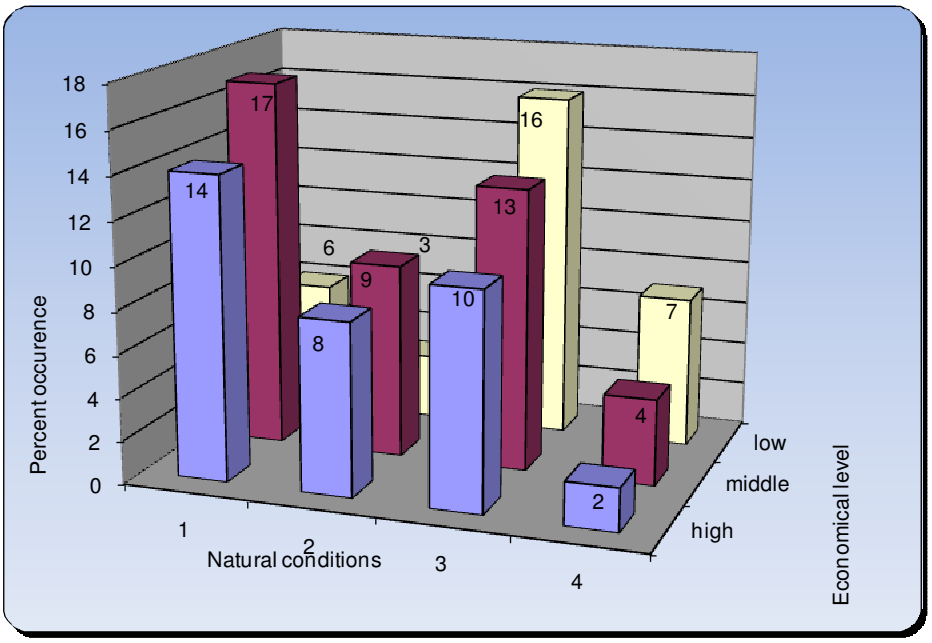
The research of connection between differentiation of agricultural companies in its economic level, natural conditions of agriculture and the specialization in production leads to the fact that we can find approximately the same variability of economic level in a group of agricultural companies which run their business approximately in the same natural conditions as in the companies of the same production structure (2), (4), (6). The mentioned research confirms also a definite accruing difference in the progress of agricultural production structure by different natural conditions, especially in the areas with less favored natural conditions The analysis of indicated development connection in agriculture opens a question



Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation
Graph 1: Percentage occurrence of different economics levels companies.

Indicator	Companies according to different natural conditions				
	1-4	1	2	3	4
The number of the companies	109	37	20	39	13
Added value per AWU in thousand CZK	248	274	268	235	198
Added value per 1 ha in CZK	12 052	13 598	15 547	11 154	8 621
Subsidies in sum per 1 ha in CZK	2 283	2 191	2 720	2 251	2 324
Subsidies per 1 CZK added value	0,19	0,16	0,17	0,20	0,27
Subsidies per AWU in thousand CZK	47	44	45	47	53

Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation
Table 1: The subsidies in companies in different natural conditions.



Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation
Graph 2: The classification of companies according to their economic level and natural conditions

.

of influence of agrarian policy tools, especially of subsidies, on the differentiation of economic development of the agricultural companies.

The aim of this paper is to contribute to knowledge of agricultural subsidies allocation in different natural conditions of agricultural production and to their use by companies on different economic levels. The range and also the structure of subsidies will be analyzed here.

Methodology

To identify an economic level of the companies, an indicator of added value per work deposit was used. The authors - Bečvářová, Grega, Vinohradský (1) - specified the added value in an indicator form (according to a profit financial statement) per one agricultural work unit (AWU) (symbol AV/AWU). Three groups of agricultural companies were identified on the basis of variability of the AV/AWU average value analyses – companies with low, middle and high economic level. The middle group was defined as the average value + - 0,4 standard deviation.

The authors decided to consolidate the subsidy support (so called subsidy titles) into groups pursuant to the effect sight because of the fact that the subsidy support system was expediently sorted in the period and there were many changes in the methodology during years. You can find the aggregation in the table 2 and 4.

The classification according to natural conditions of the agricultural companies was made in compliance with the LFA area share in four groups. The main factors for the aggregation were the share of mountain area, other LFA, the production area, and the elevation above sea level.

The definition of the four groups is:

1 – the group of companies with favored natural conditions,

2 – the group of companies with good natural conditions,

3 – the group of companies with majority of other LFA,

4 – the group of companies with majority of mountain LFA.

The selected methodological process was applied on the chosen collection of agricultural companies NUTS II South-East. The collection includes 109 agricultural companies from the South Moravia area and highlands. For the South Moravia region, typical dominants are beet and corn areas. The Highland region has suitable natural conditions for potatoes growing.

Results

On the basis of presented results (see graph 1) it is possible to conclude that in the collection of monitored companies there is approximately the same number of agricultural companies in particular categories of economic level. The added value per AWU reaches the following amounts by the individual categories: high 274 – 429 thousand CZK AV/AWU; middle from 193 to 266 thousand CZK; low from less than 289 to more than 189 thousands of CZK AV/AWU.

If authors take into consideration also the natural conditions, in which the agricultural companies run their business (graph 2), it is obvious that there is a great variability of economic levels among companies running their business in favored and less favored conditions of agricultural production. But, it is necessary to say, that the share of companies with a low economic level is high in the area with predominating LFA. It is eminent that also in these conditions there is a significant number of companies which reach the high and middle degree of economic level.

In the context of the analyses of agricultural companies with economic level differentiation, a research question arises about the possibility of different subsidy support influence. In the Economic routine, there is frequently pronounced mind about disproportionate subsidy support allocation in the companies running their business in less favored condition LFA.

The subsidy allocation in the agricultural companies running their business in different natural conditions is evident from data in the table 1 and 2. The subsidy support ranged per 1 ha agricultural land, per 1 CZK of added value, and per 1 AWU is high in the companies running their business in worse natural conditions, especially in mountain LFA. The more extensive land use in these areas and with it related the lower added value

Subsidies	Companies according to different natural conditions				
	1-4	1	2	3	4
1 General support of the financial resources	17,82	20,17	15,85	17,96	14,32
2 Support of less favoured areas	5,66	2,75	5,13	5,86	15,51
3 General support except-commodities function	1,22	0,50	0,69	1,35	4,09
4 Ecological agriculture	0,60	0,30	0,45	0,00	3,75
5 Support of the inputs	16,46	17,96	15,91	15,74	13,85
6 Support of the credits (PGRLF)	14,44	9,63	17,41	17,11	13,88
7 Commodities support – plant production	8,94	9,06	15,82	6,55	5,15
8 Commodities support - livestock	1,08	0,36	2,06	0,76	4,08
9 Commodities support – other raising	2,55	1,54	2,34	2,84	4,60
10 Sinking the influence of the diversification and losses	9,40	14,57	6,45	8,36	3,58
11 Remedy for the supply sinking	15,93	16,50	15,44	15,95	12,23
12 Other supports	5,90	6,66	2,45	7,52	4,96
As a whole in %	100,00	100,00	100,00	100,00	100,00

Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation
Table 2: The subsidy structure in companies in different natural conditions (in %).

Indicator	Economical level of the companies		
	low	middle	high
The number of the companies	32	43	34
Added value per AWU in thousand CZK	155	229	321
Subsidies in sum per 1 ha in CZK	2 191	2 394	2 210
Added value per 1 ha in CZK	6 788	11 619	15 799
Subsidies per 1 CZK added value	0,32	0,21	0,14
Subsidies per AWU in thousand CZK	50	46	45

Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation
Table 3: Subsidies in companies with different economical levels.

level per 1 ha of area under cultivation and per worker is possible to rate as a factor which impartially gets worse the financial situation of companies in these areas. A comparison of subsidies high in the fact to the added value and per AWU shows, that the dicta about disproportionate subsidy allocation in the less favored conditions are not supported by the data of the table 1.

On base of the data about the subsidy support (table 2) it is evident, that owing to different natural conditions, in the fourth group of agricultural companies there is a high share of subsidies for less favored areas, a non production function of agriculture, ecological agriculture and beef-raising. Otherwise, the subsidy structure doesn't embody essential differences according to the specific sight.

The divergence of the subsidy support range on different economic levels in companies is shown in the table 3 and 4. By approximately the same subsidies range per 1 ha arable land and different one of added value per 1 ha, the subsidy per 1 CZK added value in the companies with low economic level is 0,32 CZK, in the companies of high economic level it is 0,14 CZK. From these differences it is obvious an influence of the differences on the productivity of production activity of the agricultural companies, and also on the intensity of land use.

The subsidy structure in the different economic level groups of companies is approximately the same. There is a lower utilization of the PGRLF credit. It is related to the fact that these companies

Subsidies	Economical level of the companies		
	low	middle	high
1 General support of the financial resources	17,61	16,70	19,34
2 Support of less favoured areas	10,16	4,70	3,85
3 General support except-commodities function	2,77	1,20	0,10
4 Ecological agriculture	1,90	0,19	0,29
5 Support of the inputs	14,78	16,60	17,12
6 Support of the credits (PGRLF)	8,02	16,00	16,23
7 Commodities support – plant production	10,50	8,00	9,00
8 Commodities support - livestock	2,90	2,00	1,90
9 Commodities support – other raising	3,30	1,00	2,00
10 Sinking the influence of the diversification and losses	8,98	8,67	10,64
11 Remedy for the supply sinking	14,10	16,64	16,10
12 Other supports	4,98	8,30	3,43
As a whole in %	100,00	100,00	100,00

Source: FADN CZ VUZE Prague, Database of the thematic courses 04 and 05 research programmers MUFA in Brno, authors' calculation

Table 4: The The subsidy structure in agricultural companies with different economic levels (in %).

are in arrear with investment into a modern production base.

Conclusion

In the frame of monitored collection of 109 agricultural companies in the area NUTS II South-East it was found out that for the economic level differentiation it is characteristic that the number of companies with low, middle and high economic level, measured by the added value per AWU, is relatively the same in different natural conditions. This shows that the decisive factors for determination of variation of economic levels of companies don't consist in the natural conditions. In this respect, the presented results confirm the results of previous analyses.

The subsidy allocation analyses lead to the understanding that the support of agricultural economy was approximately of the same range per 1 ha arable area in different natural conditions in the observed periods. An especially eminent aspect is also the range of subsidies to 1 ha. It is approximately the same also by the companies with different economical level. The range of subsidy support, by recalculation per 1 CZK of created added value, embodies essential differences among companies with different economical levels. The differences in this indicator among companies in different natural conditions exist because of different weigh of the except-commodities assets of farming in LFA, especially under mountains and in mountain areas.

The structure of subsidy regarding an expedient direction is approximately the same in the monitored groups of businesses. There are slight differences among the companies which run their business in less favored conditions owing to the high share of the subsidy support addressed to the non-production assets support, ecological agriculture and beef-raising.

The results of these analyses form a knowledge base for a comparison with development of the subsidy policy after the accession of the Czech Republic into the EU.

This paper was elaborated in frame of the project of MUAF Brno, MSM 6215648904, the thematic direction 04 "The trends of agribusiness, formation of the segmented markets within the commodities' chains and the food nets in the process of integration and globalization and the changes of the agrarian policy".

Corresponding author:
Ing. Eliška Svobodová
Department of Regional and Business Economics, MZLU in Brno
Zemědělská 1, 613 00 Brno
E-mail: eliska.svobodova@node.mendelu.cz

References

[1] Bečvářová, V., Grega, L., Vinohradský, K.: Konkurenceschopnost českého zemědělství při vstupu do Evropské unie – předpoklady a možnosti. Závěrečná studie. Brno 1998, s.63

[2] Bečvářová, V., Vinohradský, K.: Intenzivní a extenzivní soustavy zemědělského hospodaření a příjmový potenciál zemědělských podniků. In Aktuálne problémy a perspektívy agrárního sektoru po vstupe do Europskej Únie. Nitra: FEM SPU Nitra, 2005, s. 27-32. ISBN 80-8069-637-3

[3] Bečvářová, V., Vinohradský, K.: Koncepce zemědělských dotací a kritérium rozdílných přírodních podmínek zemědělství. In. Aktuální ekonomická problematika zemědělských podniků III: 1. vyd. Praha: Výzkumný ústav zemědělské ekonomiky, 2005, s. 137-142. ISBN 80-86671-30-5

[4] Grega, L. a kol: Mimoprodukční přínos trvale udržitelného multifunkčního zemědělství v podmínkách ČR, část I Analýza finančně ekonomické situace zemědělských podniků a jejich důchodových zdrojů. Průběžná výzkumná zpráva za rok 2003, MZLU Brno 2004

[5] Hanibal, J. a kolektiv: Uplatnění „Zemědělské účetní datové sítě“ (FADN) v České republice. Výzkumná studie č. 78, Praha 2004 – Výzkumný ústav zemědělské ekonomiky, ISBN 80-86671-23-2.

[6] Svobodová, E., Vinohradský, K., Redlichová, R. Vliv výrobního zaměření na ekonomickou úroveň zemědělských podniků. In Firma a konkurenční prostředí 2008, 1. část. Brno: MSD, spol. s r. o., 2008, s. 379--384. ISBN 978-80-7392-020-3

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

Legal regulation of information and communications technologies as specific forms of production factor for capital in food industry

D. Šálková, A. Hes

Department of Trade and Accounting, FEM CULS in Prague

Abstract

Information and communication technologies are one of factors that markedly influence agricultural primary production and food industry as well as all other branches of the national economy. Therefore, it is necessary to analyse an effect of Community legal regulations for electronic transactions on resource utility.

The paper resulted from the institutional research intention MSM 6046070906 “The Economics of Resources from Czech Agriculture and their Efficient Use in the Framework of Multifunctional Agri-food Systems“.

Key words

Legal regulations, ICT, food industry, production resources, capital

Anotace

K faktorům, které značným způsobem ovlivňují kromě zemědělské prvovýroby a potravinářského průmyslu i všechna další odvětví národního hospodářství, patří informační a komunikační technologie. Proto je nutné se zabývat analýzou vlivu komunitární právní úpravy elektronických transakcí na využitelnost zdrojů.

Klíčová slova

Právní úprava, ICT, potravinářský průmysl, výrobní zdroje, kapitál

Aims and methods

The aim of the paper is to analyse a state of legal regulation of information and communication technologies in the food industry in the CR in comparison with the Community law. To meet the given objective it was necessary to carry out a detailed study of the current publication sources from the area of national legislation and the Community law. The main methods used in the research were primarily an analysis of the legal regulations, a comparison, an abstraction, and a deduction analogy. Primary data sources used were acts, decrees and regulations in the areas of processing and trading of food products in the conditions of the CR.

Introduction

The production of food products is, by its nature, a branch of processing industry. In general, a priority of the entire branch is to increase food security and quality; from a standpoint of strengthening of competitiveness it is essential to continue in raising the productivity and efficacy of the processing enterprises’ activities.

The food and drinks industry is one of the most important and most dynamic industrial branches in Europe. There are roughly 310 000 companies doing business in the area providing work for more than 4 million people. [1]

ICT is the abbreviation for information and communications technology. This term is understood to mean the hardware and software means for collecting, transferring, storing, processing, distributing and securing data. It includes all technology used for communication and work with information. The basic ICT facilities are no longer ownership of a mobile phone and a computer; it is chiefly an internet connection. One of possibilities of increase of the competitiveness of the food industry in the domestic and international

market is an application of information and communication technologies (ICT) and to use them to a greater degree in all partial production processes.

"The degree of ICT use is considered to be a critical factor in competitiveness and thus efficiency of national economies, that being at both the level of businesses and the national economy as a whole. Assuming their effective employment and use, these technologies are considered to be an important resource contributing to an increase in creating greater added value per employee, which should help Czech firms become companies able to compete internationally." [2]

"According to OECD and IDC estimates, the Czech Republic invests the same amount into information and communication technologies as the EU average (measured in percentage of GDP). A number of prospering Czech companies already operates managerial, enterprise resource planning (ERP) or customer relationship management (CRM) information systems. Likewise, developed firms formulated their e-business strategies and intend to allocate considerable resources to realise projects in this area. In other words it can be stated that the majority of Czech subjects, in both the public and private spheres, have already implemented information systems that are comparable with similar systems used in the other EU Member States." [2]

The degree to which information technologies have spread can be characterised, for instance, by means of a number of enterprises using a company computer network and the related technology (see table 1), or by means of a number of companies connected to the internet (see table 2).

"Apart from using wireless technologies, which is about 3 percent less on average in the EU 27 than it is in the CR (26 % and 29 % respectively), companies are lagging slightly behind the EU 27 average in expanding company computer networks and the associated basic technologies. For instance, 72 % of companies had a computer network in the EU 27 (CR 62 %), 29 % an internal web (CR 21 %) and 16 % had an extranet (CR 14 %)." [3]

"In the last three years, the proportion of businesses connected to the internet did not change and is 95 %. At the end of 2000, three of four of the monitored businesses were connected to the internet. 79 % of businesses use a fixed broadband which is 83 % of those with the internet. At the end of 2002, only 20 % of businesses had high-speed internet connections (26 % of those with internet). In the last 5 years, there has been a considerable improvement in the quality of the internet connections.

The most commonly used internet connection among businesses is ADSL. In January 2008, 46 % of businesses used it – 49 % of those which have the internet. In 2002, there was no possibility of connecting to the internet by ADSL in the CR and at the end of 2003, only 7 % of businesses used this opportunity. In 2002, an overwhelming number of Czech businesses used low-speed dial up connections through an analogue modem (51 % of the businesses connected to the internet) or an ISDN connection (43 %). Recently, the proportion of businesses using dial-up connections has indeed fallen dramatically, nevertheless, it remains a supplementary form for connecting. 6 % use an analogue modem and up to 25 % of businesses use ISDN. The proportion of businesses using other fixed (primarily WiFi) or mobile internet connections slowly grows" [3].

"The expansion of fixed broadband internet among Czech businesses is comparable at the international level. In January 2008, on average 81 % of businesses had broadband in the EU27, i.e. only 2 % more than in the CR. In the recent past, it was not the case. At the start of 2003, the percentage of businesses with a broadband connection in the EU 15 was twice as high as here – 40 % compared to 20 %. For instance in Sweden, Denmark or Finland, more than 2/3 of companies with an internet connection used broadband; it was not even a quarter (22 %) here. This difference was due to the ADSL less available in the CR in comparison with the majority of advanced EU countries. It is for the reason that other broadband connections, such as cable, mobile or wireless (WiFi etc), are relatively extensive compared to the EU countries. In contrast to the broadband connection, the actual proportion of businesses connected to the internet has reached its peak in the majority of EU countries and has not changed significantly in recent years."

In general information and communications technologies can be an important source of production with higher added value per employee,

	Total no. of firms	Firms with a company computer network + applications				
		Total	Remote access	WLAN	Internal web	Extranet
		% of total no. of companies in given group				
Total companies (10+)	**39 570**	**62.2**	**37.6**	**29.2**	**20.VIII**	**14.I**
Size of company						
10–49 employees	30 931	55.0	30.0	24.V	14.VII	11.VI
50–249 employees	7 063	86.4	60.6	42.5	36.3	20.I
250 + employees	1 575	95.5	82.6	62.5	70.6	34.4
Branches monitored						
Processing industry	*12 919*	*60.9*	*35.5*	*28.0*	*20.VI*	*11.III*
Production and distribution of electricity, gas and water	359	79.8	48.5	37.6	37.2	24.II
Construction	4 996	48.0	23.VIII	19.VIII	10.VII	7.0
Car sales and repairs	1 508	66.3	34.8	31.VII	16.III	16.VI
Wholesale	5 166	73.9	50.3	36.9	20.II	16.IV
Retail	3 666	53.1	30.IX	22.IX	14.IV	9.IX
Accommodation	577	56.6	33.6	32.1	14.VIII	14.V
Transport and warehousing	2 608	49.3	26.II	22.III	13.IX	9.VIII
Communications – Mail and telecommunications	125	90.7	77.8	62.9	67.0	45.1
Financial brokering	346	86.6	68.9	35.5	58.1	36.2
Real estate activities;...	1 337	70.0	45.0	22.VI	19.VII	10.VIII
Activities in the area of computer technology	839	97.2	82.8	61.7	74.2	58.4
Other business activities	4 359	71.5	44.1	36.7	31.I	22.IV
Audiovisual activities	64	84.4	56.2	51.9	44.1	17.IX
Culture, sport and other recreational activities	461	64.4	37.5	32.7	15.VI	11.VII
Other activities	239	26.VI	13.0	10.0	9.0	5.VIII
Region						
Firms registered outside of the capital Prague	30 771	59.3	33.3	27.0	17.I	12.V
Firms registered in Prague	8 799	72.4	52.4	37.0	33.8	19.V

Source: An Investigation into the Use of ICT in the Business Sector (ICT 5-01), CSO 2008

Table 1.

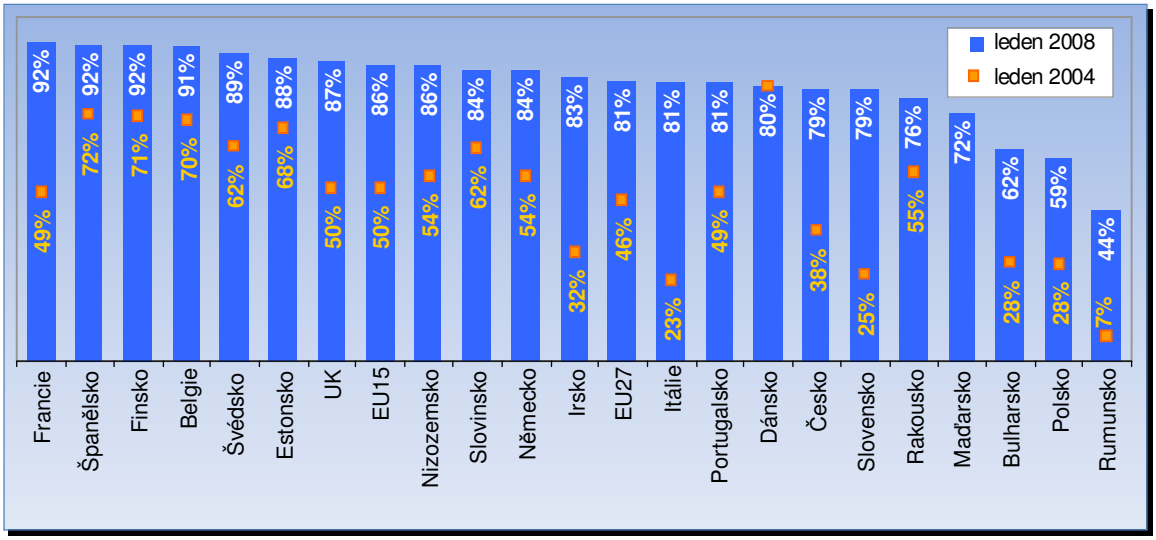
thus contribute to acquirement of a competitive advantage on the market. The internet and its use in the food industry, as an example of one of the currently frequently used technologies, represents a means that could fundamentally change the efficacy of the entire production process. One of the possibilities where the internet can also have an effect is the electronic conveyance of information in the supplier-customer chain. The electronic data conveyance is understood as an exchange of any kind of whatsoever information to secure (coordinate) the required supplies of products or services and their distribution to the customers through the internet or another computer network.

This information can be conveyed by means of any web interface using electronic data interchanges (EDI) or in the framework of an integrated information system for supply chain management (SCM). The used conveyed data in a supply chain include information on expected demand, supply levels, planned production/services and the state of supplies, i.e. the distribution of materials, products goods or services etc.

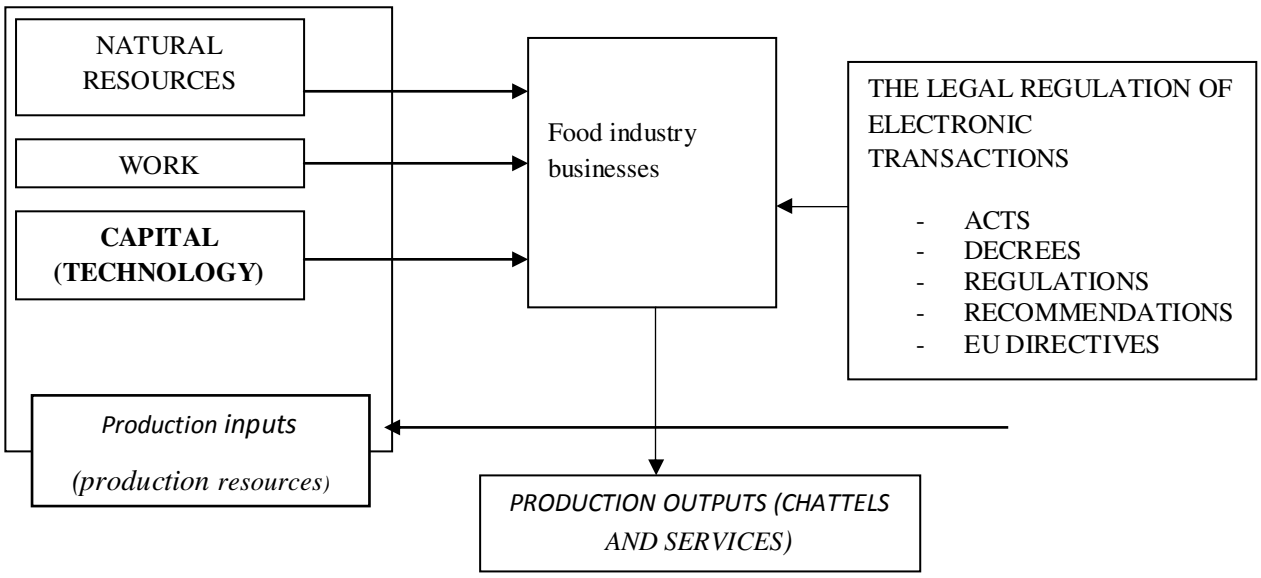
	Total no. of firms	Companies with an internet connection							
		Total	Type of connection				Broadband		
			Dial-up + ISDN	ADSL	Rent digital circuit	Other fixed (WiFi)	**Total**	>2Mb/s	>8Mb/s
		% of total no. of companies in given group							
Total companies (10+)	**39 570**	**95.1**	**30.VI**	**46.1**	**12.VIII**	**27.VII**	**79.3**	**67.5**	**9.VI**
Size of company									
10–49 employees	30 931	94.1	31.0	45.0	9.0	24.IX	75.7	64.5	8.III
50–249 employees	7 063	98.3	27.II	49.9	21.I	38.3	90.9	77.1	12.III
250 + employees	1 575	99.6	37.4	51.7	52.2	35.6	96.8	84.5	22.IX
Branches monitored									
Processing industry	*12 919*	*96.4*	*30.VII*	*42.8*	*10.VI*	*31.4*	*78.5*	*65.2*	*7.VIII*
Production and distribution of electricity, gas and water	359	98.7	37.0	36.2	14.V	43.1	86.1	77.1	12.V
Construction	4 996	96.0	33.9	47.7	9.I	22.II	77.1	66.0	8.V
Car sales and repairs	1 508	94.3	38.3	47.4	13.VI	28.VII	79.3	71.2	10.III
Wholesale	5 166	94.9	29.IX	51.2	14.III	29.IV	82.1	65.0	11.I
Retail	3 666	92.2	29.0	55.3	9.V	19.II	75.7	72.2	5.I
Accommodation	577	97.0	31.VIII	41.4	17.II	37.0	85.2	70.7	6.I
Transport and warehousing	2 608	94.4	36.5	42.4	9.VII	22.V	72.5	68.1	7.IV
Communications – Mail and telecommunications	125	99.2	25.I	33.6	47.0	44.3	92.6	92.1	60.2
Financial brokering	346	97.2	27.VII	49.4	44.0	26.IV	90.5	82.6	20.V
Real estate activities;...	1 337	97.0	30.IV	49.6	21.V	23.VIII	86.8	73.5	12.VI
Activities in the area of computer technology	839	100.0	23.IV	39.7	38.9	37.2	94.7	81.5	33.0
Other business activities	4 359	92.2	24.III	45.0	14.VIII	28.0	80.8	66.6	11.V
Audiovisual activities	64	98.2	22.VI	41.1	27.VII	48.2	90.8	89.0	36.8
Culture, sport and other recreational activities	461	92.3	31.2	42.5	13.VI	29.VII	79.6	65.1	6.IX
Other activities	239	77.2	22.0	36.5	8.V	15.III	61.4	59.2	4.IX
Region									
Firms registered outside of the capital Prague	30 771	95.1	30.V	45.4	9.VI	28.V	78.3	65.3	8.VIII
Firms registered in Prague	8 799	94.9	31.0	48.8	24.III	25.II	82.6	75.4	12.IV

Source: An Investigation into the Use of ICT in the Business Sector (ICT 5-01), CSO 2008

Table 2.



*percentage of the overall number of businesses with 10 + employees in the given EU country
Source: Eurostat, December 2008
Graph 1: January 2008 January 2004 - France, Spain, Finland, Belgium, Sweden, Estonia, UK, EU 15 Netherlands, Slovenia, Germany, Ireland, EU27, Italy, Portugal, Denmark, CR, Slovakia, Austria, Hungary, Bulgaria, Poland, Romania.



Source: own compilation

Schema 1.

Results

Technology as a specific form of production resources - capital

During the production process, inputs are transformed – production resources into production outputs, i.e. produced chattels and services. The commonly recognised basic production resources are natural resources, work and capital. All these production resources significantly affect the efficacy of food industry.

In connection with the production resources of work (purposeful human activity that uses natural resources and capital to make chattels and services to meet needs) and natural resources (soil, natural resources and natural forces) it is possible to see the third production resource, a capital, as a derived production factor as it is the result of human work.

Parts of the capital production resource are:

- **materials** (they enter the production and enable it (buildings, machines, equipment, material, etc.),
- **financial means – financial capital** (serves to obtain a material capital and pay for human work),
- **education** (as a production factor it improves the quality of work),
- **technology** (a special form of production factor making production more effective).

Technologies – ICT can thus be understood as one of elements of the production resource capital. Information and information technology, with regards to the basic production agent, represent further important factors influencing the efficacy of the production process.

Legal regulation of ICT

Information and communications technologies (ICT) usually attract the attention primarily from the standpoint of technical aspects. However, the legal aspects of this specific area cannot be forgotten as they significantly influence the efficacy and usefulness for entrepreneurial subjects i.e. the conditions for making business transactions.

For instance, the internet cannot be looked upon merely as a medium. The worldwide information network developed into a complicated structure that, from the standpoint of law, must be seen as a specific space. In the internet space it is necessary to perceive the legal relations of specific subjects and objects differently.

Currently, a basic overall source of law for the ICT area does not exist in the CR in an integral form. This branch of law is regulated complementarily in a whole number of varying legal regulations. Primarily, the legal regulation of "traditional" transactions relate to it, i.e. the provisions of the Civil Code, the Business Code, the Trades Act, the Act on Protecting Copyright, laws relating to the copyright law and other legal regulations from private and public law.

ICT environments primarily concern these areas of law.

Business law – the legal consequences of electronic communications, new kinds of and methods for binding relations to emerge, the transferral of rights and risks, the verifiability and applicability of electronic documents;

Civil law – especially protecting the individual and privacy, business records, the regulation of information and internet behaviour;

Copyright law – above all the dissemination and protection of authors' works, patents and licences, trade secrets, the issue of domains;

Criminal law – protecting information and software piracy, new methods of committing criminal acts, the verifiability of electronic records, the misuse of computer services and information.

With regards to the specifics of the media used in the ICT framework it is essential to resolve certain issues differently from the general regulations. These specifics and the necessity of their regulation are primarily given by a need to ensure a greater legal surety when realising or offering all of the services of the information society, ensuring a mechanism for implementing responsibility for faults and resolving any disputes with regards to the fact that it concerns services provided (making deals) between parties that in the majority of cases have not met personally not even when handing over goods or services and it often concerns subjects from various states.

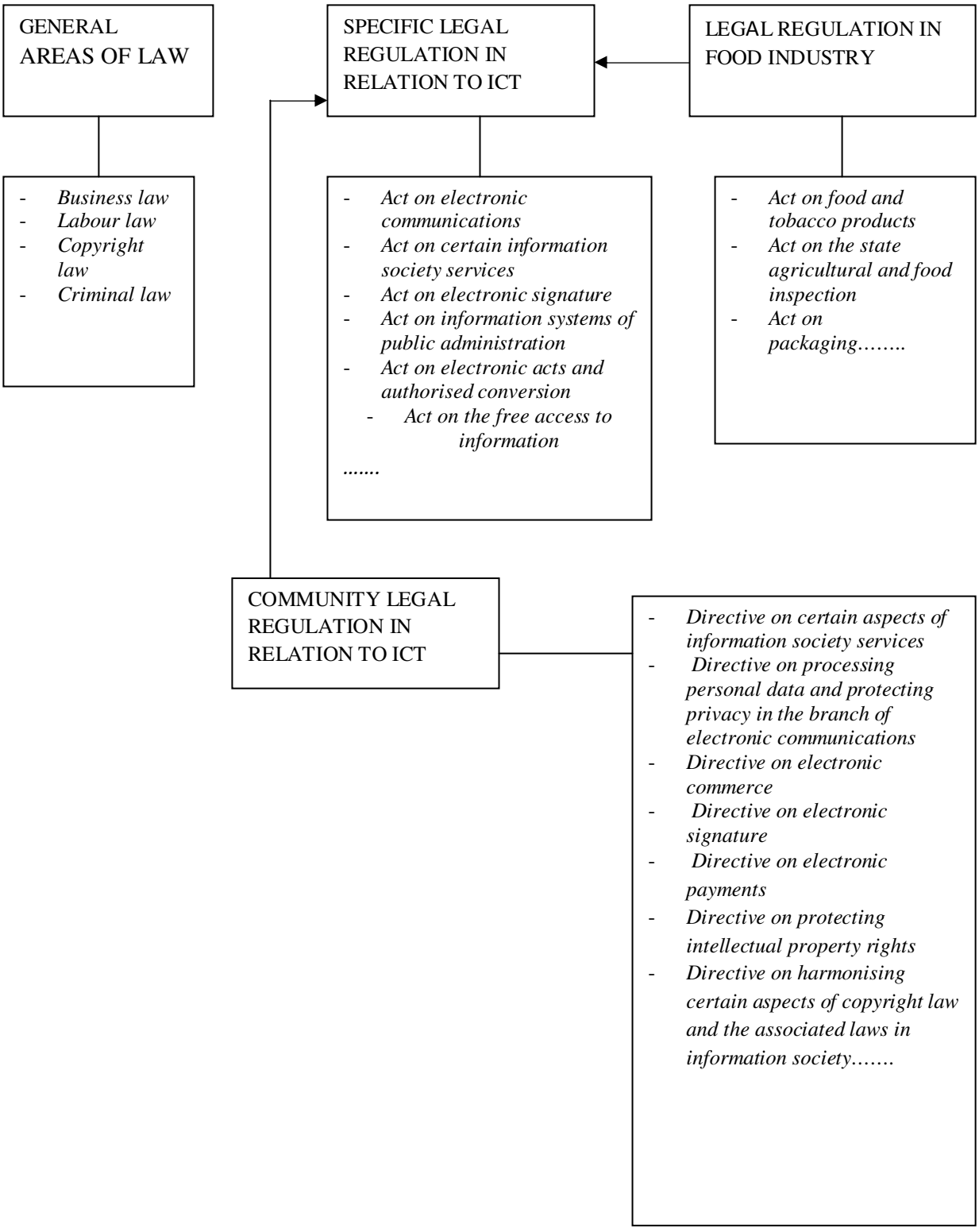
From the specific acts, relating to ICT issues, it is possible to present several of the following legal norms:

The Act on Electronic Communications, which replaced the previous Telecommunications Act.

The Act on Certain Information Society Services, which lays down the basic framework of rights and duties for providers of services to the information society.

The Act on Electronic Signatures, which above all contributed, among others, to the "legalisation" of legal acts carried out electronically.

The Act on Information Systems of Public Administration, which lays down the rights and duties associated with forming, using, running and developing public administration information systems.



Source: own processing

Schema 2.

The Act on Electronic Acts and Authorised Conversion, which will come into force be enact on 1st January 2009.

The Act on Electronic Communications replaced the term telecommunications with the broader term electronic communications (partially incorporating the issue of the technological side of digital media).

In relation to the impacts on the business environment, the aim of this legal regulation was to increase the competitive environment in the electronic communications market and reduce the administrative burden. In the area of using radio frequencies the business subjects' certainty grew and was strengthened by the legal instrument of the Czech Telecommunications Office which ensures the expedient use of the radio frequencies for providing electronic communication services and developing other business activities.

The Act on Certain Information Society Services is an important legal regulation that concerns, among others, all providers of information society services. The act was compiled on the basis of Government Resolution No. 474 as of 19th May 2003 which led to the White Paper on Electronic Commerce. At the same time, the act is drafted as a norm transposing Directive No. 2000/31/EC of the European Parliament and the Council as of 8th May 2003 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market, and likewise, the Directive on Electronic Commerce as of 12th July 2002 on the processing of personal data and the protection of privacy in the electronic communications sector.

The information society is characterised by its use of digital processing, storing and transfer of information. From information processing, there is an important economic activity, which both permeates traditional economic or social activities and forms utterly new opportunities and activities that fundamentally effect society's character.

Specifically, the Act on Certain Information Society Services regulates the responsibilities of information society service providers for the content of the information transferred, the content of the automatically temporarily stored information and for the stored content of information provided by the user.

After accepting the Act on Electronic Signatures, the electronic signature connected to a data message became a fully-fledged equivalent of a handwritten signature on a written document. With the amendment to this act in 2004, the full compatibility was achieved with EC law, i.e. with the Directive 1999/93/EC of the European Parliament and the Council on a Community framework for electronic signatures (Directive 1999/93/EC). It primarily concerns the possibilities of recognising of qualified certificates in the EU Member States, the possibilities for obtaining accreditation to act as an accredited provider of certification services for a provider with a main office in another state and on the opportunities to issue qualified certificates in a different state in accordance with this act. In this supplement, the duties of the public authorities were specified concerning their power to receive and send messages that are signed with a recognised electronic signature by means of a definition from special workplaces – electronic registries.

The advantages of an electronic signature:

An electronic signature enables the signatory's identity to be verified – the recipient knows for a certainty who is the author or sender of the message.

Confirmed integrity of the report (that it hasn't been changed) – the recipient is sure that the message was not changed during transport, which cannot be said for a handwritten signature.

Guaranteed indisputability of the message – the sender cannot deny having sent the given message with the given contents.

Inimitableness of the signature – the means for signing are solely under the given person's control.

The Act on Information Systems of Public Administration forms a technical background for implementing data shared in the public administration, it sets conditions for administering and running information systems in the public administration, and sets out the rules in the area of security and informatics management. The Act also contains an institute for issuing of "verified outputs from public administration information systems". On the basis of this regulation notaries, the holder of a postal licence (Česká pošta Czech Post), municipalities and the Chamber of Commerce can, upon request, issue verified outputs, for instance from the land registry office or the criminal records register and, gradually, from other registers. Part of the Act is also the duty to publish information on the internet in such a form so that it is available to those with health problems.

The aim of the Act on Electronic Acts and Authorised Conversion is to replace a large part of

the personal communication and postal correspondence in public administration and outside of it with electronic communication and correspondence. A unified system for delivery in an electronic manner is implemented by the authorised conversion of documents (between the printed and electronic form). In addition natural persons can use "data boxes". A data box will be obligatory for legal entities. The authorised conversion is the complete conversion of a document in an electronic form to a printed one and vice versa. The document that undergoes this conversion will be, from the legal standpoint, identical with the original. The councils of city wards, district and regional councils, Česká pošta, the Chamber of Commerce and notaries will be able to carry out an authorised conversion (Czech POINT).

According to the government decision, there are no considerations to make a separate legal regulation – a separate act on electronic commerce. The EU has issued directives on electronic operations (e.g. the Directive on Electronic Commerce, the Directive on Electronic Signatures, the Directive on Electronic Payments and others) and these directives are taken on through amendments to the relevant legal norms in the CR. With regards to the great fragmentation and frequent confusion in interpreting these amendments by subjects participating in electronic transactions, there are misunderstandings and uncertainty in the legal interpretation of the entire commercial operation.

The transposition of European legal regulations on electronic transactions into the legal regulations of the CR must be carried out. These regulations contain a number of specific requirements for closing of legal relations in an electronic manner and deal with problems arising out of the certain degree of anonymity on the internet as a medium and its extension beyond state borders, whilst, on the other hand, it is desirable to anchor a maximum amount of protection for the purchaser. At the same time, protection for the operators of facilitation services should be maintained.

As can be seen from the State Information Policy, the state's main role in this area is, from the standpoint of public administration, to give subjects, that want to use an electronic form of relations with their surrounding environment, the certainty that it concerns sufficiently safe practices and a formally accepted form of conduct. The state's aim is to ensure, from the standpoint of authorship, (the time factor and the originality and constancy of the contents) a binding legal protection to the extent as relates to comparable acts realised by any other legally binding form.

The current non-existence of a basic legal source for the area of ICT is substituted for by negotiating specific conditions when contractual parties sign various types of business contracts. The disadvantage of this approach is an absence of a basic legal surety and the impossibility of resting upon the interpretation of a specific legal regulation.

With regards to the fact that it concerns complicated and complex relations when signing such contracts, the contractual types according to the Business Code (for instance a Purchasing Contract or Work Contract) cannot be simply applied – as a rule the contracts tend to be innominate, i.e. unnamed contracts, which places greater demands on the contracts structure and contents.

An institutional approach to ICT

For the issue of information technologies, the Czech Republic chose a similar approach as some other states and formed a separate Ministry of Informatics. In principle, it is possible to distinguish two methods of resolving the competencies of this issue. There are countries that, identically with the CR, set up a body at the ministerial level (having the words information society, technology, innovations or something similar in their titles), other countries deal with this agenda through a central body subordinate to the prime minister.

The Ministry of Informatics of the CR was set up on 1.1.2003. It operated as a central organ for the state administration of information and communications technologies, telecommunications and postal services. The Ministry of Informatics was also a coordinator of developing electronic public administration, e-Government in the Czech Republic. Other priorities of the Ministry of Informatics are e.g. a competition in the telecommunications market, developing electronic commerce, and support for computer literacy in the Czech Republic.

A two-stage approach was used for electronic commerce. The gradual elaboration of two documents was set as the aim. At first a Green Paper and in connection with this a White Paper, which expresses the aims of the state, the setting of priorities and an outline of the basic objectives and barriers standing in the way of electronic commerce. However, the aim to support the development of e-commerce appeared for the first time in another document – the State Information Policy, approved by Government Resolution on 31.5.1999. In the framework of the State Information Policy, the electronic commerce was chosen as one of the priorities. A year later, in May 2000, the Action Plan for Realisation of the State Information Policy was approved, which already had a specific project for elaboration of the Green Paper which finally become a White Paper.

Despite the relatively stormy discussions in the lay and professional public, the programme declaration was met in 2006 and, by government decision, the Ministry of Informatics ended its activities as a separate department on 31st Amy 2007. Since the 1st of June 2007, its agenda has been taken on by the Ministry of the Interior, the Ministry of Trade and Industry and the Ministry for Local Development. The aim of these changes was to improve the promotion of new changes in the area of digitalising of public administration, telecommunications and the post. The power and the bargaining position of the original Ministry of Informatics was shown to be rather weak.

The Ministry of the Interior primarily took over the area of digitalising public administration, eGovernment projects, from the Ministry of Informatics. Further the Ministry of the Interior administers the public administration portal **www.portal.gov.cz**. The informatics section is responsible for digitalising of public administration and has new departments one for eGovernment projects; one for the conception and coordination of public administration information systems and one for developing and of he communication infrastructure of the public administration (the department for informatisation of public administration continues in the informatics section and so far its competence hasn't changed). The Ministry of Interior fulfils a coordinating role for information and communications technologies.

The Government Council for the Information Society, an advisory body for the government in the area of ICT and e-Government, should also contribute to ensuring the coordination and conceptual procedure. The Council's task is to advise the government on what manner they should coordinate the development of e-Government, to react to the proposed legal regulations concerning this area and, at the same time to propose a government strategy, objectives and policies in the area of information society.

- The Council follows the latest global trends in information society development and provides the government with a professional knowledge base for decision-making in matters concerning information and communications technologies and the electronization of public administration.
- The Council's task is to submit proposals for projects and solutions to the information society development such that there is more cohesion and coordination between ministerial and national projects.

An example of the Council's activities is the Strategy for Developing Services for the "Information Society", which was approved in April 2008. Its aim is to transform and simplify the processes used in public administration so that they use modern technologies in a similar manner to the commercial sphere. The Strategy for Developing Services for the "Information Society" should create the conditions for easy-to-use, safe and trustworthy communications between the citizen and public administration at all levels.

Conclusions

For an integral concept of resource approach to development of the agrarian sector and trade it is essential to have an outlook of the legal regulation of ICT. Together with economic and social research it is possible to create a space for a better allocation of resources in connection to the ascertained needs of citizens of particular EU regions. For this, a suitable analysis of the legal regulations of the processing industry, technologies and internal trade including its subsystems is highly justified, especially comparisons with the Community law /with the EU legal regulation. It was shown that developing and supported production and commercial activities with food creates a long-term synergistic effect on economic efficiency and

stability in agrarian trade in all the EU areas. It becomes the basis of sustainable development in rural areas as it is supported by the EU in its Common Agricultural Policy.

A factor that significantly acts upon and influences the entire food industry and its ties to other business subjects is the legal regulation. The state is a creator of legal regulations of varying legal powers and a coordinator of the entire business environment at the national level. By means of its institutions and bodies the state intervenes in the working of ICT and their management; other of its tasks is also to support the development of new technologies. The state forms have the opportunity to influence the conditions that electronic business is governed by.

Corresponding author:
Ing. Daniela Šálková, Ph.D.
Department of Trade and Accounting, Czech University of Life Sciences Prague
Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic
Phone: +420 224 382 359, email: salkova@pef.czu.cz

Literature

[1] Zvýšit úroveň evropského potravinářského průmyslu, (Increasing the Level of the European Food Industry) in Czech language [on-line], [20.3.2009], http://ec.europa.eu/enterprise/sectors/food/index_cs.htm#top

[2] Marčan, M.: Informační a komunikační technologie v České republice - stručný přehled, (Information and Communications Technology in the Czech Republic – a Concise Overview) in Czech language [on-line], [20.3.2009], <http://www.mpo.cz/dokument16200.html>

[3] ČSÚ, Využívání informačních a komunikačních technologií v podnikatelském sektoru za rok 2008, (The Use of Information and Communication Technologies in the Business Sector in 2008) in Czech language [on-line], [20.3.2009], <http://www.czso.cz/csu/2008edicniplan.nsf/p/9702-08>

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

Virtual form of education in lifelong learning - chance for the country

J. Jarolímek, J. Vaněk, P. Šimek

Department of Information Technologies, FEM CULS in Prague

Abstract

The availability of education, including lifelong learning, is one of the value measures of quality of life in advanced countries. However, there are still significant differences between a township and a rural region. Centres of education are mainly situated in big cities; smaller municipalities are separated from these centres by tens or hundreds of kilometers (according to the conditions of the Czech Republic). While educating young people, it is usually accepted that they commute towards education; there is a whole range of social and cultural aspects; and above all, they have time for that - it is their main "working" load. The opposite situation is the case in lifelong learning, which is conducted in parallel with full-time employment but is necessary for effective and competitive performing of the employment. For participants of lifelong learning it is impossible to commute big distances; their working load does not allow it. Thus, those forms, in which so called „education which goes to the students", are chosen.

ICT brings an enormous opportunity to bring education closer to the rural regions. A text form of e-learning is practically already standard; but a voice and image broadcast give us inexhaustible possibilities of usage. The aim of this paper is to propose and verify methods of distant (virtual) education with the use of multimedia tools.

Key words

E-learning, virtual education, lifelong learning, rural development, multimedia.

Anotace

Dostupnost vzdělání, včetně celoživotního, patří mezi veličiny, kterými se měří kvalita života ve vyspělých zemích. Stále však existují značné rozdíly mezi městskými aglomeracemi a venkovskými regiony. Centra vzdělávání se převážně nacházejí velkých městech, menší obce však od těchto center oddělují desítky i stovky kilometrů (dle podmínek České republiky). V celoživotním vzdělávání, které je provozováno paralelně s hlavním pracovním poměrem, ale které je nezbytné pro efektivní a konkurenceschopné vykonávání tohoto pracovního poměru, není možné, aby účastníci dojížděli velké vzdálenosti, neumožňuje jim to jejich pracovní vytížení. Proto se volí formy, kde takzvaně jde vzdělávání za studenty.

ICT přináší ohromnou možnost na přiblížení vzdělání venkovským regionům. Textová forma eLearnigu je již téměř standardem, ale přenos zvuku a obrazu nám dávají nepřeberné možnosti využití. Cílem práce je navržení a ověření metod vzdálené (virtuální) výuky s využitím multimediálních nástrojů.

Klíčová slova

Elektronické vzdělávání, virtuální výuka, celoživotní vzdělávání, rozvoj venkova, multimédia.

Introduction

One of the principles of European civilization is an equal access of inhabitants to sources, services, and generally to achievements of human activity. There is a range of areas and places, where it is not like that; for instance national minorities, women and men, young and old people, countryside and town etc. As for a solution to these disparities, it is necessary to use knowledge from different scientific disciplines for their elimination.

The disparity of economic and social relationships between towns and rural regions is commonly recognized; it is caused by a whole range of historical, geographical, political and economical

phenomenon. In the period of development of the information society, the potential usage of information and communication technologies (ICT) can be considered as one of the key tools for rural development.

In general, it can be said that the contribution of ICT for the countryside can be seen in the area of better accessibility to information, quality communication, accessibility of services, education etc. On the other hand, according to Salmelin et al. (2005), it must be emphasized that these general phenomena will not be addressed without creating a mutual relationships and the involvement of all appropriate regional structures.

Information and communication technologies (often substituted by the "all-encompassing" concept of the internet) form a line that connects the course of rural development, and contributions had to be sought in more effective ways, to bring economic profit. On this basis, it is possible to identify three areas in which ICT has a potential to stimulate growth and development for rural areas:

- Business support
- Business itself
- Improvement to quality of life

A benefit is to make rural or remote areas more attractive, to decrease their isolation and achieve a higher productivity through the progressive use of modern technologies of a knowledge society. It requires a systematic innovation which means parallel activities from a view of politics, technology and social implementation – education has to include all this; Jarolimek (2007).

Centres of education are mainly situated in big cities; smaller municipalities are separated from these centres by tens or hundreds of kilometers (according to the conditions of the Czech Republic). While educating young people, it is usually accepted that they commute towards education; there is a whole range of social and cultural aspects; and above all, they have time for that - it is their main "working" load. The opposite situation is in the case of lifelong learning which is conducted in parallel with full-time employment but is necessary for effective and competitive performing of the employment. For participants of lifelong learning it is impossible to commute big distances; their working load does not allow it.

The aim of the paper is to propose and verify new methods of distant (virtual) education with the use of multimedia tools and developing from the current availability of network services in the countryside, the description quote Vaněk et al.(2008) and Šimek (2008).

The development of education in remote and rural areas can be guaranteed only by the use of new e-learning technologies. This term not only includes the technical connection and contents, but also the transformation of all pedagogical systems, so that they match the need to acquire new skills and for lifelong learning. Education and training is important from the point of view of social inclusion, as well as reducing the difference between the availability of training in the rural and town areas, and thus improving opportunities.

Objectives and methods

The proposal of teaching methods with the use of multimedia tools was proposed on the basis of theoretical knowledge from researchers and available literature.

The pilot research study into lifelong learning was aimed at the target group 50+. Education within this group has a motivational as well as a social aim, whilst also addressing another aim, that of professional fulfillment. It was carried out in 7 consultancy centres; in the rural area of Pilsen region more then 200 people participated. An educational course from the field of Forestry was developed for verification in a set of 4 lectures, each in length of 40-45 minutes, part of which was the possibility of off-line communication with a lecturer, check tests, syllabi and recommended literature, including on-line sources.

Feedback was obtained on the basis of statistical outputs from LMS (Learning Management System) Moodle used to provide the educational process, and also by questionnaire enquiry (entrance and final) by the education participants, as well as interviews with lecturers and guarantors of education in the consultancy centres.

Results and discussion

The virtual education represents a new alternative to the classic attendance lecture education. It is based on the use of new communication technologies and the internet, and has components

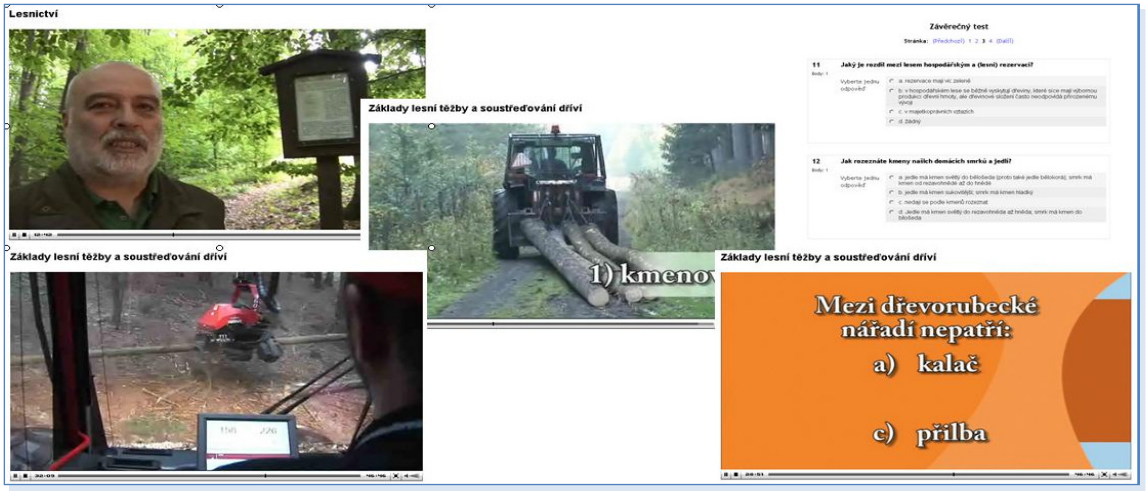


Fig. 1: Examples of the virtual lectures Forestry and Fundamentals of forest mining.

of distance teaching and e-learning. It can be also used as a suitable complement to classic attendance education.

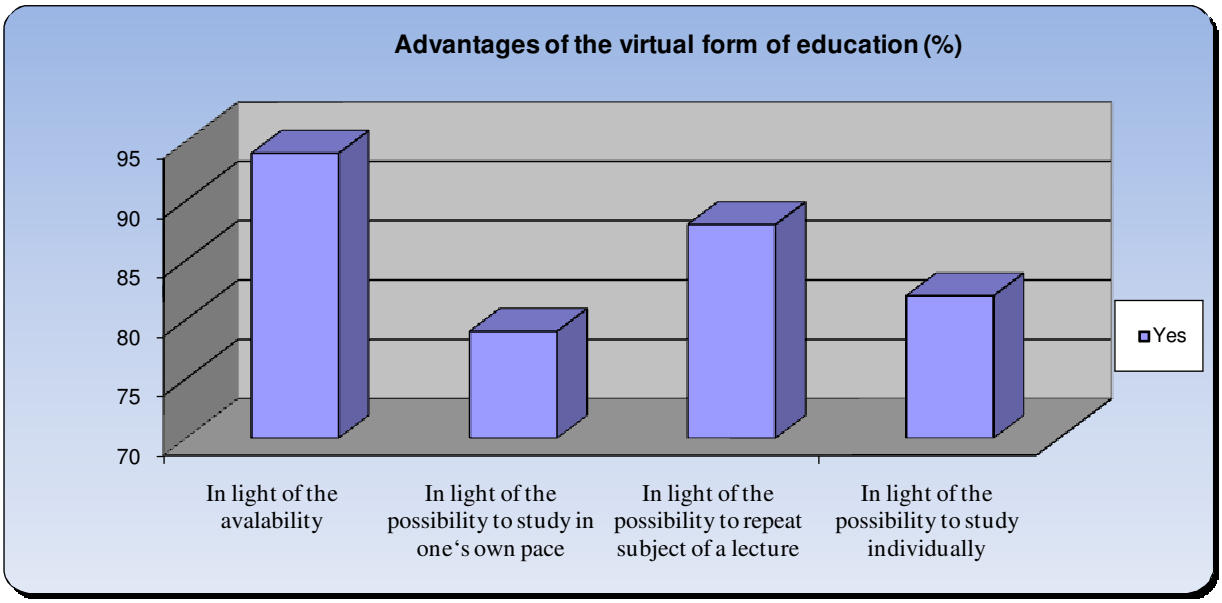
Modern didactical means of university education are developing quickly. In connection with that, the new areas of the so called "media didactics" and "media pedagogy" have originated. Media didactics first of all ask how to integrate a component media into the process of education to reach optimisation. Media pedagogy makes the media themselves and their usage, the object of analysis. Both are very closely related and intermingled. Virtual education uses these theories and experiences from the practice of university pedagogy.

Nowadays, there is an increasing tendency throughout the world towards the use of media means of all types in the field of education. Possibilities of interactive technology, and the creation of systems leading to an active involvement of all applicants, have been analysed. For instance, Yves Bertrand, a world-famous pedagogue, suggests the creation of open models - thus right virtual courses - as basic general principles of media background arrangements.

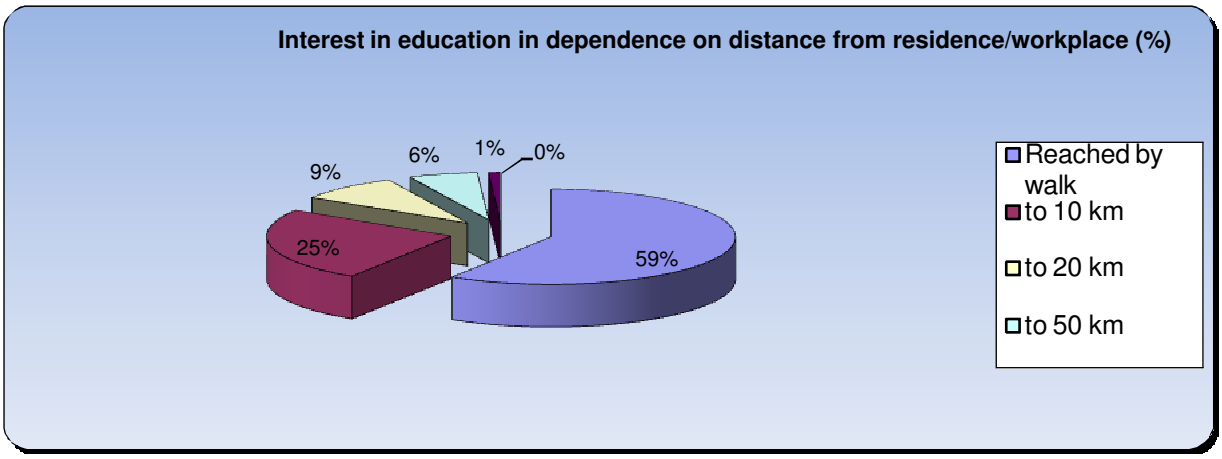
This type of education has a virtual character – multimedia lectures exist only in electronic form, they have never been really held in this form. Although they include, among others, video sequences from real lectures, the main core is a professional lecture accompanying picture material – filmed in exteriors, laboratories, details from microscope or binoculars, diagrams, scientific pictures, computer animations etc. Part of that can be also sound records, eventually supporting musical or other background effects.

The virtual education is primarily meant for staff/worker education in regions; for those who cannot take part in lectures in an attendance form, for different reasons. Topical cycles of multimedia lectures, supplemented by generated tests for each lecture, syllabi, "Questions for lecturer" and "Discussion forum" sections, or possibly further study materials, are placed on a virtual education portal. Registered students can return anytime to the virtual educational materials stored on the portal. The participants can go repeatedly either through a whole lecture, or its parts, according to their need; without place, time or background limitation. By answering questions in the generated tests they can test their grade to ensure topic mastering. Between working through the tests, they can look anytime at any detail of a lecture, which escaped their notice. The participants also appreciate the fact that they can work through the test at their own pace without time restriction and stress. They also appreciate the possibility of asking the lecturer later - after some days, after they have thoroughly thought the subject over; whereas in classical education there is only a limited time for questions immediately after the end of a lecture.

In the classical presence lectures, the participants carry off only what they managed to note down and remember; they have no possibility to return to the speech of the lecturer and the printed study materials never fully substitute for it. The main didactical advantage of the virtual method of education in comparison to the classic presence



Graph 1: Advantages of virtual form of education (%).



Graph 2: Interest in education in dependence on distance from residence/workplace (%).

Indicator	Attendance education		Virtual education	
	+	-	+	-
accessibility		bound to a place and time	unlimited by place and time 24x7	
communication	personal	unrepeated	continuous, saved for further education	impersonal
comprehensibility		depends on the lecturer, repetition is not possible	illuminating, use of multimedia, repeatability	
preparation	relatively fast			time- consuming and finance demanding
costs	low initial costs	high for repetition	minimal for repetition	high initial costs
time demands	low initial	high for repetition (time of a lecturer is a limiting factor of repeatability and extensibility)	minimal for repetition	high initial

Technical background	independent			dependence, minimum of facilities
computer literacy	is not needed		develops	at least minimal
social aspects	exist		exists in group education	do not exist in individual education

Table 1: Comparison between attendance and virtual education (Jarolimek, 2009).

lectures is just based on the possibility of repetition – repetitio mater studiorum.

Conclusion

The results of the pilot study imply that virtual education methods are usable in lifelong learning. They are particularly important for use in rural regions in which the availability of contact education is a problem. The contribution of this solved project can be seen first of all in an application of modern methods in rural regions of the Czech Republic where, in these regions, a respect for usage of information and communication technologies still prevails.

In relation to ICT it is possible to state that:

- students quickly got used to the new method of education;
- they stopped being afraid of working with a computer;
- lectured topics lead them to further self-improvement through the use of the internet.

The evaluation of the virtual education contribution is also interesting; the biggest contribution has been seen in the attainability of the education. Our own question is therefore answered, as well as from willingness / reluctance to commute towards education. The possibility to study at one's own pace and to be able to repeat the education was also very positively assessed.

Knowledge introduced in this paper resulted from the solution of an institutional research intention MSM 6046070906 "Economics of resources of Czech agriculture and their efficient use in the context of multifunctional agri-food systems".

Corresponding author:
Ing. Jan Jarolímek, Ph.D.
Department of Information Technology, Czech University of Life Sciences Prague
Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic
Phone: +420 224 382 293, e-mail: jarolimek@pef.czu.cz

References

[1] Vaněk, J., Jarolímek, J., Šimek, P.: Development of communication infrastructure in rural areas of the Czech Republic, Agricultural Economics, 2008, pp.129-134.

[2] Šimek, P., Vaněk, J., Jarolímek, J.: Information and communication technologies and multifunctional agri-food systems in the Czech Republic, Plant, Soil and Environment, 2008, pp. 547-551.

[3] Salmelin, B., Nolan, J.: Rural development & ICT. Collaboration&Work. European Communities, Luxembourg, 2005.

[4] Jarolímek, J.: Applying principles of information society in rural regions (Ph.D. thesis) Czech University of Life Science Prague, 2007.

[5] Barešová, A.: E-Learning ve vzdělávání dospělých [E-Learning in adults education], VOX, Prague, 2003.

[6] Šolc, M. et al.: Sborník materiálů zpracovaných k virtuální výuce v roce 2008 [Collection of materials elaborated to the virtual education in the year 2008], Praha, 2008

[7] Ministry of Education, Youth and Sports: National Programme for the Development of Education in the Czech Republic (White paper).

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

Prefarm Systems and economical analysis of practical experiences

P. Gnip, S. Kafka, J. Čepický, K. Charvát

WIrelessInfo, Help Service Remote Sensing, Litovel, Czech Republic

Abstract

The system of Precision farming guarantees a detail monitoring of data and information necessary for a successful decision in a crop production. The system is designed for a data collection from several sources. The data are collected by a service company and also directly by farmers. The paper also analyses the economical efficiency on the base of Medlov Farm. Next development is currently running under projects Prezem and AgriSensor.

Key words

GPS, GIS, precision farming, economical analysis, monitoring.

Anotace

Systém hospodaření Prefarm zaručuje detail monitorování dat a informací, které jsou nezbytné pro úspěšné rozhodování v rostlinné výrobě. Systém je určen pro sběr dat z různých zdrojů. Údaje jsou shromažďovány servisní organizací, ale i přímo zemědělci. Článek shrnuje praktické zkušenosti na podniku Medlov. Systém je v současné době dále rozvíjen v projektech Prezem a AgriSensor.

Klíčová slova

GPS, GIS, precizní zemědělství, ekonomická analýza, monitoring.

Material and Methods

A technology of Precision farming guarantees a success of this system on the market. Difficulties of technologies, currently and continually involved in this system, argue against its practical use by farmers. In this case, a service company wants to offer a suitable environment not only for data collection, data processing, but also for the high quality of other information related with a farm management and a crop production. The practical distribution of results to customers helps them to ensure a variable application of results on the field. The most important part of services is a technology of data collection, a system of data processing. Remote sensing, crop scanning and soil sampling for management zones classification mean for farmers or other users a simplification of the difficult operations and recommendations including economic calculations.

A professional service in the market in this area uses a follow tools:

- navigation system GPS with or without Differential GPS,
- environment of Geographic information system (GIS),
- internet as a tool for data transport, data presentation,
- map server technology, web mapping services (wms / raster).

The complex advisory and service system on the market is based on results of field trials in different crops and locations. The data for WEB processing are prepared and stored by service organization and farmers. A central database store data is following:

- soil measuring (EM 38 data, soil type data),
- soil sampling (lab analysis for Phosphor, Potash, Magnesium, Calcium, soil pH.…),
- crop scanning (NDVI data created from satellite or airborne pictures),
- yield data from yield monitor created during harvest,
- other remote sensing data (N-sensor scanning),

- agronomy, field management data (crop rotation, variety, data of applications, weather conditions…..).

The main point of system is to collect different data in the easiest way on a field and on a farm, and then to use the collected data for data processing via web tools.

Open source solution Mapserver. Inside of services it was developed a mobile interface for this Open Source solution and also there were implemented OGC standards (WMS) for utilization of data in distributed system. A connection with another open source systems (GRASS, etc), was established. Current solutions are Internet Mobile Systems, including analytical tools. The most successful and currently used application from the service system is „GIS server for precision farming application with mobile access“. It is focused on increase of agricultural profitability and reduction of fertilizer and chemical bad influence on a surrounding environment.

The system provides analysis as follow:

1. Field area calculation – number of hectares for crop rotation, field cutting (Fig. 1, 2)

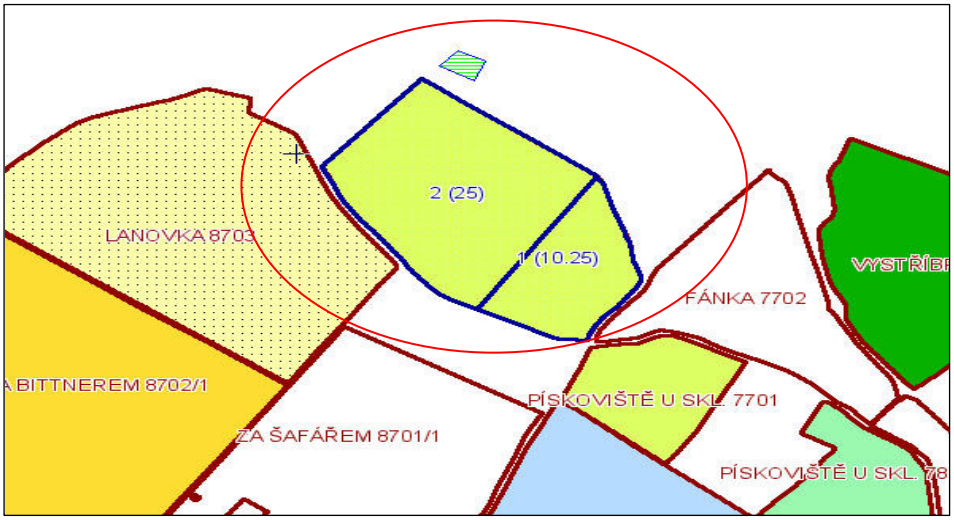


Figure 1.

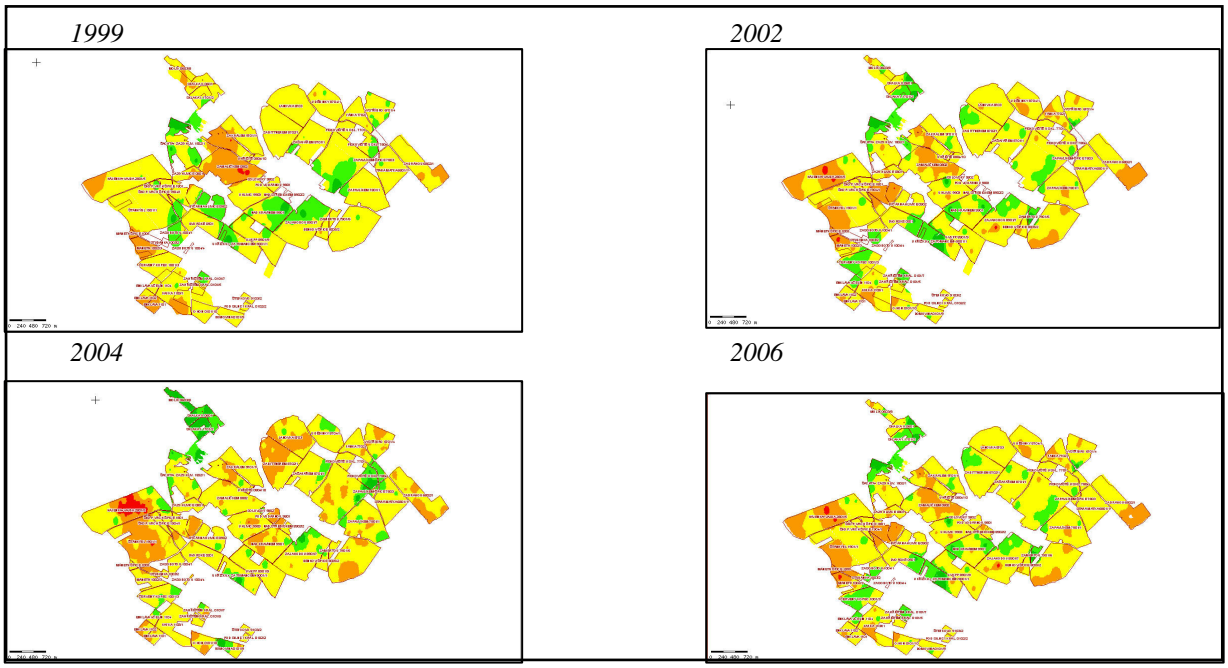


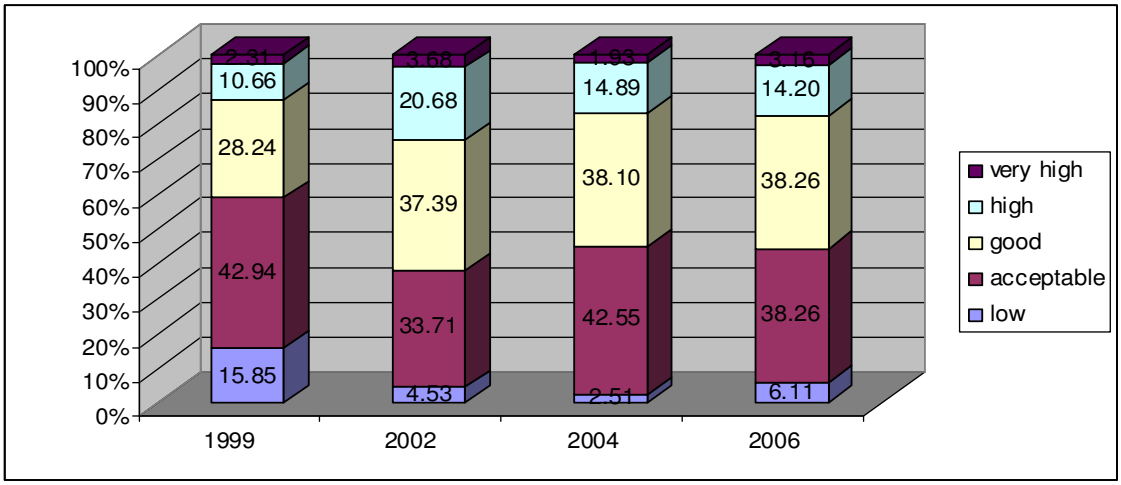
Figure 2.

2. 1999 -2006, Phosphor content in topsoil, % of categories (Graph 1)

4. Variable rate (VRA) and multivariable rate (MVRA) recommendations for basic fertilizer application(P, K, Mg, Ca and Nitrogen). (Fig. 3, Graph 2, 3)

5. History – Traceability (Fig. 4)

Management zones are a result of map analysis to get an optimal amount of each input in crop production founded on variability of soil characteristic and other factors conditioning a crop yield. In this case, the analysis can be done in one time for one field, a group of fields, or a whole farm with the same or similar conditions for the crop planning. In the system a location can be set with a very high resemblance of soil conditions or other elements and monitored characteristic. The GIS in farm management allows us to analyze data and yearly results from the crop production on the farm.



Graph 1.

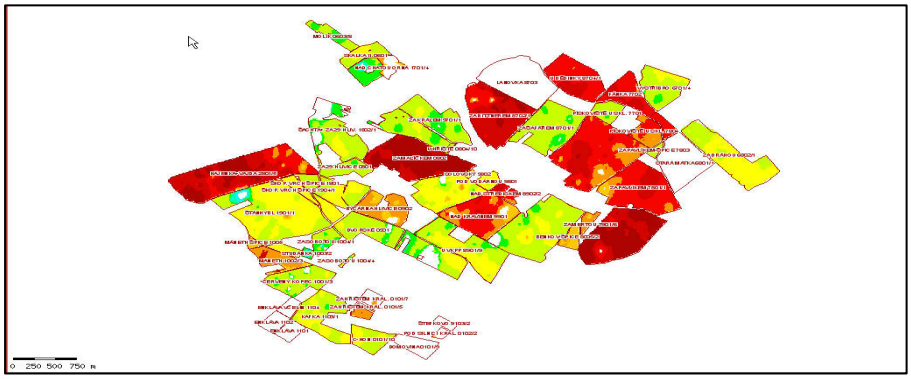
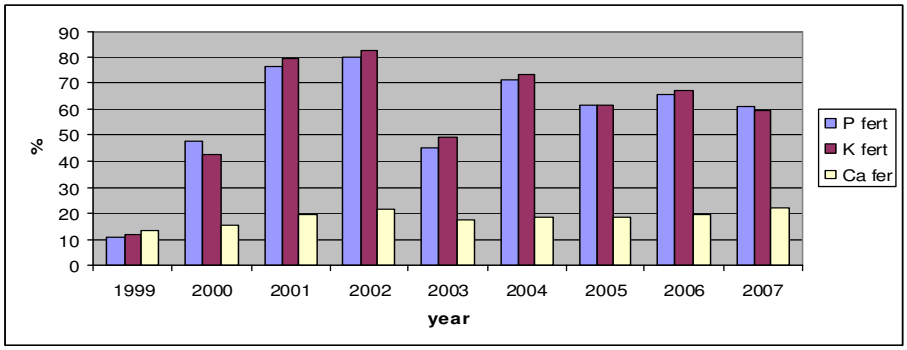
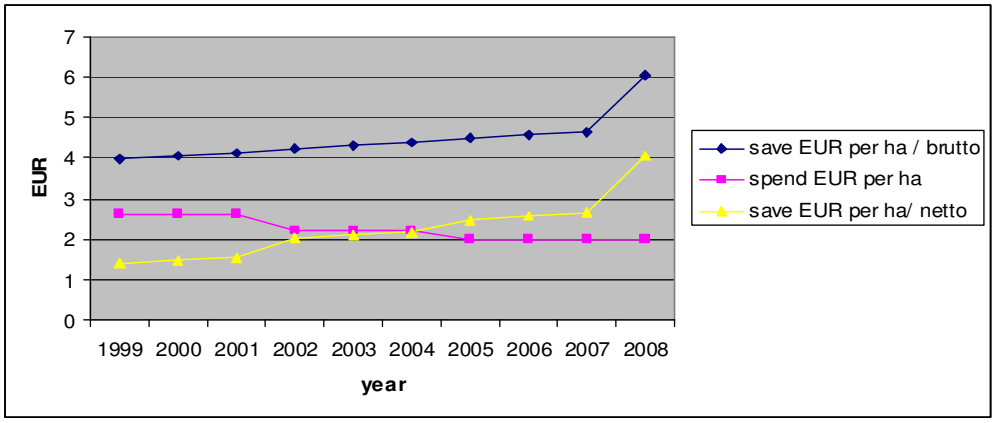


Figure 3.



Graph 2.



Graph 3.

datum	akce	co	detail	množ.	jedn.	poznámka
2007-07-18	Sklizeň-seč	vojteška setá	MORAVA	94.434782608696	q	3.seč
2007-08-02	Plán osevu	pšenice ozimá potravina		0		množení cca 70 ha,zbytek Cubus
2007-08-25	Hnojení	prum. hnojivo	DRASELNA SUL 60%	1.33	q	
2007-08-25	Hnojení	prum. hnojivo	AMOFOS	1.41	q	
2007-09-19	Plán osevu	kukurice na siláž		0		
2007-09-28	Plán osevu	pšenice ozimá potravina		0		
2007-10-10	Setí, sázení	pšenice ozimá krmná	ETELA	2.4	q	Olseed Olomouc
2007-10-10	Setí, sázení	pšenice ozimá potravina	BARROKO	2.1	q	Agro Brno
2007-10-10	Setí, sázení	pšenice ozimá potravina	AKTEUR	2.1	q	Agro Brno
2007-10-10	Setí, sázení	pšenice ozimá potravina	RADUZA	2.1	q	Bzenec
2007-10-11	Setí, sázení	pšenice ozimá potravina	MULAN	2.1	q	běžné pěstování
2007-10-11	Setí, sázení	pšenice ozimá krmná	MLADKA	2.1	q	Mulan,běžné pěstování
2008-01-08	Plán osevu	kukurice na zrno		0		
2008-01-08	Plán osevu	jecmen jarní sladovnický		0		
2008-01-17	Hnojení	prum. hnojivo	LAV	2.5	q	plán na jaro 08
2008-03-02	Hnojení	prum. hnojivo	DUSIČNAN AMONNÝ (34%N)	100	kg	1.regenerační
2008-03-10	Plán osevu	hrách		0		
2008-03-10	Plán osevu	mák		0		
2008-04-10	Ochrana	stimulátor rustu	CYCOCEL 750 SL	1.5	l	TM N Fenol Mix
2008-04-10	Ochrana	stimulátor rustu	N-FENOL-MIX	0.2	l	
2008-05-13	Ochrana	fungicid	JUWEL TOP	0.8	l	s Trendem
2008-05-13	Ochrana	fungicid	ALERT S	0.6	l	TM Talius
2008-05-13	Ochrana	fungicid	TALIUS	0.1	l	TM Alert

Figure 4.

How to start?

A system of adoption and running, described below, was built on the farm by an Advisor Company including a data collection and a field application, so the farmer does not have to be trained on different technique and equipment or a special knowledge. Every step and result is translated to agronomic or farm management language. The system was adopted in the first 3 years periods, than modified in the next 3 years, periodically repeated so far.

First year

1.1. Calculation of system adoption

- Field boundary mapping by GPS. First of all, we have to make a field geographical description in Geographic information system (GIS). We map by GPS a field boundary on the farm and clarify field area in GIS. Foundation of field database in GIS.
- Management zone definition, by analysis of satellite imagery. This is the first data processing and calculation to describe variability of each field.
- Soil sample grid setting - calculating of soil sample control point for soil sampling.
- Agronomic yield data description
- Price calculation of system adoption

1.2. Data collection

- Soil sampling and analysis of samples for phosphorus, potash, magnesium, calcium, soil pH and soil granularity.
- Map analysis of heterogeneity of each monitored element and soil characteristic
- Editing agronomical data to GIS
- Recommendation for variable rate application of lime, phosphor, potash or

magnesium fertilizer independently according to needs.

1.3 Variable rate application of fertilizer
- Variable rate application of P, K, Mg and lime fertilizer

Second year

2.1. Data collection
- Crop monitoring for Nitrogen variable rate application (winter wheat and barley only)
- Yield prediction analysis
- Editing agronomical data to GIS – crop rotation
- Recommendation for variable rate application of lime, phosphorus, potash or magnesium fertilizer independently according to needs.

2.2. Variable rate application of Nitrogen fertilizer (winter wheat and barley only)
- Production and quality variable rate of N fertilizer
- Variable rate application of P, K, Mg and lime fertilizer

Third year

3.1 Data collection
- Crop monitoring for Nitrogen variable rate application (winter wheat and barley only)
- Yield prediction analysis
- Editing agronomical data to GIS – crop rotation
- Recommendation for variable rate application of lime, phosphorus, potash or magnesium fertilizer independently according to needs.

3.2 Variable rate application of Nitrogen fertilizer (winter wheat and barley only)
- Production and quality variable rate of N fertilizer
- Variable rate application of P, K, Mg and lime fertilizer

1. three years period										
Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
P	136	80	240	180	15	27	0,36	13,22		
K	134	120	350	200	15	30	0,24	9,65		
Ca	47	500	2000	1400	35	490	0,032	7,37		
Total								30,24	14	16,24
Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
N	21	210	250	240	8	19,2	0,12	2,30	4	
N	19	220	250	240	7	16,8	0,13	2,18	4	
N	24	200	240	230	10	23	0,15	3,45	4	
Total								7,94	12,00	-4,06

Table 2: Cost investment table for 3 x three period in fertilizer saving.

2. three years period										
Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
P	195	80	240	180	13	23,4	0,37	16,88		
K	204	120	350	200	12	24	0,26	12,73		
Ca	57	500	2000	1350	25	337,5	0,033	6,35		
Total								35,96	9	26,96

Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
N	22	230	260	245	5	12,25	0,12	1,47	4	
N	21	235	260	250	4	10	0,13	1,30	4	
N	19	230	270	250	8	20	0,15	3,00	4	
Total								5,77	12,00	-6,23

Table 3: Cost investment table for 3 x three period in fertilizer saving.

3. three years period										
Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
P	187	80	240	180	15	27	0,39	19,69		
K	189	120	350	200	16	32	0,48	29,03		
Ca	61	500	2000	1500	30	450	0,023	6,31		
Total								55,04	9	46,04
Fertilizer	% of farm area	min. rate in kg/ha	max rate in kg/ha	averidge in kg/ha	save in %	save in kg/ha	price for 1 kg of fert	EUR save per ha	extra cost in EUR/ha	profit in EUR/ha
N	22	250	300	270	6	16,2	0,12	1,94	4	
N	21	250	300	270	7	18,9	0,14	2,65	4	
N	24	250	300	270	7	18,9	0,15	2,84	4	
Total								7,43	12	-4,58

Table 4: Cost investment table for 3 x three period in fertilizer saving.

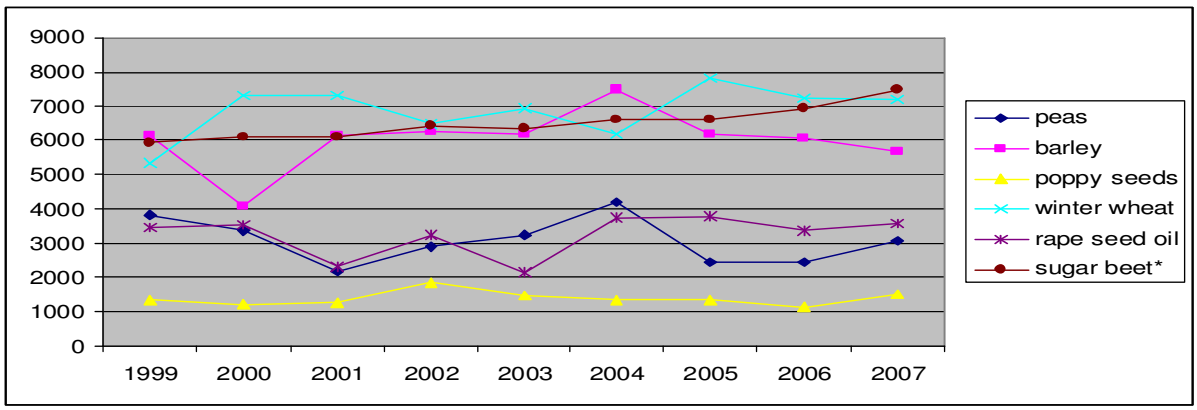
.

The distribution of N fertilize is focused on the yield and the quality of yield, so saving is not on the first place, however, farmer saved also the same fertilizer in the application.

What about yield? (Graph 4)

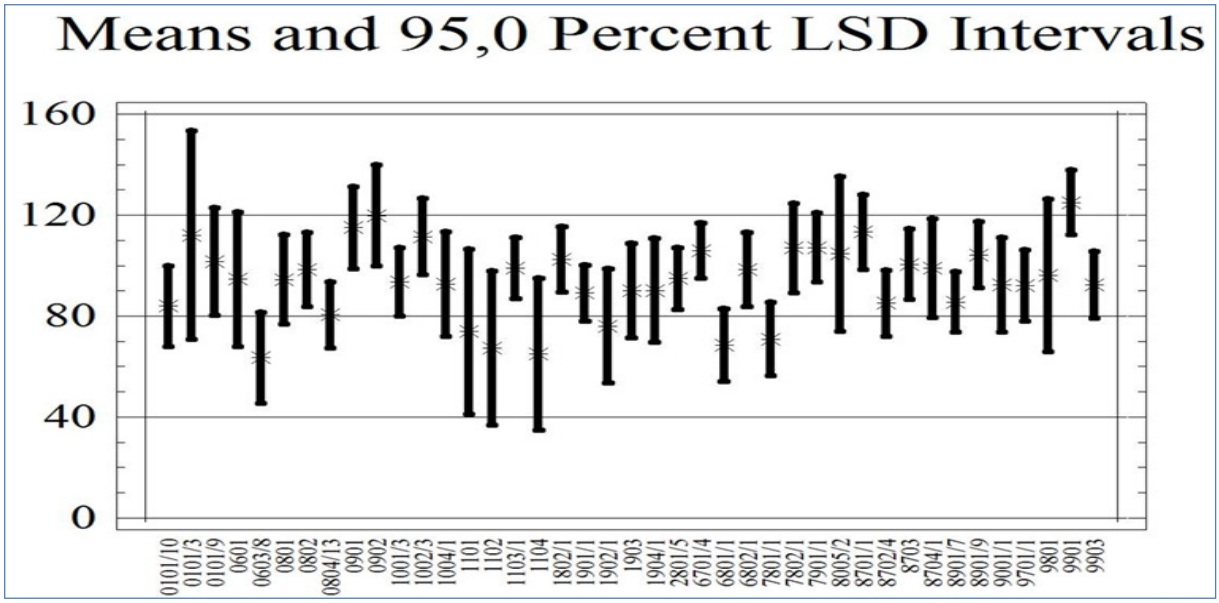
What next?

Variability between each field showed up during a 3 three years period (Graph 5)..



*yield of sugar beet is recalculate on 16 % of sugar contain and divided by 10

Graph 4.



Graph 5.

X = % of yield index in the time, y= fields

According to above mentioned figure, variable rate application and the fertilizer saving does not cause yield homogeneity of each crop, but Theky show up very clear which field is more productive and which less. The farm management continues in next decisions with ideas redistribute more a digger amount of fertilizer on fields with a higher productivity and to change the crop rotation system according to the produktivity of fields.

Discusion

The farm management forms collect necessary tasks which contain the ownership and the renting plan management for soil, the monitoring of seedling plan and plant production for each field. In the European context, one of the most important results is to explain simply the data of results to a final user, and to train him/her, how to work with the system, and what is the benefit from?

First of all, we have to pay attention for the data collection system which is dependent on accuracy, density and repetition in time. An easy work with data in the central database is one of the most important characteristic of the system. The main aim was to prepare a solution accessible from an office and also from a field. Other advantages of the system are following:

- transparent results of data analysis (Maps and tables),
- easy data access (map view, tabs, statistic, new notes),
- multifunction level of use on a farm or company (chairman, lawyer, crop manager, driver),
- traceability – complete notes (crop plan, fertilizer using….),
- possibility of another database connection (WMS, cadastral maps…).

The Precision farming is a system focused on keeping a detail record in farming when each task of operation is recorded to the field as the smallest element, but each task is captured to a specific location (a part of the field). The farmer can achieve a lower cost or to increase a yield of the crop by using this technology. The Precision farming manages a very precise application of chemicals and fertilizers according to really needs on the field, and by these methods the farmer can decrease also the bad influence of use of chemicals in farming, which is very important for the surrounding environment.

The collaborative environment provides a possible area for farmers, EO data providers and other organizations to communicate, share and exchange information. Also, any recent changes can be notified to the coverage and portfolio of related products and services.

The implementation of Web based technologies and OGC is compliant to WMS and WFS to assist the

user in describing the area of interest and in retrieving appropriate product details from the catalogue.

Mainly methodologies, which are based on analyses of satellite or airborne imagery, offer possibilities to start with the precision farming without a small initial investment on the side of farmers. Practically, before the service company start to present collected data and results to farmers, the data must be taken and treated in the central database.

Corresponding author:
Ing Pavel Gnip
WirelessInfo
Cholinská 1048/19, 784 01 Litovel, Czech Republic
e-mail: gnip@wirelessinfo.cz

References

[1] Charvat at all, Precision farming trough Internet and mobile communication, GIS Europe

[2] Charvat, K. at all Premathmod, Third International conference Geospatial information in Agriculture and Forestry, Denver, USA 5.-6.11.2001

[3] Charvat at all. Wireless Communication in the Agri/Food-Industry, Mobile Europe March

[4] Charvat at all E-content agriculture applications using wireless communications ITT Baltic April 2002

[5] Charvat, K. – Gnip, P: GIS server for precision farming application with mobile acces, abstrakt, prezentace IST – 2000-28177 PREMATHMOD, workshop Mobile Information System in Agriculture2002, Keszthely, Maďarsko,18.10.2002, CD

[6] Gnip, P. PREFARM – System of precision farming in Czech Republic.

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

FutureFarm vision

K. Charvát, P. Gnip, W. Mayer

WirelessInfo, ProGis, Litovel, Czech Republic

Abstract

This paper defines the first version of a vision of Future Farming project and also a knowledge management system used by European farms which will be designed and developed by the Future Farm project. An important part of the vision is a definition of external drivers and their influence on farm business in future. Paper is looking on a situation in three periods: short (2013), middle (2020) and long-term (2030). Our vision expects that the farming system will continuously converge to the situation of two types of farm: an industrial farm, which will guarantee both the food safety and the food security for European citizens, and multifunctional farms focused on environment protection. The recommendation proposes an architecture based on communication of interoperable services, so called Service Oriented Architecture (SOA), for easy integration of different levels and components of farm management.

Key words

Farming, external drivers, future vision, knowledge management, SOA.

Anotace

Tento dokument definuje první verzi vize budoucnosti Evropského zemědělství a znalostního managementu v zemědělství, jak který je navrhován a vyvíjen v projektu Future Farm. Důležitou součástí vize je definice externích driverů a jejich vlivu na hospodaření zemědělských podniků v budoucnu.. Článek předpovídá situaci ve třech obdobích : krátkém (2013), středním (2020) a dlouhodobém (2030). Vize předpokládá, že v zemědělství budou v budoucnu vznikat dva typy podniků : průmyslová hospodářství, které zaručí jak dostatek potravin tak jejich kvalitu pro evropské občany a multifunkční hospodářství, která budou zaměřena na ochranu životního prostředí. Doporučení navrhuje architekturu založenou na interoperabilních službách, tzv. Service Oriented Architecture (SOA) pro snadnou integraci různých systémů a součástí řízení zemědělských podniků.

Klíčová slova

Zemědělství, externí vlivy, vize budoucnosti, znalostní řízení, SOA.

Introduction

In order to build a vision for future knowledge management in arable farming, there were analysed examples of existing knowledge management systems and also drivers, which will have a potential influence on agricultural sector in future. The objective of knowledge management is to help farmers to be competitive on the market in the sense of required products, quality and amount, to be to able to react on changes on the market, changes in subsidies systems, requirements about the environment protection, but also to be able to react for example to increase of inputs costs or to climatic changes. It is also important to produce sustainability of the farm in a long term, to protect soil as the main mean of farming production.

Within the Future Farm project, a trans-European investigation has led to the definition of the key objectives needed for realization of this vision of a new concept of farming knowledge management respecting changing conditions and demands.

As a result of the Future Farm analysis we can recognise next groups of drivers which will have an influence on farm management and which could also eventually stimulate a new demand for the knowledge management:

Climate changes

- Demography (Growing population, Urbanisation and land abandonment)
- Energy cost

- New demands on quality of food (Food quality and safety, Aging population and health problems, Ethnical and cultural changes)
- Innovative drivers (Knowledge based on bio economy, Research and development, Information and communication, Education, Investment)
- Policies (Subsidies, Standardisation and regulation, National strategies for rural development)
- Economy (Economical instruments, Partnerships, Cooperation and Integration and voluntary agreements)
- Sustainability and environmental issue (Valuation of ecological performances, Development of sustainable agriculture)
- Public opinion (Press, International Organisation, Politicians)

A result of the knowledge system analysis is a division of knowledge management systems into three levels:

- Macro level, which includes management of external information, for example about market, subsidies system, weather prediction, global market and traceability systems, etc.)
- Farm level, which include for example economical systems, crop rotation, decision supporting system.
- Field level, including the precision farming, collection of information about traceability and in the future also robotics.

Future farm knowledge management systems have to support not only direct profitability of farms or environment protection, but also activities of individuals and groups allowing an effective collaboration among groups in agri-food industry, consumers and wider communities, especially in rural domain. Having these considerations in mind, the proposed vision lays the foundation for meeting ambitious but achievable operational objectives that will definitively contribute to fulfilment of identified needs in the long run. From the level of cooperation or collaboration requirements, the knowledge management systems could be split into two groups:

- Groups of individual farmers that cooperate and share machines or also workers - e.g. organized with the help of cooperatives as there are machine cooperatives
- Supply chain management itself - that means also when a chain management of car industry is much easier than a chain management of farmers, it has to be organized also with the help of IT in the future. The farmers, partners of farmers organized in cooperatives, than partners of the farmers, who deliver input to the farm and buy products from the farmers have information needs that have to be covered by chain management structures. Today, farmers have to document lots of information to different stakeholders of the market:
  - Ministries for subsidies or government bodies for several other tasks,
  - Buyers of food products from a farm need to get documents to allow them to follow the farm-to-fork legislation;
  - It is expected that in the near future (2010), farms producing biomass will have to document information for the biomass industry for reasons of sustainability.

Rationale

The agriculture sector is a unique sector due to its strategic importance for both European citizens (consumers) and European economy (regional and global) which, ideally, should make the whole sector a network of interacting organisations. Rural areas are of particular importance with respect to the agri-food sector and should be specifically addressed to this scope. As in no other sector, there is an increasing tension among requirements to assure a full safety and keep costs under control, but also to assure the long-term strategic interests of Europe and worldwide. The balance between food safety and food security will be important task for future farming worldwide, but also for farming knowledge management. Complexity arises both with regard to the production itself, taking into account its diversity and perishable nature of food products, which is much higher than in many other sectors, and the very nature of the sectoral networks. Knowledge management systems for generation of homogeneous information for traceability transfer and business as well as integration and management of such information are thus specifically complex issues in this sector. Therefore, the challenging problem is twofold.

Firstly, how to assure the full security and safety of products, but minimising costs. Secondly, how to provide benefit to the food sector networks of organisations enabling them to interoperate, to exchange information and data and to fully integrate miscellaneous business functions along the value chain. These problems (partly valid for a number of other sectors) are increasingly becoming critical and difficult in the agri-food sector (due to complexity of full traceability and minimal margins).

The farming sector doesn't play only a role of food producers, but there are also other tasks or challenges of farming sector. The most controversial issue in last years is a bio energy production. The last year´s experiences open many new questions about bio energy production, and it is clear, that current methods of bio energy production are not able to guarantee the long time sustainability of food production. There are clear requirements for innovation and mainly new development in knowledge based bio economy.

Other important aspects of the farm decision are, if it is better for a farm to be oriented on food or non-food production, or on non-production farming activities as agro tourism, or any combination of it.

An important question is also the environmental role of farming. The farming could positively or negatively influence the landscape, but, there is also an influence on water protection, soil protection and on CO2 production. These all are interests not only of farmers, but all society. So, there is important, who will pay these costs, and how it will be valorised to farmers.

The domain

The objective of the vision and its subsequent implementation is to investigate, develop and facilitate the uptake of a set of most demanded innovative knowledge management solutions and tools that will facilitate a transformation of arable farming into competitive and dynamic knowledge-based networked organisations. By this, agriculture production will be better adapted to the changing conditions of the knowledge based economy being capable of sustainable growth, generating or maintaining more and better jobs and greater social cohesion. Vision results will enable efficient knowledge creation; sharing and exploitation thought collaborative activities involving the whole value chain of agri-food companies, a paradigm of networked organisations. In addition to this and, through the development and implementation of such tools, the Future Farm will also provide European Leadership, in a response to this challenging problem: safe, integrated, traceable European Food including traceability systems combined/ embedded in the other business applications and taking into consideration wide variety and richness of EU regional, national and local food products. The application of the knowledge management solutions to the rural and very specifically in the food domain will enable all European citizen consumers to benefit from and participate in the Information Society.

Tasks for Knowledge management

As it was already mentioned, over the next 20 years, rural Europe will have been radically transformed in terms of the distribution of people and of economic activity within its regions. These changes are inevitable and many forces conspire to bring them about. The common and future position of each important driver can be different in reality; in many cases two drivers can stay against each other and their future influence on Agri-production and food market depends on regulations and common policy. For example:

- Food quality and safety ⟺ Food requirements for growing population
- Growing requirements for food ⟺ Renewable energy production technologies
- Renewable production energy demand ⟺ Demand on more environmentally friendly production

To be possible to overcome these problems, it is necessary to define new methods of farm management which will look for optimal solutions in changed conditions. As it was already mentioned in this document, the main decision has to be provided at the level of single farm. For instance: the decision about production in regions/countries etc. Could it have a negative influence on market? - if all farmers change their behaviour at the same time, it could have a negative influence on the market (for example, two or three years ago, a large orientation of all farmers lead to a deficit of food on the world market).

Vision of farm of tomorrow

2013

It is expected that the process of WTA negotiation will be closed during this period and a common agreement about free market with food and agriculture product and about subsidies systems will be defined. Also in the year 2013, it is expected a CAP reform in which new regulations will be introduced. But both of these facts will not have direct influence on farming till 2013.

Currently, the aim of the CAP is to provide farmers with a reasonable standard of living, to provide consumers with quality food at fair prices and to preserve rural heritage. To enable an average midsized European farmer to compete on the world market in a populated region with a high demand on the environment and on environmental products, these products have to be evaluated and must become part of the farmer's income. Until 2013, a revision of currently used economical instruments for managing agriculture production is expected. All these processes, which are necessary, could be delayed by the current economical crises by two or three years, but in principle, they have to start. But for the vision of farm of 2013 it is necessary to consider the current regulation of rural development policy for 2007 to 2013. It is focused on three themes. These are:

- improvement of the competitiveness of the agricultural and forestry sector;
- improvement of the environment and the countryside;
- improvement of the quality of life in rural areas and encouraging diversification of the rural economy.

For Europe, no big urbanization impact is expected until 2013. Land abandonment will slow down because of the higher prices and the return to using land more intensively. The temporary following scheme with payment for set aside of the past will disappear. In the short term period, the food safety will be increased by the wide adoption of organic farming and integrated crop management approaches. The importance of specific food production for aging populations with specific diet requirements will grow. There will be requirements for more fruit and vegetable production. And already in this period agriculture production will need to respect cultural and ethnical diversity. The percentage of population, which requires specific products, is growing.

Influence of climatic changes in this period on production will not be so dramatic. Probably, there could be growing problems with draught in south part of Europe, which we experience already now. On the other hand, there will be growing push from public opinion on changes of agriculture practices. It is related with a current discussion about human influences on climatic changes. Other aspects, which will be subjects of public discussion, will be GMO, food safety and security problems and energy production. There will be a task for research community to provide serious research in this area, but also provide public awareness of these facts and results of research.

The different demands for the food safety – food security – energy production will require increase link between research and production. The transfer of new knowledge and methods to production will start. New approach called Knowledge Bio Economy (KBBC) will address major challenges beyond growth and employment:

- The growing demand for safer, healthier and higher quality of food;
- The increasing risk of epizootic and zoonotic diseases like avian flu, and food related disorders, such as obesity, and the need for successfully preventing these;
- Threats to the sustainability and security of agricultural and fisheries production resulting in particular from climate change.
- The growing demand for sustainable production and use of renewable bio-resources for eco-efficient products;

The process of farm diversification will continue and generally we can define three types of farms which will dominate over European agriculture:

1. Multifunctional farms
2. Large-scale industrial farm production of food or energy
3. Farms with focus on specific production like bio production or production of foods for specific groups of consumers

Multifunctional farms

The main characterization of this farm will be to support energy efficient production, ecologically friendlier, to play a social role in countryside, to form the countryside, non-production functionality like tourism and protection of cultural heritage. This multifunctional farming will be the main direction of farming in less favoured areas, but also in tourist destination, mountains, costal zones etc. The key issue for multifunctional farm will be the economical sustainability; to create an honest and open dialog among small number of farmers and big majority of EU citizens in other jobs. Without agreement of all society and without an economical valuation of non production role of farming sector it will be difficult to guarantee the economical sustainability of multifunctional farms. In typical tourist destinations it will be probably easier to introduce multifunctional farming, because the role of farm sector will be important for landscape and will be easy to generate a profit for farmers. Typical examples are for example Austrian Alps.

Large scale industrial farms

The focus of this farm will be on introduction of newest results of research in the area of KBBE, but also using of new decision supporting systems and precision farming. This type of farm already exist in some new member states, but also for example in north of Italy. The existence of this farm will be important for Europe to guarantee the food security. With the future growing demand for food worldwide, it will be necessary to guarantee European competitiveness. It is expected that till 2013 this type of farm will be subsided, but the level of subsidies will decrease. The main border for production of this farm will be given by such standards like standards coming from the Water Framework Directive and also standards for food quality. The demand for food quality will probably grow more from the side of retailers, then from political decisions. So, the importance of economical instruments will grow. This type of farm can also play an important role in bio energy production in future, but to guarantee the protection of environment and food security, there will be necessary to define exact rules for bio energy production. An important issue for this farm will be also guaranteeing their long-term sustainable production; the main issue will be the soil protection.

Farms with focus on specific production

The role of farm with focus on specific products like bio products will grow. The demand will be stimulated mainly by people with higher income, but also with people focused on alternative life style. The focus will be mainly on fruit and vegetable, but also on other crops. It will grow with growing population originated from other cultural conditions.

It could be expected, that at this time there will be two types of farm with focus on specific production. First will be around large agglomeration to supply fresh product to urban people or people from urbanized rural areas (villages around large cities) to guarantee fresh and high quality production. The second part of farm will belong more to multifunctional farms which will be managed by people with alternative life style or will be focused on tourism and other part of activities.

The main border for production will be given by quality standards. Also here it could be expected that standards given by consumer organization will be more and more important, then standards given by politicians. This will have strong an influence on activities during production and on ICT solution. So, the role of traceability tools and direct communication with consumers will grow.

Due the fact of specific of production, we could expect a complicated discussion, if this kind of production will be subsidized in the future. On the one hand, this production is environmentally friendly and negative environmental influences are minimized, but on the other hand, the main consumers will be people with higher incomes.

2020

General vision of farm of tomorrow

By 2020, the current food production methods will be unable to meet the worldwide food and energy demands of the growing world population and it will also have an influence on European farming sector. The food security will be a problem as larger parts of the world populations will start consuming at present developed countries' levels. We can't afford unsustainable production with the growing human population. The demand for food increases requirements for a better utilization of results of

research and for new management methods. Combined with advanced bioprocess engineering, the development of high performance crop plants is a key for this vision to become a reality. Crops will serve as factories for enzymes, amino acids, pharmaceuticals, polymers and fibres, and will be used as renewable industrial feedstock to produce bio-fuels, biopolymers and chemicals. Green biotechnology will be employed since conventional or smart breeding alone will probably not be able to provide the required increase in performance. It is anticipated that already by 2020, in addition to the then mature gasification technologies, the conversion of ligno-cellulosic biomass by enzymatic hydrolysis will have been a standard technology opening up an access to large feedstock supplies for bioprocesses and the production of transport fuels. Research breakthrough in the second generation of bio-fuels derived from lignocellulosic material will make bio-fuels production more competitive and without using food material. The medium term influence will be to have food products with higher nutritional values, reduced chemical contamination and more advanced traceability systems. In this period, the average age of populations will continuously grow. This generation will be more active than previous senior generations and will require specific diets. It is expected that the percentage of ethnic groups in Europe and US will increase. They will have an influence on specific requirements of agriculture and food production. Investments in high-value crops, high quality food products and new technologies in crop production will be the case in the medium term. In the medium term, the need for more food and for energy from crops due to the high prices of fuel will also boost R&D in Europe and worldwide.

In the medium term, climate change could benefit agriculture of higher latitudes by enabling the introduction of new crop varieties, increasing yields and expanding areas of land under cultivation. In certain lower altitudes, it will be probably necessary to focus on varieties that are more resistant to draught.

The new standards and regulations will require a strong cooperation with WTO, but also with food producers and markets. New standards will combine market requirements for food, with requirements for energy, but also the environmental protection. Currently, it is difficult to judge the result of the CAP reform. There is a demand that subsidies should be made available for specific innovative investments and experiments aimed at increasing environmental performance of the farm, such as resource-saving technology (energy, water, etc.), renewable energy technologies, low emission stable systems, etc. With the CAP reform, national strategy will also be changed. It is expected that there will be a shift from direct payment to supporting environmentally friendly production and food safety.

The success of all measures to reduce the environmental problems and mainly to reduce the climatic changes effects will be revealed. Any success or failure will affect directly the farming practices and management of the farms leading to more agro-environmental measures taken by the states. By 2020 and further on, the effects on the climatic change will be clear and it is believed that more worldwide treaties will be enforced. The first environment valuation programs will start and failures will lead to restructuring and changes; as the environment is not a local or regional or national problem, this question has to be taken on a higher platform and must be discussed on a worldwide level. The economical instruments will strengthen reflect issues, such as healthy production, food safety and environment protection. Agriculture will largely adopt new collaborative models which will support not only sharing of resources, but also of knowledge. In the medium term, partnership agreements will be more widely used and will be specialized in different sectors, such as the production of energy crops where local industries will produce oil and bio-fuels as well as in other agricultural sectors mainly for industrial crops.

Diversification of three basic types of farm from previous period will continue and differences mainly between first two types will be deeper. In some way, diversification inside the third group will continue there and both directions will in some way converged to the first two groups.

Multifunctional farms

The adaption to environmental production will continue, but it will strongly depend on valuation of ecological parameters. The guarantee of sustainability of multifunctional farms will be

necessary on the base of public dialog to pay their non-production role. The main paradigm will be a non-extensive production with focus on greenhouse effect. The main task will be to produce food in a sustainable way which meets the consumer's demands. The target will be a balanced use of agricultural products. (between food & bio-feed stocks, bio-energies), farms will produce their own fuels decrease their dependence on energy sources. Important parts will be of multifunctional farm tourism and consumptions of products directly on the farm.

Large scale industrial farms

Large scale industrial farms will guarantee European food security. Because the subsidies for this type of farm will be dramatically reduced, it will be necessary to discus all standards of production which will be required from this type of part. It is clear that there will be needs for such standards like water protection or CO2 production, but it is necessary to take into consideration that too strong regulation, if is applied only in Europe, could destroy this important group of farm. In any case, there will be grooving demand from consumers for guaranteed food quality also.

It could be expected that the energy cost will grow in this period again, so, there will be also an open question of energy production.

Farms with focus on specific production

The differentiation to two types of farms with specific production will grow. The first group of farm will be focused on a delivery of high quality of food, which will be produced by environmentally friendly methods, vegetable and fruits, or foods for people with specific cultural or dietetic requirements to bigger percentage of population. These groups of farms, with respect to their specificity, will converge more and more to industrial farms. This group of farms will have extremely high requirements on new results of research and will be base for knowledge based economy. Also, there will be extremely high requirements on ICT, mainly on monitoring, but also on a very precise production management. Also marketing and real time delivery will be important.

The second group of farm will be focused on the consumption of products on the farm. The requirements will be mainly for the management of quality of production.

2030

The global food production has to grow by 50 per cent by 2030 to meet the increasing demand of growing population. Massive efforts are required to maintain fertile cropland. Demand for animal protein may increase, triggering massive investments into genetically modified food, aquaculture, and stem cells for meat production without growing the animal. Seawater agriculture on desert coastlines could produce bio-fuels, pulp for the paper industry, and food for humans and animal bio-fuels, while absorbing carbon and reducing the drain on fresh water. In the biggest part of Europe, urbanization and land abandonment will result in more concentrated production in urbanized areas and a reduction of the production in less favoured areas. A long term strategy is necessary to solve the impacts of raising energy prices like increasing field areas or increasing production of bio-energy from agriculture.

However, the net benefits of climatic long-term are less certain. Particularly, in lower areas, droughts and desertification will create significant social challenges in some of the world's poorest economies. Areas such as Siberia, Scandinavia and Canada will profit from global warming.

The key issue will be also the food quality. A long term influence will be on the intensive use of traceability systems in the food supply chain and this will be compulsory for all farmers producing food stuff and to the retailers. The focus on aging population and health will be a major requirement of food production. There will be an important shift in composition of production in direction of vegetable, fruits, fish, chicken, etc. The percentage of ethnic groups will grow further. Around 2030, ethnic groups could comprise a major portion of the European population. This will influence food and agriculture production. There will be a complete change of economic instruments which will influence the production. The main focus will be on removal of distortion of the market but a support of healthy and environmentally friendly production, and a support of world wide food security. In the long term, partnership agreements will be more 'mainstream' where local industries will be closely connected to the region, and farmers will sell their

products directly to them, securing prices in disposal of their production. The agricultural production will be horizontally and vertically integrated.

Biotechnology will be an important pillar of Europe's economy by 2030, indispensable to sustainable economic growth, employment, energy supply and to maintaining the standard of living. It will be increasingly used in labour-intensive sectors, e.g. industrial processing, pharmaceuticals, agriculture and food. The increasing demand of energy will keep prices high and support the demand for bio-fuels. Therefore, the investment interest will continue. In this period, if the oil reserves estimation is correct, it is expected that some oil reserves will be depleted and this will worsen the supply of energy. Thus energy prices will increase and investment in Renewable Energy Sources and biomass produced by the farms will be enhanced. A new dimension of farms will also take place, such as pharmaceutical crops, industrial crops as well as high quality and safety food. A research in agriculture for new and advanced agricultural commodities will be needed to keep raw material supply at low cost. The trends of the previous period will be maintained and funds will be available for research in the sector. If the climatic change scenarios are verified, strict measures have to be adopted. This will be an important driver for farms to change practices and management to more environmental friendly direction. A worldwide valuation of ecological performances with rules like "who has to pay how much for whom", taking into consideration the impact of environmental caretaking for local, regional, national, continental or worldwide influence.

Efforts to enhance the environmental performance of agriculture will play an important role. Social and political pressures for increased environmental standards are expected. Resulting policy tools, whether positive (subsidy based) or negative (penalty based), if substantial enough, could play a major role in shaping future agriculture. On the other hand, the cost of dealing comprehensively with the above set of environmental issues would be many times greater than the public funds currently available through the main policy programs. It may be that public funds continue to play a marginal role in protecting or enhancing the rural environment. No dramatic increase in environmental regulation governing agriculture is expected.

The important question, which is till now open, is if agriculture production is subsidized, and what agriculture production will be subsidized. The final decision will depend on a discussion of member countries. The final decision is not clear, but it is expected that financial incentives should be available for farmers who produce according to sustainability criteria because they bear additional costs (compared with unsustainable production) which will not directly be paid by consumers. In the transition period until 2030, the incentive should increase with the degree of implementation of such criteria.

It could be expected that due to the requirements on quality of production and also on the environmental friendly production on one hand, and on the other hand in increasing of demand for the high quality food, vegetable and fruits, and also growing demand for special production, the conversion of two types of farms to two main groups will continue and in the final stage we will have two basic types of farms:

- Multifunctional farms
- Industrial farms with focus on high efficiency and high quality of production

Multifunctional farms

The focus will be on efficient agriculture from an environmental and socioeconomic point of view. The role of farm will depend on a public dialog and a valuation of non-production goods. The focus will not be only on production, but also on landscape and cultural heritage. The landscape is one of the most commonly cited of the multifunctional characteristics of the agriculture sector. However, the impact of agriculture on landscape has not always been positive. This will be changed and agriculture will play important role in forming of landscape. Rural viability via agricultural employment will be one of the multifunctional outputs of agriculture. There is expected a link between agricultural employment and agricultural production, but part-time farming, diversification of income sources of the farm household, and the development of non-agricultural activities in rural areas, will mean that agricultural employment and

rural development are much less inter-dependent than in the past. There will be also other values as historic buildings and associated cultural heritage values in rural areas.

Industrial farms with focus on high efficiency and high quality of production

The main requirements will be to produce enough food and energy in a sustainable way which meets the consumer's demands. The farms will have to respect strict regulations, but also will need to produce effectively. There will be necessary to find a balance between restrictive methods like the regulation and standards on one side and an economical stimulus like subsidies on the opposite side. The requirements to produce a high amount, high quality and environmentally friendly will demand new methods of management and also an application of new scientific results. A research in agriculture for new and advanced agricultural commodities will be needed to keep raw material supply at low cost. The trends of the previous period will be maintained and funds will be available for research in the sector.

Demands for Future Farming system

Demands from external drivers

For suggestion of functionalities and interrelation of the future knowledge management system, the previous analysis has to be considered. The basic principles of interrelation could be expressed by next image:

If this scheme is studied deeply, we can expect the following transfer of knowledge:

Climate changes

- Macro to level – Global trends in long and short time
- Farm to Micro level – regional forecast, decision about crops, application of pesticide, herbicide, fertilisation
- Micro – to farm level – local forecast, local changes, alert situation

Demographic

- Macro to farm level – changes in demand on amount of food
-

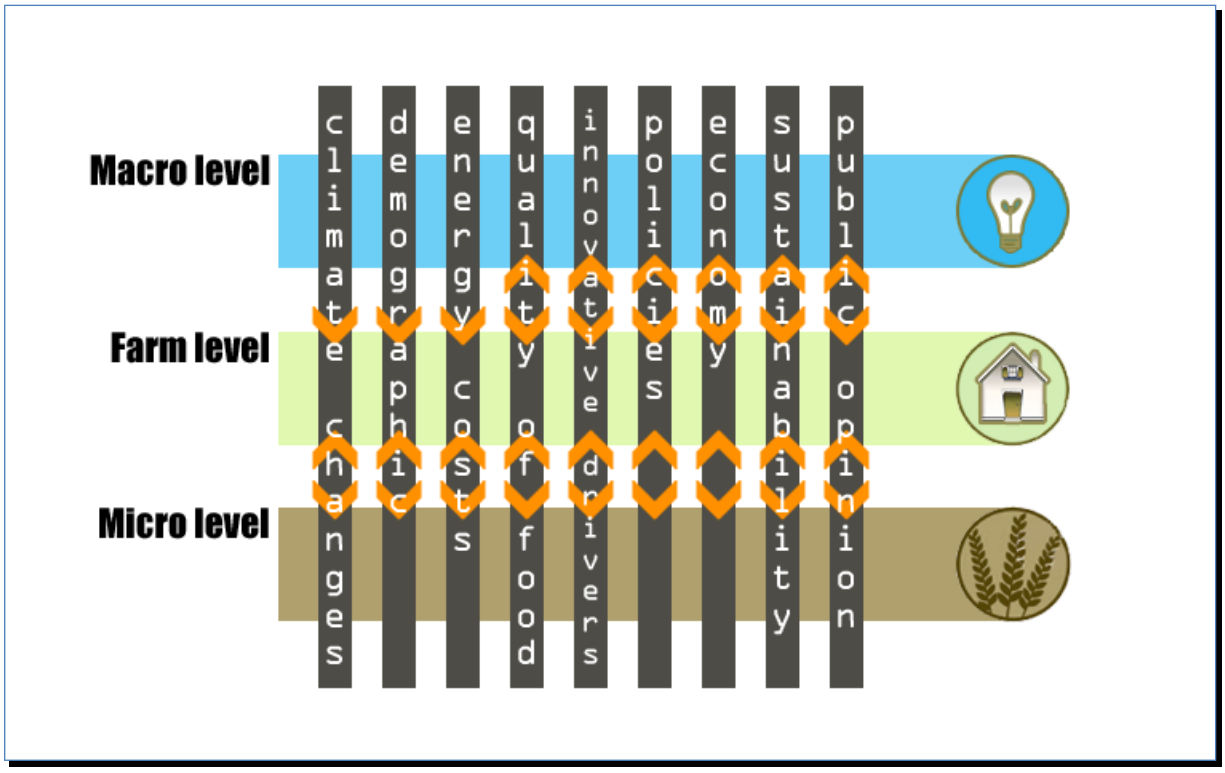


Figure 1.

- Farm to Micro level – selected methodology of production
- Micro to farm level – yield monitoring

Energy cost

- Macro to farm level – cost of energy, demand on bio energy
- Farm to Micro level – selected crops, selected methodology of production
- Micro to farm level – yield monitoring

Quality of food

- Macro to farm level – prices, demand on quality
- Farm to Micro level – selected crops, selected methodology of production
- Micro to farm level – yield monitoring, traceability
- Farm level to Macro - traceability

Innovation

- Macro to farm level – new crops, new methods of work
- Farm level to micro - new crops, new methods of work
- Micro to farm level– data for research analysis
- Farm to macro level - data for research analysis

Policies

- Macro to farm level – regulation, subsidies
- Farm level to micro - selected crops, selected methodology of production
- Micro to farm level– traceability, evidence for subsidies
- Farm to macro level – traceability, evidence for subsidies

Sustainability and environment

- Macro to farm level – regulation, valorisation
- Farm level to micro - selected crops, selected methodology of production
- Micro to farm level– traceability
- Farm to macro level - traceability, evidence for subsidies

Public opinion

- Macro to farm level – changes in public opinion, public requirement.
- Farm level to micro - selected methodology of production
- Micro to farm level– traceability
- Farm to macro level - traceability

Visions of knowledge technologies

2013

There will be majority of European rural areas covered by broadband and the majority of farm businesses will adopt ICT technology as tools for farm management. The growing demand on decision support systems will be in all three types of farm. The application of ICT in the agricultural sector would have a beneficial effect on the appropriate use of resources and keeping of profitable agriculture. Increasing precision input applications, appropriate genetic material and automation would lead to more sustainable farming systems and permit farmers to conform to the definitions and rules of sustainability. The key strategy will be to provide effective knowledge transfer to as many people as possible, through a range of services, and to meet the diverse knowledge and information needs of our customers and stakeholders.

The specific for different types of farms will be:

- Multifunctional farms – traceability and controlling systems, subsidies management systems, quality controlling system, e-commerce systems, control of compliance with environmentally production rules, marketing tools.
- Industrial farms focus will be on precision farming, traceability, quality controlling systems, monitoring of compliance with existing regulation, access to market information, high quality machinery using advanced ICT solution, support for effective economical decision.
- Farms with focus on specific production will require mainly the tools for monitoring of quality of production and compliance with standards. Important will be also effective marketing tools to offer production.

The important aspect of technological development will be:

- Web-based off site FMIS.
- Information intensive.

- Pervasive networking wired and wireless, software as a service.
- Gain of farmers efficiency by intensive use of ICT/FMIS/web.
- Automated assisted decision making.
- Information available in time and space.
- To understand the private (farmers) and public (ministry, chamber) information need and integrate the farmers.
- To understand and document the farmers available support in environment caretaking.

The important problem, which has to be solved, will be • Availability / non availability of macro level data.

2020

Principles of ambient mobile intelligence will be adopted by farming sector to guarantee effective management of production but also traceability. Agriculture will require a highly educated staff. There will be a large shift from manual work to knowledge management. The main principles will be:

- Management decisions are based on accurate process data and updated external information => resulting real-time monitoring and rapid reactions.
- Service – based system => shared workload by outsourcing.
- Sensors.
- Easy data flow market <- farm => field.
- Market ⇔development ⇔ field.
- Every task will be automatically controlled. DSS, traceability, sustainability.
- Decision models both in space and time.
- Intensive use of the latest scientific knowledge.

2030

Agriculture will become fully knowledge driven. This will require a full adoption of ICT. New sensors and nanotechnologies will become a part of management. ICT facilitated the development of robotics and automation now used in many industries, including the agri-food sector. New systems, such as self-milking systems for dairy cows, are being developed, as well as process automation to reduce labour and improve productivity.

Recommendation for Future Farm knowledge management based on analysis of existing platforms and farmer satisfaction

The analysis of existing platform and also new requirements coming from external drivers analysis demonstrated that for future farming system interconnection of different part of farming systems and communication will play the most important role. From this reason the recommendation for the Future Farm project is a usage of the Service Oriented Architecture (SOA) which provides methods for systems development and integration where systems group functionality around business processes and package these as interoperable services. An SOA infrastructure allows different applications to exchange data with one another as they participate in business processes. Service-orientation aims at a loose coupling of services with operating systems, programming languages and other technologies which underlie applications. SOA separates functions into distinct units, or services which developers make accessible over a network in order to users were able to combine and reuse them in the production of business applications. These services communicate with each other by passing data from one service to another, or by coordinating an activity between two or more services. In the future farm is recommended to use SOA for integration of the Software (SW) tools and web services and to implement an idea of Open Agriculture Service (OAS). The integration and communication among the independent components of the system is based on the implementation of the Open Standards defined mainly by the World Wide Web Consortium (W3C), Open Geospatial Consortium (OGC) and Organization for the Advancement of Structured Information Standards (OASIS).

This choice provides the capability of easy access to the individual services exposed by any domain specific application wishing to participate in the knowledge management system. The framework also helps to easily provide the insertion of new services and components, and the re-use of existing blocks and services, hence a great flexibility both in the platform management, especially in the choice and integration of system components and services, and in the requirement for developers of new services, as these are loosely coupled object

oriented systems that are distributed and maintained with eventual service level agreements by the single service provider.

The approach has to be based on a service-oriented basis and these both reflect in the user view of the platform facilities and provisions, and in the approach for application providers and developers that implement new components.

A system architectural design has to be evolved from monolithic applications to more client-server oriented ones. Nowadays, a brand new architectural paradigm has to appear from the standardization of the Web Services. The Service-Oriented Architecture (SOA) is a software architectural concept that defines the use of services to support business requirements. In an SOA, resources are made available to other participants in the network as independent services that are accessed in a standardized way. Normally, the definitions of SOA identify the use of Web Services (using SOAP and WSDL) in its implementation.

In view of the project objectives – especially those that relate or influence the environment within the Future farm system – developments in the following domains will be highly relevant to the project:

- Geographic Information Systems (GIS). The intelligent use of technologies for maintaining, querying, displaying, and analyzing geographic information will be an important determinant to the project's success.
- Information Integration using XML: an important objective of this project is to present to end-users information from a wide variety of sources that can have very different types of content organisation (geographic databases, textual information, graphic content, …) The family of technologies, that are being developed around the XML format, provide an obvious environment for developing the necessary content integration and content transformation tools.
- Robotics will play important role on farms.

It is of utmost importance for the Future Farm offer possibility of efficient knowledge management on all levels of management. In general, we can say that the ecological, technical business and legal requirements need new structures that are able to fulfill and support the farmer's needs. As existing structures - this is valid for public structures like ministries or government driven extension services but also for semi-governmental organizations like chambers of agriculture have a tendency to move slowly as every change hurts and sometimes a change shows also a wrong structure of existing organizations. This could show us that in countries that have no structures yet technology is implemented much faster because when a new structure is set up this will be done with newest technology. The danger is given for the European structures that have been in general very effective for the farmers need during the last hundred years but are not so effective or contra productive for the needs of the future.

It is necessary to mention one risk. If all farmers use the same input knowledge and the same deterministic algorithm, the usage of such decision could lead to distortion of market. Then, two possible options exist, which could guarantee a non-uniform decision:

- To use suboptimal variants
- To use non deterministic methods for decision

Conclusion

The future farming and also the future farming knowledge management system will have to solve many problems. Different problems will grow also in the world scale which will also influence the farming. We point out for example the above mentioned requirements on food quality and safety, and on the opposite side on the food requirements for growing population and on renewable energy production technologies. It is curios, but the production of renewable production energy could have a negative influence on the environment. Thus, any decision will be very knowledge sensitive.

The importance of biotechnology will grow till 2030 and also research will be closer to farming.

On the base of the requirements for the quality of production and for the environmental friendly production on one hand, and the increasing demand for high quality food, vegetable and fruits, and also the growing demand for a special production on the other hand, we expect that two main groups of farm will exist in 2030:

- Multifunctional farms
- Industrial farms with focus on high efficiency and high quality of production

The focus of multifunctional farm will be on the efficient agriculture from the environmental and socio-economic point of view. However, the future of multifunctional farms will depend on a public dialog and a valuation of non-production goods.

The focus of industrial farm will be to produce enough food and energy in a sustainable way which meets the consumer's demands. The quality of food will be important in Europe and it is expected, that also the bio-production will be industrialized or will become knowledge intensive. The expectation is that the industrial farm will be able to exist without subsidies, but it will depend on the level of restriction. Science will be a key driver.

In 2030, agriculture will become fully knowledge driven. This will require a full adoption of ICT. New sensors and nanotechnologies will become a part of management. ICT facilitated the development of robotics and automation now used in many industries, including the agri-food sector.

On the architecture level of information systems we recommend to be focused on service oriented architecture which could guarantee a better connection and interoperability of future systems. It will influence use of GIS system, a better acceptation of XML standards, but also the importance of robotics will grow.

For adoption of new technologies also two horizontal issues, education and standardization will be important. Without an educated staff it will be not possible to introduce new knowledge intensive methods. The importance of standardization will grow for interconnectivity of different levels of farming knowledge systems.

FUTURE FARM - the solution was achieved with financial co-funding by the European Commission within the Seventh Framework Programme with registration number 212117 and name "Integration of Farm Management Information Systems to support real-time management decisions and compliance of management standards".

.

Corresponding author:
RNDr. Karel Charvát
WirelessInfo
Cholinská 1048/19, 784 01 Litovel, Czech Republic
Phone: +420604617326, e-mail charvat@wirelessinfo.cz

References

[1] Charvat K. at all D1.2.3 Visions and recommendations for knowledge management, Report from FUTUREFARM project

[2] AGRICULTURAL POLICY SCENARIO AND FOCUS ON THE ENVIRONMENT- Some Reflections, Brendan Kearney - Economic Consultant, http://www.teagasc.ie/publications/reps2000/reps2000_paper03.asp

[3] Verdouw, C.N., Wolfert, J., Beulens, A.J.M., 2007. Information Integration in Multi-dimensional Agri-Food Supply Chain Networks: a Service-Oriented Approach. In: Cunningham, P., Cunningham, M. (Eds.), Expanding the Knowledge Economy: Issues, Applications, Case Studies 4. IOS Press, Amsterdam, pp. 1024-1031.

Agris on-line Papers in Economics and Informatics

Volume I Number 2, 2009

Agris on-line Papers in Economics and Informatics

The international reviewed scientific journal issued by the Faculty of Economics and Management of the Czech University of Life Sciences Prague.

http://online.agris.cz

ISSN 1804-1930