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Analysis of Factors Affecting on Risk Management of Wheat Production Among Wheat Farmers (Razavieh Region, Khorasan-E-Razavi Province, Iran)

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Abstract

The main purpose of this study was to analyze the Factors Affecting on risk management in wheat production among farmers of Razavieh region (Khorasan-E-Razavi province, Iran). Statistical population of the study was 1520 farmers that they had water cultivation. By using of stratified proportional random sampling 156 respondents were selected from 8 villages. For the calculation of the risk-aversion coefficient degree among farmers, the Safety First Rule model was used. The findings revealed that the dominant respondents (65%) were risk-averse. The results of exploratory factorial analysis showed that five factors determined about 74.267 % from total variance for wheat farmers' risk management that consist of: economy & marketing management factor, planting management factor, harvest management factor, infrastructure management of farming and risk-sharing management factor. From among of the above mentioned factors, the most important factor of risk management in study region was factor of economy & marketing management.

Key words

Wheat farmers, Risk-aversion, Risk management, Drought, Agricultural extension.

Introduction

Agricultural production is characterized by risk. Each year Iranian farmers confront the sudden and untimely rainfalls, flood, chilblain and frost, hail, drought, vegetable pest and other natural disasters, and on the average they face with serious economic losses because of these incidents that are sometimes irreparable within the household economy of farmers. Beside these uncontrollable natural hazards, unnatural events such as fire, theft and so on should be added. Such factors are often unpredictable and they increase risk and lack of certainty of agricultural activities. Risk is an unavoidable factor in the business of agriculture. Production can vary widely from year to year due to unforeseen weather and market conditions, causing wide swings in commodity prices. But risk (while inevitable) is often manageable. Farming in Razavieh region in Khorasan-E-Razavi province, as an example of the agricultural area in Iran, is naturally considered as a risky activity by comparison with other occupations. Because drought, water shortage and unfavorable climatic factors such as hail occur largely there and these factors affect a lot the wheat farmer's decision and performance of agricultural activities (wheat is the dominant cultivation of Razavieh region). Therefore, recognition of the factors that have an influence on the risk management of wheat farmers' production can be considered as one of the main foundation in Razavieh region and other similar area in Iran. About the risk management of farm, Sandmo (1977) refers to the arrangement of input, output and determination of the best levels in combination of these two cases in the risk management .He points out that more price risk in the lower levels will be useful by the utilization of the input and output. In his opinion the final level of the input and output chosen by producers is variant for different people in the same condition.

Extensive researches have been done on the factors influencing wheat farmers' risk management in the different countries of the world; for example a research by Meuwissen et al. (2001) showed that in farmers' view, price and production risks are among the most important risks and production with the lowest possible expenditure and insurance

are the most important management strategies. But in a study by Sonkila (2005), changing agricultural policy is shown as the most important risk factors and protection of sufficient liquidity is shown as the most important risk management response. The results of a research by Falco and Perring (2005) showed that the most farmers' concern is about the price risk of goods, production risk and the changes of government's laws and regulations. In this study some farmers expressed that the cost of inputs is the greatest source of risk. They also declared that the maintenance of liquidity, use of secondary markets and insurance are the main risk management strategies.

In a study that was done by Akcaoz and Ozkan (2005), farmers are divided into three categories: risk-averse, risk-neutral and risk-taker. In risk-averse farmers' view the most important source of risk is the change of government's agricultural policies and the least important source of risk is the farmhands' hygienic problems. In their opinion the financial and security factor is the most important factor in risk management. In risk-neutral farmers' view, the most important source of risk is the change of the input and output's cost. Financial and security factor, out of farm investment and working outside the farm have been introduced as the most important factors influencing risk management, by risk-neutral farmers. Among the risk-taker farmers, the price changes of the inputs and the products are the most important source of risk and the relationships between families are the least important source of risk. In this study, the financial and the security factor, marketing and variety of income are the most important factors influencing risk-taker farmers' management of risk.

Moghaddasi and Yazdani (1997) in his research entitled "Studying the Factors of Risk: (a case study of Potatoin Feridan Isfahan)" reached the conclusion that the most farmers in this study are risk-averse. He also introduces the use of extensional curses in the utilization of new technologies such as pesticides, fertilizer and improved seeds as an important factor in the management of production risk. Finding of a research by Tyraei Yari (2002) which was about investigation of the personality factors affecting the risk-taking in the acceptance of crop insurance program, indicated that there is a significant positive relationship between the extent of farmers' risk-taking and the variables in agricultural work experience, the rate of land under cultivation, the total extent of agricultural lands, the amount of relationship with the extension experts, a close relationship and communication with the agricultural services centers. Also according to the results of step by step regression analysis, some variables could predict 23.9 percent of farmers' risk-taking changes. These variables consist of having non-agricultural jobs, private-leasing mixed exploitation system, credit and social status of people in front of others, the ability to tolerate failure and to be influenced by others.

Rostami et al. (2005), in their study entitled "risk management of wheat production in domestic beneficiary system (the case study: Harsin region in Kermanshah province" concluded that the existence of five major risk factors (pests and diseases, climatic and environmental factors, factor of input, factor of lack security and factor of economic-credit) in wheat production have been effective on the study area. Also the results of risk management factorial analysis revealed that there are five factors in the risk management (risk-sharing management, water and soil management, cultivation management, harvest management and marketing management) for reducing the above-mentioned risks. Ultimately the results of factorial analysis sector revealed following correlations: positive significant correlation between risk-sharing management and these five factors (pests and diseases, climatic and environmental factors, input factor, lack of security factor and economic-credit factor), positive significant correlation between water and soil management and these two factors (pests and diseases, climatic and environmental factors), positive significant correlation between harvest management and factor of pests and diseases, positive significant correlation between marketing management and these three factors (factor of lack of security, factor of economic-credit and factor of input).

Roosta et al. (2010) investigated the factors affecting the capability of farmers in risk management among Wheat Producers in Khorasan-E-Razavi Province. The results this study indicated that most threatening risks in wheat production were either natural or of economic nature and the most important strategies taken to confront them were either technological or financial ones. Correlational analysis revealed that there were significant relationships between a farmers' capability in risk management and his educational standing, his attitude towards risk, crop yield per unit land, level of land under wheat cultivation, total area of the cropping land, wheat marketing value, frequency and extent of consultation with agricultural experts and TV programs. So the main aim of this study was the analyze of the effective factors on risk management among the wheat farmers in the Razavieh region of Khorasan-E-Razavi (Iran); and the special objectives of this study consist of the following:

Description of the personal and professional characteristics of respondents,

- determination of the degree of respondents' risk-aversion;
- Ranking amount of the use of risk management methods in wheat production, among the respondents;
- Determination of explanatory factors in wheat production management, among the respondents.

Material and methods

This study in terms of purpose was applied, in terms of the extent and the control degree of variables was a field-work and in terms of the collecting data method was a descriptive-correlation research which was designed and conducted in Iran (Razavieh region in Khorasan-E-Razavi province).

Statistical population of the study was 1520 persons that included all wheat farmers of Razavieh region that they had water cultivation. By using of stratified proportional random sampling and Cochran formula, 156 respondents were selected from 8 villages and for data collection, used of interview method. Razavieh region of Mashhad city consisted of 75 villages that this first, eight index villages were selected by dividing the Razavieh region into four parts: south, north, west and east parts. In the next stage, the respondents were chosen and studied randomly from each village in proportion to the wheat farmers' population. The research tool was a questionnaire includes 63 items that 12 questions are about individual features; 19 questions are about factors that determine the risk-aversion and 24 questions were about the wheat farmers' opinion of the relationship with the extent of the variant methods use in the risk management of the wheat production in the region. Deliberate items and independent variables of the study were compiled in a series of regular expressions, with a specific order and equal rhythm on a Likert scale of none to very high range (score 0 to 5). Other items (8 items) because of other purposes were presented open and two-dimensional in the questionnaire.

Considering that some parts of the questionnaire, according to the research topic, included some new questions that required explanation to the wheat farmers. So in order to complete each questionnaire, the interview method were used to be sure that there was no ambiguity for the wheat farmers. To determine the validity of the questionnaire first 30 questionnaires were handed out among the wheat farmers who were out of the sample study and validity of the questionnaire indices were found by using of Cronbach-Alpha coefficient, higher than 0.7, that was a reason for suitability of the research's material. The face validity of the questionnaire was confirmed by a panel of faculty members of agricultural extension and education and agricultural experts of region. To measure the effect of risk willingness on famers' decision and determination of the risk-aversion degree in output production, the Safety First Rule model were used. This model is one of the rules that discuses in relation to risk willingness of the wheat farmers. According to this rule, the beneficiaries take actions to choose a technology and apply it in the production of input just when they feel comfortable and have confidence on providing their own living needs. Randhir (1997), Parikh & Bernard (1988), Sekar & Ramasamy (2001), Rostami (2004) and Ajetomobi & Binuomote (2006) used this method in their surveys in order to determine the risk-aversion degree of farmers.

In this model:

- $R_j = [E^*_j - E_j]/[S_j]; \quad j = 1, 2\ldots, n$
- R_j: Risk-aversion degree of wheat farmer (j)
- E^*_j: Critical income level of wheat farmer (j)
- E_j: Expected income of wheat farmer (j)
- S_j: The standard deviation of the wheat farmer (j)'s annual income (in the past three years of agricultural and non-agricultural sites)

The standard deviation of the household's income were obtained according to the household's approximate income from agriculture and non-agricultural sites in the past three years (data extract from formal documents of Agri-Jihad organization in region). The reason of selecting these three years was avoiding from the standard deviation obliquity as a result of the respondents' forgetfulness.

- E* = 152950 (FAM - CHI / 2) + DPT – (UAR +UAR')
- E = VP (1 + DMG) – TC

The weighted crop damage variable was defined as:

$DMG = (\sum K_i DMG_i)/\sum Ki$

DMG is the weighted crop damage variable. This was obtained by enquiring how much they perceived to have lost due to the adversity by giving prices of the crops as weightages (Ki) (Sekar and Ramasamy, 2001). In other hand, it is believed that regression weights will show the relative importance of the crop damage variable. It is the shadow value of yield loss, and the weighted crop damage would yield unexpected total damage for

each farm (Parikh and Bernard, 1988). The parts of the above-mentioned formulas are as the following:

- 152950: The per capita cost of supplying the least calorie supply in one year (The standard rate in Iran).
- FAM: The user household size.
- CHI: Number of children (at least active members of the family in the work of agricultural).
- DPT: The amount of farmer's debt to formal and informal institutions in terms of Rial (The unit of Iranian currency).
- UAR: The beneficiaries' annual income from sites other than farmlands in terms of Rial.
- UAR': The beneficiaries' annual income from sites that was based on non-agricultural sites in terms of Rial.
- VP: Total value of wheat production in terms of Rial.
- DMG: The proportion of farmer's damage due to losses and abnormal incidents as a weighted average.
- TC: Total wheat production cost in terms of Rial (in the same year).
- The risk-aversion coefficient degree calculated in this study (table 1) is between -1 to +1 which is as the following:

$0.1 \leq R_j \leq 1$	$-0.1 \leq R_j \leq 0.1$	$-1 \leq R_j \leq -0.1$
farmer of risk-taker	farmer of risk--neutral	farmer of risk--averse

Table 1: Exposition of risk-aversion coefficient degree.

Findings

Personal and professional characteristics of the respondents

The most age frequency of the respondents was (43 percent) between 51 to 60 years old. With a view to the gender of the respondents, 84.5 percent were men and 15.5 percent were women. The most Literacy rate frequency of the wheat farmers were secondary education level and they were 33 percent of the sample and also 21 percent of wheat farmers were illiterate and only 9 percent of statistical community had a degree higher than diploma. The most experience of wheat cultivation among the respondents was between 21 to 30 years and in view of the marital status 83.3 percent of respondents were married and the others were single. The most frequency of duration of familiarity with the extension services was between 5 to 10 years and on the average more than 83 percent of respondents went to the extension services centers fewer than six times annually. Also, with a view to the extent of farmlands, the highest frequency was related to the farmers who had 4 to 7 hectare. The most experience of farming among the respondents were 31-40 years. The average amounts of farmlands were 1.14 hectare.

Risk-aversion degree of respondents

In the table (2), risk-aversion coefficient degree (Rj) was calculated according to the Safety First Rule model. Based on the findings, 65 percent of the respondents in the study were risk-averse, 27 percent were risk-neutral and 8 percent were risk-taker. It seems, recent droughts happened in the past few years have had a direct impact in the risk-aversion nature of the most farmers.

Risk- aversion coefficient	Status of wheat farmers	Frequency	percent
$0.1 \leq R_j \leq 1$	Risk-taker	12	**8**
$-0.1 \leq R_j \leq 0.1$	Risk-neutral	43	**27**
$-1 \leq R_j \leq -0.1$	Risk-averse	101	**65**
Total	-	**156**	**100**

Table 2: Status of the respondents, by the risk- aversion coefficient.

Analysis of correlation between the respondents' individual, farming and economic variables with risk-aversion coefficient

To determine the correlation between independent variables of the study and the wheat farmers' risk-aversion coefficient variable, the Pearson and Spearman correlation coefficients were used. According to the results of table)3(, there was a significant positive correlation between age variables and agricultural experience with risk-aversion coefficient degree in significant level of 1 percent. There was a significant negative correlation between literacy level and the amount of insured lands with risk-aversion coefficient degree in significant level of 1 percent. Also, there was a significant negative correlation between the agricultural annual income, number of agricultural equipments ownership, familiarity with extension services, number of going to the agricultural service centers in month, amount of leasehold lands, total amount of farming lands and amount of under wheat cultivation lands with the risk-aversion coefficient degree in significant level of 5 percent. But there was no significant correlation between number of children variables, amount of private lands, amount of participative lands, amount of lands that should

be shared with others, Total amount of wheat production in the current year, total amount of wheat sale in the current year with the risk-aversion coefficient degree.

The frequency Distribution of the risk management methods in wheat production among the respondents

The mean was used for ranking of factors, to obtain the priority of the different methods in the management of wheat production risks by the respondents in the region. According to the results of Table (4), sale of product to the agents and Short sale of product in the respondents are first and second priorities compared with the use of other methods in management of wheat production risk in the region. But, the amount of applying biological fights against the pests and using of under pressure watering systems were in the last priorities.

The results showed that the items that have earned the highest ranks highlighted the higher priority risks of financial and marketing for farmers in the region of study. Considering lack of proper organization in the market for sale of wheat products in the region, it seems that farmer's financial security has been affected more than the other indicators of risk management. But, the fact that items that have the lowest ranks suggest the poor educational indicators in relation to these in the region exist.

Factorial Analysis of effective factors on the risk management of wheat production among the respondents. The appointed variables were put in the Factor Analysis in order to determine the understanding condition of the wheat production risk among the wheat farmers. The factorial analysis was used to decrease the study variables to fewer factors and to determine the portion of each factor. According to table (5), the amount of KMO was 0.725 and it revealed that the condition of data was appropriate for the factorial analysis. Also the amount of Bartlett's test was equal to 1029.250 that was significant in level of 1 percent. Therefore, data were suitable for factorial analysis.

Variables	Type of correlation coefficients	Amount of correlation coefficients	Sig.
- Age (years)	Pearson correlation	0.386**	0.001
- literacy level	Spearman correlation	-0.512**	0.00
- Annual agricultural income (in Rial)	Pearson correlation	-0.241*	0.022
- Number of children	Pearson correlation	0.156	0.352
- Number of agricultural equipments ownership	Pearson correlation	-0.220*	0.033
- Agricultural experience (years)	Pearson correlation	0.435**	0.00
- Amount of familiarity with extension services	Pearson correlation	-0.311*	0.031
- Number of going to agricultural service centers (monthly)	Pearson correlation	-0.187*	0.011
- Amount of private lands (in hectares)	Pearson correlation	0.443	0.431
- Amount of leasehold Lands (in hectares)	Pearson correlation	-0.317*	0.041
- Amount of participative lands (in hectares)	Pearson correlation	0.154	0.342
- Amount of lands that should be shared with others (in hectares)	Pearson correlation	-0.353*	0.124
- Total amount of farming lands (in hectares)	Pearson correlation	-0.191*	0.020
- Amount of under wheat cultivation (in hectares)	Pearson correlation	-0.246*	0.015
- Amount of insured lands (in hectares)	Pearson correlation	-0.477**	0.00
- Total amount of wheat production in the current year (in hectares)	Pearson correlation	0.654	0.466
- Total amount of wheat sale in the current year (in Rial)	Pearson correlation	0.435	0.146

Table 3: Correlation coefficients between individual variables and the respondents' risk-aversion coefficient degree.

Risk factors	Amount of using different methods in risk management of wheat production											
	Very rarely		Rarely		Occasionally		frequently		Very frequently		Mean	Rank
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent		
Sale of product to the agents	0	0	0	0	2	1	16	10	138	89	4.73	1
Short sale of product	0	0	0	0	12	8	11	7	133	85	4.66	2
Use of drought resistant varieties	0	0	0	0	12	8	24	15	120	77	4.49	3
Planting of varieties with short growing period	0	0	16	10	0	0	34	22	106	67	4.26	4
Use of appropriate fertilizers to increase soil fertility	11	7	8	5	10	6	3	2	124	80	4.21	5
Observing crop rotation	0	0	0	0	29	19	38	24	89	57	4.10	6
Use of modified seeds	8	5	10	16	15	10	45	29	78	50	4.03	7
Use of governmental												
Loans	21	13	0	0	12	8	63	41	60	38	3.68	8
Use of appropriate pesticides to fight with pests	0	0	6	3	45	29	29	19	76	49	3.55	9
Use of appropriate herbicides to fight with weeds	0	0	24	15	32	20	44	29	56	36	3.45	10
Sale of product to cooperatives	0	0	25	16	34	22	38	24	59	38	3.27	11
Making of planting diversity	21	13	23	15	60	38	12	8	40	26	3.23	12
Participating in the extension classes	8	5	29	19	38	24	40	26	41	26	3.21	13
Action to leveling the under cultivation lands	24	16	2	1	51	31	34	22	45	30	3.14	14
Action to drainaging under cultivation watery lands	45	29	20	13	21	13	29	19	41	26	3.12	15
Insuring the crop	3	2	76	48	40	26	0	0	37	24	3.08	16
Use of non- governmental loans	24	15	33	21	0	0	56	36	43	28	2.76	17
Cultivation of wheat in different parts with a view to fertility	11	7	34	22	45	29	43	28	23	14	2.64	18
Use of Zinc Phosphate (Rodentiocide) to fight against rodents	78	50	33	21	24	16	11	7	10	6	2.43	19
Participatory cultivation	69	44	33	21	34	22	20	13	0	0	2.23	20
Use of disinfected and sifted seeds	15	10	88	56	53	34	0	0	0	0	2.15	21
Use of windbreak to prevent from stem lodging	70	45	0	0	37	24	33	21	16	10	1.98	22
Saving (having liquidity)	77	49	33	21	23	15	11	7	12	8	1.95	23
Use of under pressure watering systems	111	72	10	6	5	3	13	8	17	11	1.77	24
Biological fight against the pests	120	77	24	15	12	8	0	0	0	0	1.58	25

Table 4: Frequency distribution of the risk management of wheat production methods among the respondents.

To determine the number of factors in this study based on the Kaiser Criteria, just factors were accepted that their eigenvalues were larger than one. So, five factors were extracted that their eigenvalues were larger than one. In table (6), there are the number of extracted factors associated with their eigenvalues, the variance percentage of each factor and the cumulative frequency of variance percent.

In the next step, the factors were rotated by the Varimax method, and the variables related to each factor were identified, and finally the obtained factors were named that are perceived in the table (7). Generally, all the five mentioned factors have been able to explain 74.268 percent of total variance of the variables. The five factors including economic and marketing management, planting management, harvest management, infrastructure management of farming and risk-sharing management. Also, According to the results of the table 6 (the percentage of variance), the first factor is the most important effective factor.

KMO	Bartlett's Test	
	Coefficient of Bartlett test	Sig.
0.725	1029.250	0.00

Table 5: The amount of KMO and Bartlett's Test results.

Component	Eigenvalues	% of Variance	Cumulative %
1	4.812	21.314	21.314
2	3.371	19.515	40.829
3	3.218	16.243	57.072
4	1.575	9.643	66.715
5	4.831	7.553	74.268

Table 6: Factors from factorial analysis of risk management in the wheat production among the respondents.

Factor	Variables	Factor loading
Economy & marketing management	Short sale of product	0.895
	Sale of product to the agents	0.864
	Sale of product to cooperatives	0.738
	Use of governmental loans	0.683
	Use of non-governmental loans	0.663
Planting management	Use of drought resistant varieties	0. 874
	Planting of varieties with short growing period	0.741
	Use of modified seeds	0.691
	Use of disinfected and sifted seeds	0.641
Harvest management	Use of appropriate fertilizers to increase soil fertility	0.769
	Use of appropriate herbicides to fight with weeds	0.757
	Use of appropriate pesticides to fight with the pests	0.698
	Use of Windbreak to prevent from stem lodging	0.675
	-Use of Zinc phosphate (Rodentiocide) to fight with rodents	0.638
infrastructure management of farming	Observing crop rotation	0.736
	Use of cultivation diversity	0.727
	Action to drainaging under cultivation watery lands	0.603
	Action to leveling the under cultivation lands	0.579
Risk-sharing management	Insuring the crop	0.762
	Participating in the extension classes	0.652
	Participatory cultivation	0.523

Table 7: Specifications of extracted factors, by factorial analysis.

Conclusions

This study was about the analysis of factors affecting wheat production risk management among the wheat farmers in Razavieh region of Khorasan-E-Razavi province. Results of calculating the coefficient degree of risk-aversion were indicated that the most of wheat farmers (65 percent) were risk-averse. It seems that, according to the recent droughts and numerous psychological and financial damages, most wheat farmers in the region are averse to accept risk conditions and prefer to be careful and conservative in the cultural activities. Under such circumstances, investigation of the psychological causes of risk-aversion and the solutions to adjust them in the region and the compilation of executive directions in order to present a guaranty that support the wheat farmers in confronting with drought and economic critical conditions and a comprehensive use of crop products insurance in the region.

Results of correlation analysis between the independent variables in the study and the amount of wheat farmers' risk- aversion indicated that the younger wheat farmers who had more income, farmlands and higher literacy rate are more ready to accept more risk factors and implementing programs related to risk management. Also, wheat farmers with more rentable lands were looking for a way to get the maximum benefit and are ready to accept risks. Provided that farmers with more agricultural experience have more risk-aversion. It is necessary to, mention that the familiarity with the agricultural extension services was effective on the acceptance of wheat production risks. According to farmers with insuring land accept more risks for wheat cultivation activities, it seems that the planning of the agricultural extension services center in region for promote agricultural awareness and give more cognation had a necessity as compared with the benefits of insuring wheat product. The risk-aversion of wheat farmers in the study, revealed the necessity of holding extension classes and other extension methods in order to improve the wheat farmers' positive view to accept technologies that need wheat production risks.

According to the results of factorial analysis, factors that determine the risk management of wheat production risk among the wheat farmers were summarized in five factors including economic and marketing management, planting management, harvest management, infrastructure management of farming and risk-sharing management that explained 74.268 percent of effective factors on the risk management of wheat production among the wheat farmers. The economic and marketing management factor in the wheat production is the most important factors among the above-mentioned factors. Therefore, it is proper to pay attention to the composition of agricultural extension plans by the deliberate marketing extension methods of wheat production sale in the region and to be done by the assist of agricultural extension services center in order to compensate some parts of wheat production risks in the region.

Therefore, there are some effective suggestions in order to promotion of risk management of wheat production among the wheat farmers including: the development of appropriate agricultural technologies, decreasing risks, strengthening governmental supports from the aspect of credits and loans, allocation of supportive subsidization to the poor wheat farmers, correction of administrative and legal process of having loan by the wheat farmers, reinforcement and supporting of cultural products insurance case in the wheat cultivation, purposeful leading the training of the wheat controllers in the region about the risk management, methods for preventing and controlling them, and also paying attention to the awareness programs of wheat farmers in the region related to the insuring farmlands.

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References

[1] Ajetomobi J.O. & Binuomote S.O. (2006). Risk Aversion among Poultry Egg Producers in Southwestern Nigeria. International Journal of Poultry Science, Vol. 5, No. 6, pp. 562-565.

[2] Akcaoz, H., & Ozkan, B. (2005). Determining risk sources and strategies among farmers of contrasting risk awareness: A case study for Cukurova region of Turkey. Journal of Arid Environments, Vol. 62, No. 4, PP. 661-675.

[3] Falco, S. D., & Perrings, C. (2005). Crop biodiversity, risk management and the implications of agricultural assistance. Ecological Economics, No. 55, pp. 459-466.

[4] Meuwissen, M., Huirne, R., & Hardaker, J. B. (2001). Risk and risk management: an empirical analysis of Dutch livestock farmers. Livestock Production Science, No. 69, pp. 43-53.

[5] Moghadasi R., & Yazdani, S. (1997). Studying the Factors of Risk: (a case study of Potatoin Feridan Isfahan). Journal of Agricultural Economics and Development. Vol. 4, No. 2, pp. 45-58.

[6] Parikh, A., & Bernard, A. (1988). Impact of risk on HYV adoption in Bangladesh, Agricultural Economics, Blackwell, October, Vol. 2, No. 2, pp. 167-178.

[7] Randhir, T. (1991). Influence of Risk on input use in south Indian tanked fakes, Indian journal of agricultural economics, Juan and March, Vol. 46, No. 1, pp. 52-83.

[8] Roosta, K., Hoseini, F., Chizari, S. M., & Hoseini. M. (2010). A Study of Factors that Affect the Capability of Farmers in Risk Management (Case Study: Wheat Producers in Khorasan-E-Razavi Province). Iranian journal of Economics of Agricultural Research and Development. Vol. 40-2, No. 3, pp. 129-144.

[9] Rostami, F., Shabanali Fami, H., Movahhed Mohammadi, H., & Irvani, H. (2005). Risk management of wheat production in domestic beneficiary system (the case study: Harsin region in Kermanshah province). Journal of Iranian agricultural science, Vol. 37-2, No. 1, pp. 93-106.

[10] Rostami, F. (2004). Risk management of wheat production in domestic beneficiary system. Thesis of M.Sc. in rural development field, College of agricultural economics and development, Iran, Tehran University.

[11] Sandmo, A. (1977). On the Theory of the Competitive firm under price uncertainty, the American Economic Review, Published by: American Economic Association, Vol. 61, No. 1, pp. 65-73.

[12] Sekar, I., & Ramasamy, C. (2001). Risk and Resource Analysis of Rainfed Tanks in South India. Journal of Social and Economic Development. No. 3, pp. 208-215.

[13] Sonkila, S. (2005). Farmers' Decision – Making on Adjustment into the EU. Helsinki: USA. Manual report. pp. 56-77.

[14] Tyraei Yari, N. (2002). Personality factors influencing risk insurance plans accepted postulates in agricultural products by beneficiaries of Khozestan province (Iran). Thesis of M.Sc. in agricultural extension and education field. Department of Agricultural Extension and Education, Tarbiat Modarres University.

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Assessment of agricultural land fund in the Czech Republic, importance and future

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Abstract

Assessment of land depends on the production function of soil and additional connections given by environmental requirements, by the evaluation of public goods or by the requirements for formation a fair tax policy and even by the interests of landowners. Analysis of coherences during the soil appraisal shows a relatively strong dependence on the development of year-by-year yields and cost including subsidy policy, which is strongly reflected in the grasslands. Development of subsidies does not basically influence a long-term return and costs ratio for the production on arable land. The requirements for formation of prices are given due to the need for stability of the mutual relations between the quality of soil and climatic conditions, which manifests itself mainly in land consolidation or the categorization, useful for example for the determination of LFA. The comprehensive solution provides a system of land evaluation by cost-revenue relationships, which includes evaluation of environmental context on the base of the assessment of physical characteristics of soil and economic contexts in BPEJ categorization. The development of value system relations according to the proposed annual gross rental effects (HRRE) shows a relatively stable assessment of land fund for arable land. The adjusted system of land value permits preferably to express a pointed value of land, which corresponds to the trend of a points system of VÚMOP. The actual current rating BPEJ is proposed to make in dependence on the level of market prices to a one point. Due to the different trends in the market prices of arable land and grassland is proposed to introduce a separate assessment of arable land and grassland.

Key words

Soil evaluation; land value; production functions.

Anotace

Oceňování půdy závisí na produkční funkci půdy i dalších souvislostí daných environmentálními požadavky, oceněním veřejných statků nebo požadavky na tvorbu spravedlivé daňové politiky i zájmu vlastníků půdy. Analýza souvislostí při ocenění půdy ukazuje na poměrně velkou závislost ceny na vývoji ročních výnosů a nákladů a na dotační politice, která se silněji projevuje u travních porostů. Vývoj podpor však zásadním způsobem neovlivňuje dlouhodobý poměr výnosů a nákladů na výrobu na orné půdě. Požadavky na tvorbu cen jsou dány především potřebou stability vzájemných relací mezi kvalitou půdně-klimatických podmínek, která se projevuje zejména při pozemkových úpravách nebo při kategorizaci území, využitelné například pro LFA. Komplexní řešení nabízí systém hodnocení půdy podle nákladově-výnosových vztahů, který v sobě zahrnuje ocenění environmentálních souvislostí na základě vyhodnocení fyzikálních vlastností půdy a ekonomických souvislostí v kategorizaci BPEJ. Vývoj hodnotových vztahů podle navržených hrubých ročních rentních efektů (HRRE) ukazuje poměrně stabilní hodnocení půdního fondu pro ornou půdu. Nastavený systém hodnoty půdy je nejlépe vyjádřit bodovou hodnotou půdy, které trendově odpovídá relacím podle bodového systému VÚMOP. Vlastní aktuální hodnocení BPEJ je navrhováno provést v závislosti na úrovni tržních cen k jednomu bodu. Vzhledem k rozdílnému vývoji tržních cen orné půdy a travních porostů je navrženo zavést samostatné ocenění orné půdy a travních porostů.

Klíčová slova

Ocenění půdy, hodnota půdy, produkční funkce.

Introduction

Agricultural land fund is characterized by multifunctionality of its importance for the agriculture and society. The basic function of the agricultural land is its productive character for agricultural production, which is its primary value level from the point of economic relations given by the supply and demand for agricultural products. In terms of society-wide interests, the additional functions of agricultural land are more and more enforced, mainly resulting from the role of agricultural land for landscape maintenance. This role becomes particularly relevant in the context of the declining primary profitability of agricultural commodities given by the productivity of crops based on production costs and sales prices, as well as by increasing levels of social supports. In this context, grassland is an important component which is very sensitively perceived mainly because of the organic character of production and with regard to the economic system of animal production. Another important point can be seen in the demands for soil protection against various degradation factors. Overall, then decrease of suitable land for intensive agricultural production and increase of the areas which are enforced by various protective measures, with increased costs for growing crops.

As a consequence the situation leads to social requirements for security coverage of corresponding costs. The newly formed constraints are evaluated as the production of public goods, including financial support. If we want to evaluate land according to economic indicators, then the question arises of a philosophy of land value and the impact of the assessment in particular on long-term nature of its evaluating influences. This creates prerequisites for long-term shift in values. The resulting disproportion between the perception the quality of agricultural land as a production factor and the perception of land value as the value of public goods is reflected potentially even in its own pricing of land. It is necessary to answer the question whether and how support can be used to determine a land price according BPEJ and what is their role in the definition of other functions in society. Next questions as follows: (1) According to what land value has to be set, in case it has to be set; (2) What land value could be used for example for the implementation of comprehensive land consolidation or compensation for the removal from agricultural land? (3) What land value can be used for the evaluation of land ownership? (4) Is it necessary to distinguish between the land value including the calculation of public goods and without it, so particularly with the value of permanent cover of permanent grassland and with arable land, or take into account an universal assessment?

State of land evaluation by BPEJ

Qualified soil-ecological units (BPEJ) were established in 80th years of the last century primarily as a management tool in agricultural policy and reflected the quality of soil, based on the description of the major soil units, the inclusion of climatic regions and according to the configuration of land parcel due to slope, exposure, depth of soil and skeleton (Klečka [4], Mašát [7]) in the system of costs and revenues on agricultural production. The primary assessment of soil was based on a broad database of approximately 5000 plots monitored for 10 years. The assessment was regularly updated (Němec [8], Štolbová [13]), but primarily on the basis of expert assessments and global price parameters. A specific problem is the evaluation of agricultural crops, which is narrowed down to two types of land - arable land and grassland respectively. The introduced use was took into consideration in the price list of arable land itself and of permanent grassland (Regulation 316/1990Coll.). In 1994, the assessment of both cultures is merged by Regulation No. 178/94Coll. At this time there were not introduced any specific payments to any individual culture and current monitoring had not any essential reason.

Lack of the accuracy and reliability of the classification, especially concerning plots with a smaller acreage, when defining and mapping BPEJ during the time of the development of large scale agricultural production there were established and for this purpose used implementation methodology, outputs and purpose-build interpretation. For example areas smaller than three hectares were mapped in case of they had strongly contrasting character and their area was at least 0.5 ha. At the same time the contrasting character was considered the difference of five degrees of a slope difference in skeleton, texture and soil depth of at least two categories, waterlogging of land, etc. Flat projection of under limited shapes (smaller than 0.5 ha) were drawn into the maps by a mark.

BPEJ were maintained for evaluation of agricultural land even in the current system. BPEJ is still updated by the reclassification of “Soil-Ecological Bonity Units” (BPEJ) and for more accuracy which suits better to the new ownership relations and economic conditions of small farms. The original intention to establish a tax liability of the owner or a user failed to fulfil with regard to a need to simplify orientation in the system as well as some unresolved technical

problems at locating of BPEJ and thus started the calculation of the tax from the parcel according the average price BPEJ of land in the cadastral area. Use of BPEJ for economic purposes is reflected in the Act on prices and its implementing regulations. For the update of official prices of agricultural land, ÚZEI provides the documents and statements and are used in all cases where is impossible to use an individual (market) price of land, particularly for:

- Determining the real estate tax, (land tax),
- Calculation of the inheritance tax, gift tax and real estate transfer tax,
- Payment of income taxes for physical person, if the agreed price is lower than the price according the price regulation,
- The determining the price of a parcel during its appropriation for public purposes,
- Exchange of land plots during the comprehensive land consolidation,
- Determination of payments for withdrawal of agricultural land from agricultural production
- Determination of the estate in the application of the Act on Bankruptcy and Settlement,
- Design and budget activity,
- Regulating the use of agricultural land (putting land aside, conversion to other land types, etc.).

The actual official price is normatively fixed price based on the capitalization of rental effect (net income) determined for individual BPEJ according to 13 selected crops. Prices are for 2199 BPEJ in the CR updated by prising regulations to the Act No. 151/1997 Coll., about appreciation of the property and about the change of some laws (Act on Property Valuation). BPEJ are independently measured by rate CZK/1 m2. The price of land is formed in the part of achieved negative rental effects on the base of the assumption that the price of land must not fall below 5000 CZK/ha, the amount was later adjusted to 10 000 CZK/ha. Methodology for current pricing and value of agricultural land was described by Němec [8] and Štolbová [13]. Gross annual rental effect (HRRE) represents the difference between the normative values of production from 1 ha in CZK in the given structure of the crops and hectare yields, and the sum of inputs for their production. The current method of determining revenues and expenses is based on the factors given by configuration of plots, i.e. slope, exposure, depth of soil and skeleton. To indicate a production capacity of the soil are used in determining HRRE yields of main agricultural crops grown in the country. The crops grown on arable land are wheat, rye, barley, oats, grain maize, sugar beet, potatoes, oilseed rape, corn silage and perennial forage crops on arable land, that representing an area of more than 90% of the total arable land in the CR [18]. There is also evaluated permanent grassland on areas, which do not meet the requirements for environmental and economic management. Yields of main agricultural crops, including grassland are expressed for BPEJ suitable for their cultivation on the base of results of long-term monitoring of the impact of soil and climatic conditions on crop yields. At the same time are determined and applied coefficients for reducing the basic yields in the case of skeleton soils, slopes, and for their exposure to the south in the warm, dry regions and to the north in the cool, humid regions. Historically BPEJ were used in the sense economically necessary costs and revenues for the evaluation of companies in order to determine the support. These subsidies were not included in the measurement, otherwise it would not be possible the evaluation for the purpose of the support to be used. A similar importance is the assessment of land for the purposes of the LFA, which also includes the need for an objective assessment of economic conditions for business on agricultural land without any support. The problem with valuation of the current value of land is primarily in their use for tax and other purposes in case of application of the Act on prices, when prices are prices BPEJ used for property purposes. Market prices of agricultural land form an additional component of land evaluation, because, on contrary to the original pricing BPEJ now incorporate an influence of capitalization of subsidies and other effects of the investment behaviour of landowners. Gradually are formed four key levels for the assessment of land:

- **evaluation to determine the primary efficiency of agricultural production**, represented primarily by local needs of complex landscaping and objective values for evaluation of firms in relation to the possible need for the determination of the objective amount of a subsidy
- **evaluation for the need of soil conservation**, which is represented mainly by levies rates for agricultural land and for need of environmental payments
- **evaluation for the need of public goods, which to some extent penetrates environmental constraints and the LFA, but may have a relationship with the value of the landscape**
- **evaluation for property needs of landowners, fiscal and administrative value for the needs of the state, which is based on current market prices and yield prices**

From this list it is clear that a universal price list and the philosophy BPEJ is possible to realize in a very difficult way, it is necessary to set up a system that will be coherent and its target will meet the abovementioned needs.

The main research questions then are:

Can have a system of land assessment for the above mentioned purposes a common basis?

Is BPEJ and its economic evaluation an universal base suitable for the assessment of land?

Can be set an objective economic rate of return price BPEJ without influence of subsidies?

How to update the assessment?

1) Common approach

Basis for all purposes of land evaluation is possible on the basis of common features that can be expressed in the requirements for a stable system without major changes in the short term, the possibility of quantification of value relations, sufficient accuracy for the need of the abovementioned objectives. In consideration according FAO (2007) seem to be: evaluation of soil fertility in accordance with soil physical parameters (Fertility Capability Classification FCC, Sanchez [14]), evaluation of soil productivity in relation to yields of crops, evaluation of soil potential rating classes (depending on income, expenses on technology and the impact on social, economic and environmental values), subjective scoring of land with regard to individual land factors (Land evaluation and Site assessment LESA, presented by Wright, Young, Googins [19]), agro-ecological zoning (AEZ) described by Arshad and Martin [1] . These methods are further extended for the needs of farm systems (Land evaluation and farming system analysis - LEFSA etc.), Sustainable Land Management (SLM). Despite the relatively rich amount of methods for the land evaluation remains unresolved problem the own focus on the assessment according to economic output or by other indicators, and both systems have their positives and negatives. A fundamental attitude to this choice comes from the majority need on the proposed system if that should be used to evaluate production or in environmental context. Methodology for land evaluation is described in many other works, mainly by FAO, most methods to explain or predict the use potential of land describe Van Diepen et al., 1991 [15, 16]. The theoretical framework for land valuation, which is used also in the Czech Republic, analyse Rossiter [11,12]. Agro-environmental indicators are still more accepted in land valuation. The main challenger is given by Bruyas, Kayadjanian, M. & Vidal [2], and OECD [10]. Evaluation methods should take into account a range of objectives covering both local and global effects [20].

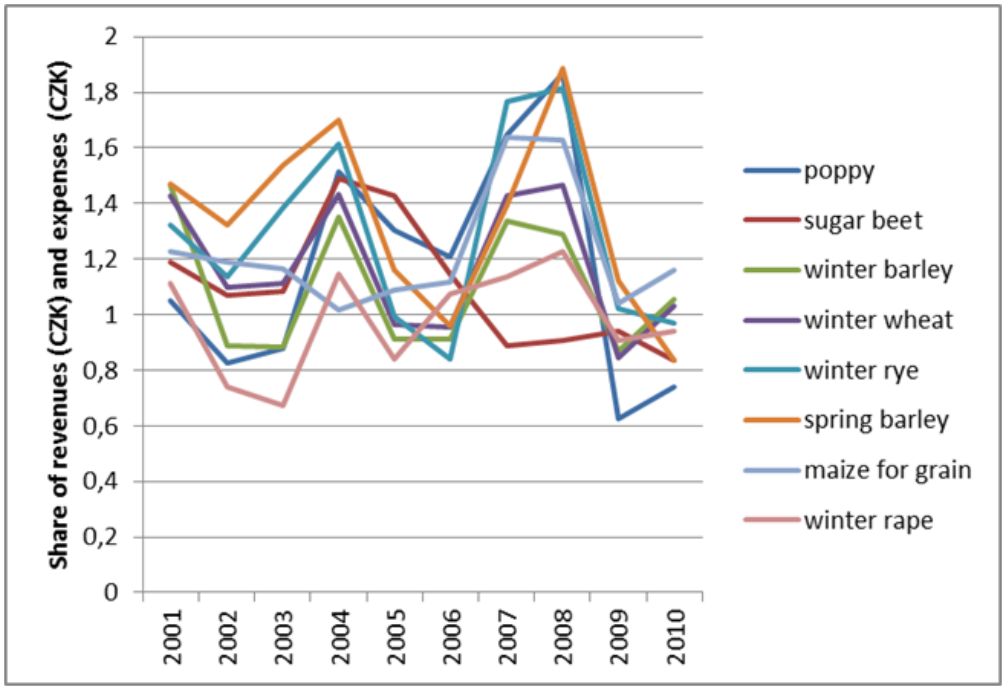
In the Czech Republic the evaluation was implemented in compliance with reached revenues and expenses (gross annual rental effect HRRE) and produced energy of the production process, which had been performed by VÚMOP in the early 80's (Novák [9]). The biggest advantage of the economic evaluation of land according to revenues and expenses is the possibility to set of value relationships based on objective economic calculation. In contrary there is instability of assessment based on current prices relations. Figure 1 shows the evolution of revenues and expenses of farms in the last ten years. From the course it is obvious a cyclical development of achieved prices.

Figure 1 follows that the heterogeneity of the results of each year in the absolute level of cyclic, but with the exception of maize grain the internal relations between crops remain essentially preserved. The comparison reveals even smaller differences between the profitability of the individual crop production in the last two years.

The absolute value of rental effects is influenced even the support of agricultural production, which forms an increasingly important item among individual years. Figure 2 is mentioned a comparison of the absolute size of the production subsidies by the each pillar of agricultural supports. By a comparison of both graphs follows that the absolute size of the supports has not a basic impact on the profitability of production, because it itself is adjusting market value of inputs and outputs. However the size of the aid is significantly reflected in the level of achieved rental effects without subsidies that reach mostly negative values.

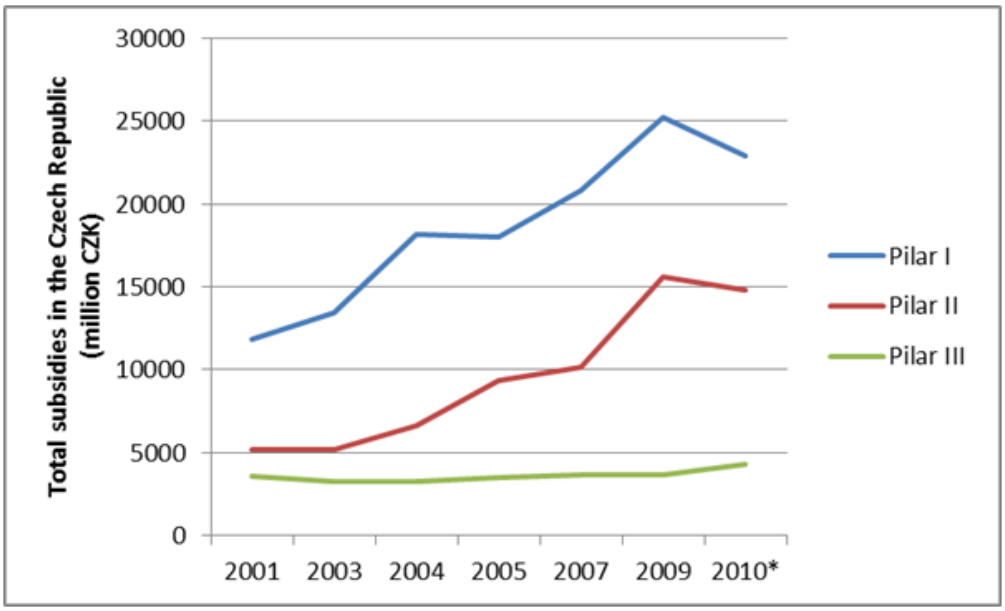
A distinctive significant impact on the development of internal relationships among BPEJ has however a relationship between the profitability of production on arable land and grassland, which is shown in Figure 3.

From the development are noticeable distinct trends of the growth of the price level of arable land compare to grassland. Market prices are derived from development in market prices of the Land Fund of the CR achieved sales of land under § 7 of Act No. 95/1999 Coll. as amended, by which was not put in the effect the thirty years instalment. At the beginning of the sales the prices reflected the price according to the calculated rental effects, but next further and quicker development of market prices of grassland was going on. In relation to agricultural policy a different development HRRE



Source: Expense survey ÚZEI.

Figure 1: Development of revenues and expenses of the main agricultural crops on one ton of a product.



*predicted
Source: ÚZEI.

Figure 2: of the total subsidies from 2001 to 2010.

has an impact on mutual equilibrium of arable land prices and prices of grassland, which are currently being evaluated in some cases, using the percentage of arable land, which represents the degree of extensification given by BPEJ. Percentage of arable land is given by the ratio of arable land to the sum of areas of arable land and grassland and is based primarily on research conducted at VÚMOP in 1990 (Kvítek [5]). The inclusion of this percentage of arable land in the determination of HRRE is potentially causing a different kind of dynamics concerning development of types of parcels directly in the base of evaluation affected by BPEJ. With regard to the current support of grassland, some fundamental changes are seen in the representation of grasslands, which are carrying out dynamically in recent years. Since 1996, grassland area of 81 000 ha has increased,

meanwhile the acreage of arable land decreased by 13 000 ha (source CUZK) . Grasslands are one of the main tools to contend with soil degradation and mainly against water erosion. Support of grassland is necessary for landscape maintenance, but the price of grassland is significantly less dependent on the production capacity of the soil than arable land and is more dependent on the current support. The basic question that should be answered to the above questions is whether the existing system BPEJ can be used both for the evaluation of the economic context as well as for environmental context given by the size of the corresponding restrictions on production. Another issue is to setting of the current assessment of land value.

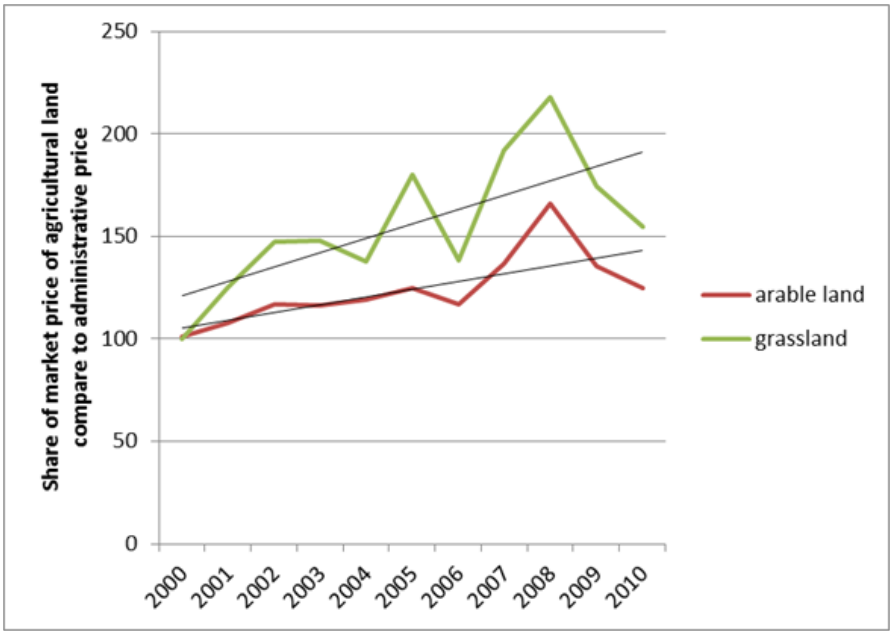
Methods of the proposal of BPEJ assessment

Relation between the agricultural production and the soil protection is the subject of the project NAZV QH72257 and methodology is given by Voltr [18]. Methodology is based on the model relations for expressing soil fertility through the production function according to Dabbert [3]. In addition to understanding the importance of each production factor on revenues and expenses is dealt also the impact of production even on soil compaction, relation to the use of nitrogen as the main component affecting soil productivity and at the same time the rate of the environmental damage and also biosphere levels in the soil given by humus content including biological activity of soil. The extent of erosion was not directly the content of this project, but the evaluation of technological operations for crops and by the inclusion of appropriate crops for the land assessment can be economically evaluated the impacts of measures against erosion on the costs and revenues on BPEJ. In relation to nitrogen as intensification factor can be expressed economic effects of restricting the level of inputs into the soil.

The overall approach to the evaluation of soil can be expressed by the diagram in Figure 4.

Indicators primarily affecting crop yields and costs

The main procedure for the determination of land value lies in the definition of key operating indicators in the production, based on crop production functions and evaluation of the economic impacts by standardized inputs in agricultural production. The proposed functions based on the operational monitoring of land can be extrapolated onto the other conditions of agricultural production, which were not the subject of monitoring. The base is the definition of **physical parameters of soil and properties HPJ, climatic indicators, indicators of crops nutrition, relation to technological processes and the relationship to the land configuration.**



Source: Land Fund of Czech Republic, own calculation.

Figure 2: Profitability of production on arable land compare to grassland.

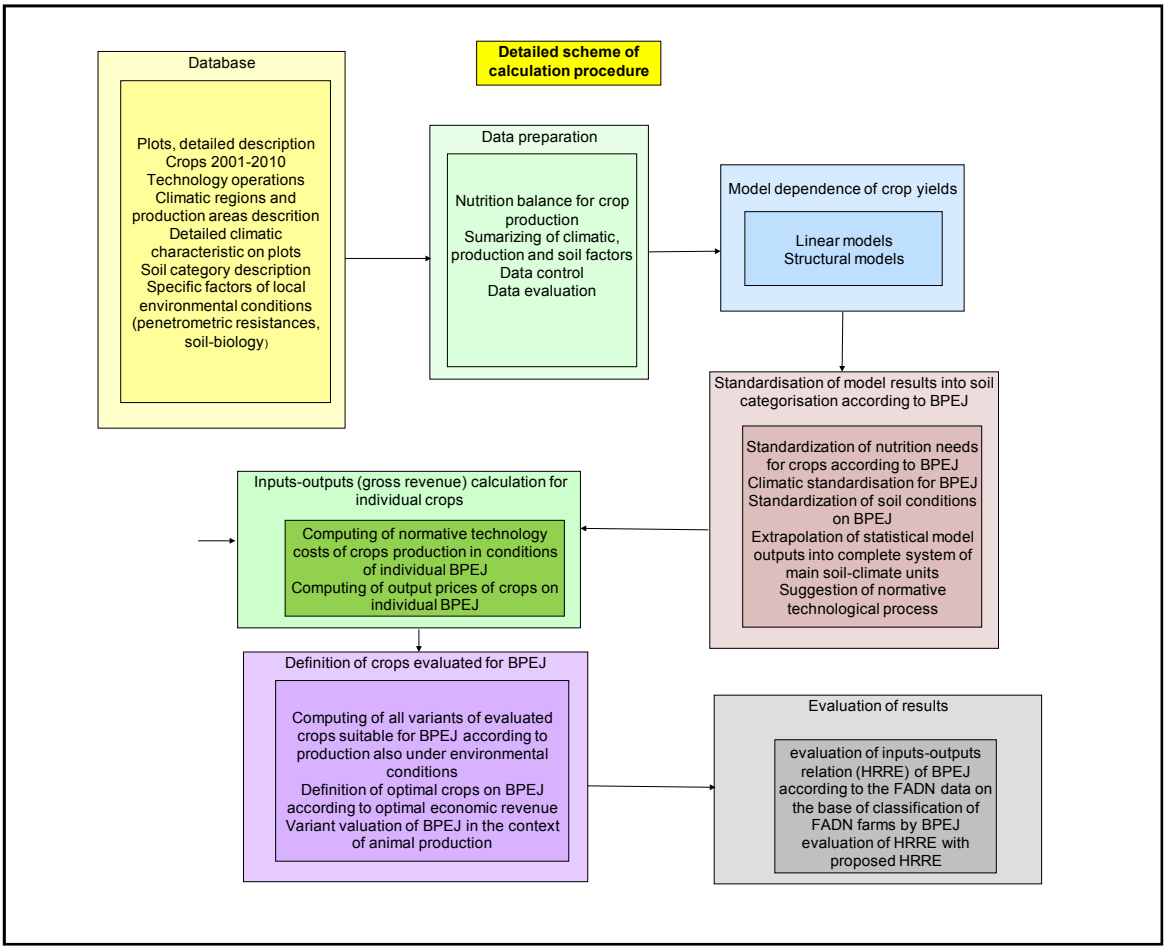


Figure 5: Scheme of the proposal solution of evaluation of BPEJ.

Results

Crop production functions consist of a set of basic models of mutual interaction among the basic variables used to predict crop yields, including the intensification factors, which are mainly a nitrogen dose and intensity of chemical protection. The results of the proposal are assigned to categorization of land according to BPEJ.

Production functions in the complex effect of these given factors including dependence on the dose of nitrogen explain revenues by the significant model, including the individual intensification elements. An example of prediction for winter wheat by climatic region is shown in Figure 5.

Crop yields were found out on the base of the production function coefficients for the standardized values of climatic factors. Due to the scattering of model values were yields adjusted by a maximum of 10% above or below the normative indexed yield on the current average of yields. Alternatively, the yields were estimated by VÚMOP points (Novák [5]). Based on the appraisal of groundwork about yields and assembled normative HRRE were calculated according to a new method of determination of revenues and expenses based in dependence on many items as follows:

a standardized dose of nitrogen fertilizer in the given conditions, and other elements in accordance with the consumption of nutrients by the crops, the number of chemical protection, the corresponding fuel consumption, live work and standardized technological procedures established for the given conditions. These costs reflect the objective conditions including the effect HPJ and soil texture.

Present results of the methodology proposal based on point values calculation HRRE on a point system (Voltr [17]) are shown in Figure 6 for arable land. The results are compared with the corresponding point value according to the data used from HRRE 2004 and with the original point value of VÚMOP. The results show on average a lower point value of arable land compared to the original point value proposal HRRE and VÚMOP. In the presented proposal of points is omitted the sugar beet in the rotation of crops, compared to previous crops the

selection became broader by triticale and poppy due to their area expansion of these crops. In this comparison supports are not considered. The selection of crops used in the proposal correspond to the long term yield and cost relationships in the period 2001-2010 based on the optimal HRRE for a variant proposal of crop representation on arable land (OTS). Different level of points between variants is given mostly by methodology for technology valuation (VÚMOP calculate only outputs) and by evaluation of grassland, because the present score is derived from both uses of land: arable land and grassland. Final relations of BPEJ is subject to final completion of project.

For the calibration of the proposal of evaluation is designed enterprise data analysis based on FADN data link according to the records of BPEJ. For the analysis method was chosen the method of the comparing proposals deviations from achieved reality by HRRE difference and the difference between revenues and expenditures of enterprises FADN. The present results show the legitimacy of the proposed approach, which exhibit the best agreement with the results of FADN network from all of existing valuation methods.

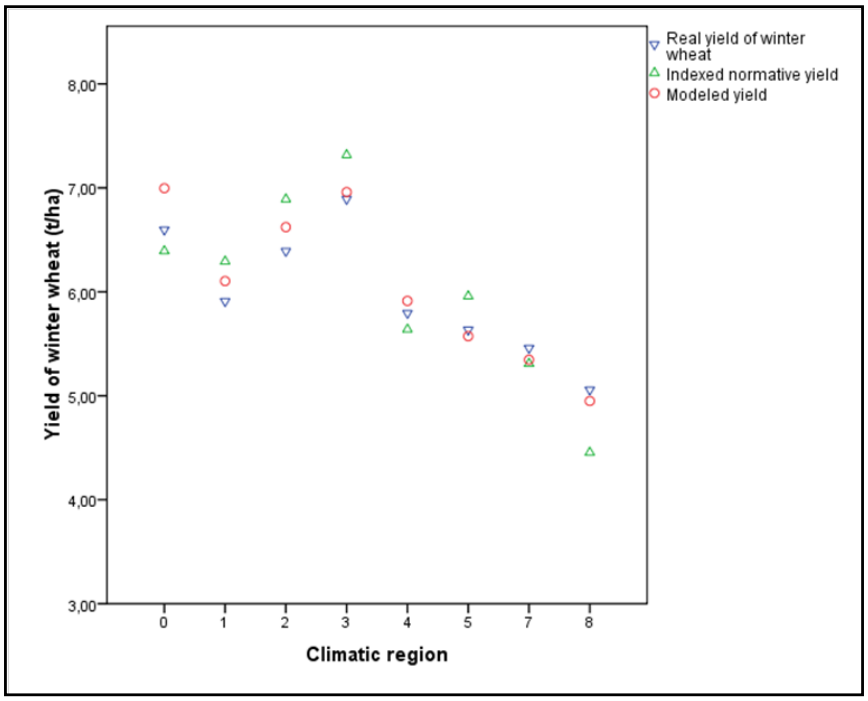


Figure 5: An example of prediction of yield of winter wheat according to climatic region.

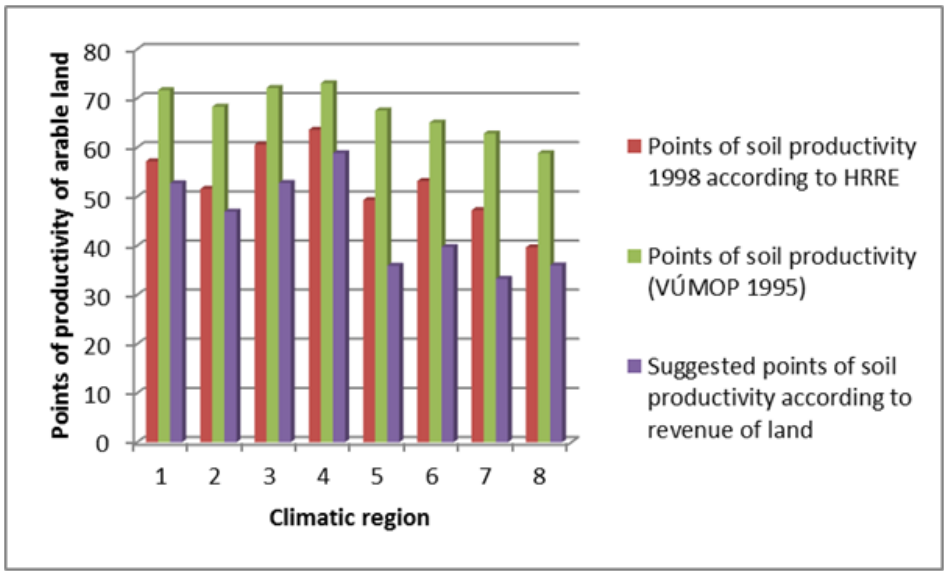


Figure 6: Comparison of point value course of arable land on the base of revenue calculation (HRRE).

Main conclusions for the evaluation of land in the future

Relations between revenues and material inputs to production are determined significantly by production functions that develop very slowly and can be seen in real time as constant. The slow development in time can be estimated on the basis of equivalent land evaluation results according to the VÚMOP method. What is important is the choice of valuated crops, which substantially affect the overall relations within BPEJ. The selection of crops used in the proposal correspond to the long term yield and cost relations in the period 2001-2010 based on the optimum HRRE for the variant proposal OTS.

For BPEJ indicators were found out significant links to the HPJ and the configuration of the terrain for most crops and thus remain an appropriate tool for assessing the relationship to the land. With the regard of demonstrated effect of soil texture on yields is appropriate to take into account possibilities for a better consideration of granularity in the classification of the soil.

Impact of subsidies is mainly seen in the difference in market land prices of grasslands resulting from a differing state subsidy policy in contrary to arable land. Due to potential and existing inequality in the development of prices of both cultures it can recommend their separate assessment.

Real gross annual rental effect from production fluctuates annually due to changes in input prices and output prices. If prices BPEJ should be kept up to date, then they could be proposed the following way:

A) The proposed fixed-point value under existing cost-yield relationship and optimization of representation valuated crops on the base of the stabilized proposed parcels of these crops. To accomplish appraisal of a one point according to the development of market land prices and the found average value of the market price in the current conditions at one point found from the set HRRE. To propose a point value alternatively for the environmental constraints on a parcel, in accordance with the inclusion of soil to the technological restrictions on the land including any possible individual appraisal.

B) Calculation of the corresponding official land prices in a given year, according to a cost-yield relationship under HRRE can be estimated on the basis of:

1. index development in prices of inputs and outputs of monitored crops in a given year with regard to the standardized long-term land price derived from long-term average yields and costs for already assembled crops on BPEJ
2. the annual update HRRE for individual BPEJ including the development of area of evaluated crops. This method of calculation is expected an annual change of terms BPEJ

With regard to the significant time demands and requirements for updating the source values can be recommended the option A. Using the price proposal according the original price calculation methodology in the area of negative rental effects also arises the problem of indexing the proposed prices, which is not possible to do by a linear method due to hyperbolic course of depending on land prices on HRRE in this area, under the previous methodology.

Separate part of the proposed update of BPEJ is also the possibility of using the observed data for modelling of production relations for the central purpose even of the frame business analysis in connection to the LPIS.

Crop production functions in BPEJ system may help by evaluating the impact of environmental constraints.

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References

[1] Arshad, M.A. Martin S.: Identifying critical limits for soil quality indicators in agro-ecosystems. Agriculture, Ecosystems and Environment 88, 2002, p. 153–160.

[2] Bruyas, P., Kayadjanian, M. & Vidal, C.2002. Results of the LUCAS survey 2001 on Land use. Building agri-environmental indicators. Report ot the European Commission.

[3] Dabbert, S.: Ekonomik der Fruchtbarkeit. Stuttgart, Ulmer 1994, 201 s. ISBN 3-8001-4092-6

[4] Klečka, M. et al.: Economic characteristic of soil-ecological bonity units in the Czech Republic. (Ekonomická charakteristika bonitovaných půdně-ekologických jednotek v ČSR). Final report VÚEZVž, 1980, Praha, 65 pp.

[5] Kvítek T. et al.: The principles of delimitation of cultures and use of grasslands in attenuation extensive conditions (Zásady delimitace kultur a využívání travních porostů v útlumových extenzivních podmínkách). VÚMOP, 1994, Praha, 60 pp.

[6] Land evaluation. Towards a revised Framework. FAO, 2007, 107 pp.

[7] Mašát K. et al.: Methodological principles of selection and evaluation of land for economic purposes. (Metodické zásady výběru a hodnocení vzorových pozemků pro ekonomické účely). Final report, 1973, ÚZPP, Praha, 58 pp.

[8] Němec J. (): Bonity and evaluation of agricultural land of the Czech Republic. (Bonitace a oceňování zemědělské půdy ČR), 2001, VÚZE, Praha, ISBN 80-85898-90-X, 257 pp.

[9] Novák P. et al.: Proposal of point valuation of soil. (Návrh stanovení bodové hodnoty půdy). Final report RE 093095002, VÚMOP, 1995, Praha, 13 str. 62 pp.

[10] OECD: Environmental indicators for agriculture. Organisation for Economic Cooperation and Development, Paris, 1999

[11] Rossiter, D.G.: Economic land evaluation: why and how. Soil Use and Management 11, 1995, p. 132-140.

[12] Rossiter D.G.: A theoretical framework for land evaluation. Geoderma, Volume 72, Issues 3-4, August 1996, Pages 165-190.

[13] Štolbová M. et al.: Proposal of innovated valuation profitability of the agricultural area. (Návrh inovovaného ocenění výnosnosti zemědělského území), second part, VÚZE. Annual report of the project No GF 3082, Updating LFA, 2005, Praha, 45 pp.

[14] Sanchez, P.A., Coutol, W., Buoll, S.W.: The fertility capability soil classification system: Interpretation, applicability and modification Geoderma, Volume 27, Issue 4, June 1982, pp 283-309.

[15] Van Diepen, C.A., Van Keulen, H.. WolL J. and Berkhout, J.A.A., Land evaluation: from intuition to quantification. In: B.A. Stewart (Editor), Advances In Soil Science. Springer, New York, 1991, pp. 139-204.

[16] Van Diepen, C.A., Wolf, J., Van Keulen, H. and Rappoldt, C. WOFOST: a simulation model of crop production. Soil Use Manage., 1989, 5: p. 16-24.

[17] Voltr V.: Evaluation of agricultural land fund by point method (Hodnocení zemědělského půdního fondu bodovou metodou). VÚZE, 1998, Prague, 40 pp.

[18] Voltr, V.: Methodology of agricultural land resources valuation with respect to environment conservation. (Metodika hodnocení zemědělského půdního fondu se zohledněním ochrany životního prostředí). Economics of Agriculture, VIII, 2008, No 4., p. 82-89, ISSN 1335-6186.

[19] Wright L. E., Zitzmann, W., Young, K. Googins R.: LESA—agricultural land evaluation and site assessment. Journal of Soil and Water Conservation March/April 1983 vol. 38 no. 2, p. 82-86

[20] Werf, H.V.D., Petit, J.: Evaluation of the environmental impact of agriculture. Agriculture, Ecosystems and Environment 93,2002, p. 131–145.

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Coherent Quantitative Analysis of Risks in Agribusiness: Case of Ukraine

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Abstract

Modern methods of quantitative risk analysis, specifically value-at-risk and expected shortfall approach, provide comprehensive and coherent risk evaluation throughout entire distribution of outcomes and can take agricultural business from the realm of uncertainty to specific, quantified risks. Monte Carlo simulation with autocorrelation of standard deviation shows the best results in risk modeling and is used for this research. The analysis showed that production risk is systemic within climatic regions of Ukraine with coefficients of correlation ranging from 0.25 to 0.85. Yield correlation among crops in several oblasts is low to negative, creating opportunities for diversification. However, positive price-yield correlation is dominant for agricultural products in Ukraine due to high dependency on global prices and a large share of export. It is hypothesized that price-yield correlation is directly proportional to the share of country's international trade in that agricultural product.

Key words

Production risk, price risk, value-at-risk in agriculture, expected shortfall.

Introduction

Risks in agriculture mainly appear as production and price risks. In spite of simple nature, these risks are substantial and can easily make an enterprise unprofitable, especially in developing economies. Agricultural risks are often difficult to quantify due to limitedness of accurate and comprehensive historical data. A combination of modern methods of quantitative risk analysis provides sufficient amount of information on risks for managers and investors managers to make adequate decisions. Ukrainian agricultural sector possesses typical risk features of a developing economy: dependability upon external price fluctuations, lack of technological innovations, high level of internal political and economical uncertainty, and ongoing land reform. Such extreme conditions are well suited for testing innovative approaches in risk assessment.

Material and methods

In the recent OECD[1] research (Antón, 2009), it has been mentioned that downside measures of risk, based on distribution of outcomes, show to be the most effective and accurate for stochastic-like risk factors such as temperature, rainfall, and price fluctuations, which make up production and price risks in agriculture. Arguably, the best approach to measuring downside risk is a modern method of value-at-risk (VaR) which is being actively adapted to agriculture from financial industry. Cotter et al. (2011) apply VaR along with expected shortfall for evaluation of price risk for agricultural products, which are sold on Chicago Board of Trade. Cabrera et al. (2009) measure crop yield risk with conditional value-at-risk to account for cyclical climate dynamics caused by El Nino. Chuan et al. (2010) use VaR method to analyze price risks of fruit markets with different types of distributions. Popularity of VaR approach is explained by its ability to combine all risk factors into one measure, based on portfolio theory. The most comprehensive and profound description of VaR methodology is given by Jorion (2003), including grounds for normal distribution preference. In case of Ukraine, where statistical data is insufficient for any historical modeling, Monte Carlo approach to finding VaR is deemed the most appropriate. Monte Carlo method is used to check accuracy of other VaR measures by Herwatz (2009) and Wong (2010), which makes it inherently superior. In addition, Monte Carlo simulation accounts for heavy tails,

[1]Organisation for Economic Co-operation and Development

which are common in price fluctuations and recent temperature trends.

While price volatility is cyclical and price shocks tend to be repetitive through decades (at least in percentage terms), factors that affect production rapidly change. On one hand, there is global warming that increases temperature swings and alters rainfall cycles, on the other hand, advances in biotechnology bring more resilient to drought sorts of crops. Therefore, when analyzing crop yields, some sort of autocorrelation should be used to account for the changing balance between climate change and technology, as shifts in this balance make volatility a dynamic variable. For this, simple GARCH[2] 1,1 model (Bollerslev, 1986) should suffice, considering that it is implemented into Monte Carlo simulation and calculations may seem tedious as is. GARCH volatility is widely implemented into different approaches of VaR calculations, and as shown by Iorgulescu et al. (2008), it indeed appears to improve accuracy.

Despite being the most wraparound, it is widely accepted that VaR alone does not provide a complete picture about risk as it covers only a part of a distribution, specifically a confidence interval. A tail, which is often heavy and significant, remains outside of VaR's reach. Although a probability of an event happening outside of a reasonable confidence interval is unlikely, in agriculture it represents catastrophic events and risks that they carry. Especially in the light of recent climatic events, such as droughts that regularly set 30-50 year records in various regions (e.g. Russia in 2010, France and UK in 2011), catastrophic risks must certainly be accounted for and given an adequate weight during risk evaluation. Also, Ukrainian government does not provide support to agricultural producers in case of catastrophic events, which makes catastrophic risks even more relevant. To solve this problem, a conditional measure of risk, also known as conditional value-at-risk (CVaR) or expected shortfall (Yamai et al., 2005), is used. Daníelsson et al. (2006) shown that most downside risk measures, including expected shortfall, provide even results as they all interpret heavy tails in a similar manner. It is logical to use expected shortfall with VaR as they complement each other according to Szegö (2002). In case of this research, expected shortfall is defined by arithmetic mean of the tail of the distribution. Combination of VaR and expected shortfall measures make up coherent evaluation of risk.

In order to adequately evaluate agricultural risks, a confidence level of 90% is chosen, where VaR shows the worst probable outcome that shouldn't be exceeded more than once every 10 years (for yearly data sets), with everything that occurs rarer and with greater negative impact considered a catastrophic risk. 10 year interval is justified by an approximate pay-off period of an average agricultural enterprise in Ukraine.

Results and discussion

Production risk

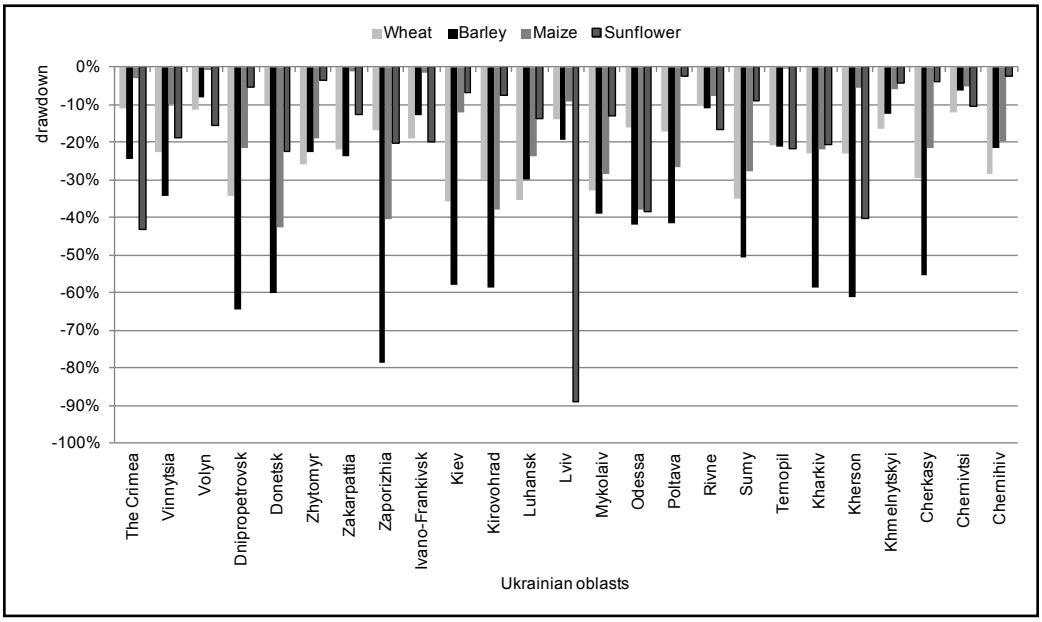
Among the most popular and profitable crops that are grown in Ukraine are consistently wheat, barley, maize and sunflower. Yet, due to variety of climatic regions, deviations of yields from these crops differ considerably between oblasts. Using distribution methods, described in previous section, possible declines in yields, which should not happen more often than once every ten seasons, are determined (fig. 1).

It is evident that that some traditional crops are too risky for certain regions, such as sunflower in Lviv or barley in Zaporizhia. Such crops may be avoided in crop rotations and replaced by less profitable, but with lesser risk.

Table 1 shows quantitative measures of decline in yield, obtained by calculating VaR at 90% confidence interval (also showed on fig. 1), and losses which are likely to occur in case of a catastrophic event (when confidence level is breached). Official statistical data was used for all calculations, provided by State Statistics Committee of Ukraine (Lukjanenko, 2010, State Statistics…). It is important to state that the data sample was rather small: only 6 years of generalized data for each oblast. For businesses in many small countries, including Ukraine, only such limited data is likely to be available. It is noticeable, that a detailed picture of risk could be projected with only 6 samples (years) of data per oblast.

Catastrophic risks in many oblasts for some crops are quite low, especially for maize and sunflower. For instance, maize production catastrophic risk in western oblasts of Volin, Ternopil, Zakarpattia, Ivano-Frankivsk is within 7%, which makes costly risk reduction measures, including insurance, unnecessary. Sunflower yields in central Ukraine are less volatile and stay within 20% even in case of the most extreme circumstances. Data also shows that some crops are intrinsically detrimental to cultivate in some areas of the country. Those crops that possess catastrophic risks over 100% are likely to be wiped out by droughts or floods due to the climatic features of that region. Considering weak government support of agricultural insurance in

[2]Generalized Autoregressive Conditional Heteroskedasticity



Source: Author´s research.

Figure 1: Possible drawdown from production risk for crops in each oblast in Ukraine.

Ukraine, it is likely that insurance products for high risk crops will not be available for certain areas.

Coherent risk analysis, which interprets the full probability density function (PDF), gives managers an idea of how to form financial and business strategy, aids in planning, and helps to adequately choose risk minimization policies. Its main advantage is a currency form. In this paper, Ukrainian currency is substituted by percentages to make results more apprehensible for international readers. In business management, however, currency-denominated risk figures are extremely convenient.

One thing to notice is that each crop is viewed as a separate asset in this paper, while all risks, which influence production, are approached as a portfolio. While analyzing combinations of crops, one can choose two approaches: combine selected crops into a portfolio and apply coherent PDF analysis to each combination, or calculate correlation between crops separately and just choose preferred crops based on the minimum variance approach. During the early stage of this research, it became apparent, that the latter is much easier and just as efficient.

Two types of correlations typically interest risk managers in agricultural production. One is a measure of systemic risk, which measures yields of a single crop across various areas. The other shows how yields of different crops correlate in the same area. Production risks seem to be systemic within three main climatic regions of Ukraine: Steppe, Forest-steppe, and Woodlands. Figure 2 depicts correlation of crop yields through oblasts for each region. Such high correlation signifies that producers tend to experience losses simultaneously, which has several major effects. With high level of systemic production risk, price volatility on domestic market tends to increase, along with negative price-yield correlation. Also, systemic risks are harder to pool and that limits choices of available instruments for risk management for agribusinesses. It appears that relationship between correlations and risk in agricultural production is more complex than linear or geometric. This is an argument for the use of individual approach in crop production risk analysis. Portfolio approach would imply that diversification is always possible at a reasonable cost and any amount can be diversified into. Such implications seem unrealistic for most agricultural businesses. Hence, correlations ought to be taken into account, but kept outside of coherent risk analysis model.

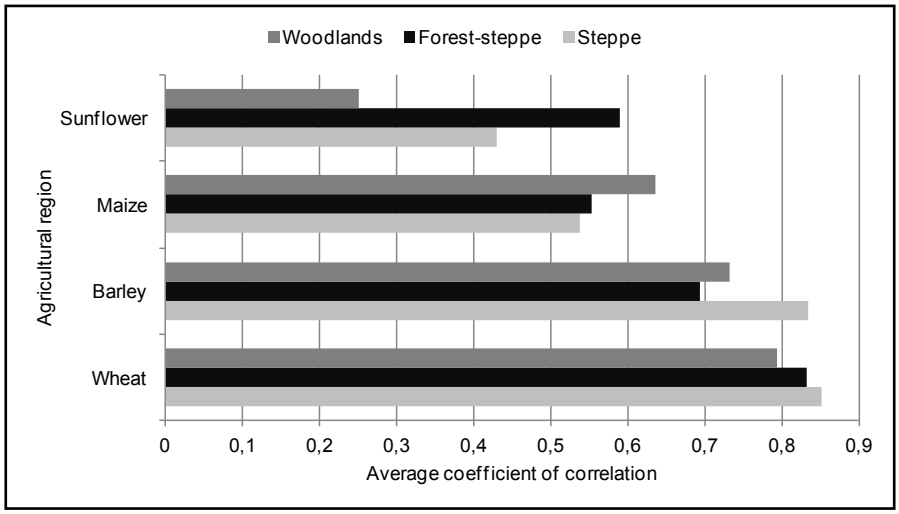
Among factors that cause high systemic risk are mainly droughts that consistently effect large areas, often entire regions. Wheat and barley yields uphold the highest level of intraregional correlation in Ukraine, as the most affected by droughts. However, wheat's average yield volatility is relatively lower, as shown in table 1, and the risk is less tangible.

For some areas, diversification remains the only viable method of risk management, especially where risks are too systemic to be marketable. Negative correlations between crop yields in several oblasts are observed. Table 2 shows a correlation matrix of the lowest correlations among yields within oblasts.

	Possible drawdown in yield, %				Catastrophic risk, %			
Area / Crop	Wheat	Barley	Maize	Sunflower	Wheat	Barley	Maize	Sunflower
Ukraine	-20.8	-37.1	-9.3	-5.5	-33.3	-64.3	-15.4	-10.3
Oblasts								
The Crimea	-10.8	-24.2	-3.1	-43.3	-17.3	-40.0	-25.2	-70.2
Vinnytsia	-22.7	-34.2	-10.0	-18.9	-32.0	-51.9	-24.6	-22.5
Volyn	-11.3	-8.2	-0.7	-15.5	-16.7	-19.8	-6.6	-27.8
Dnipropetrovsk	-34.2	-64.6	-21.5	-5.4	-53.4	-83.2	-29.0	-7.8
Donetsk	-9.8	-60.1	-42.8	-22.4	-26.7	-83.0	-75.4	-30.5
Zhytomyr	-26.0	-22.5	-18.9	-3.6	-37.8	-34.5	-33.0	-11.0
Zakarpattia	-22.0	-23.8	-1.1	-12.7	-29.5	-33.4	-3.3	-18.4
Zaporizhia	-16.9	-78.7	-40.6	-20.4	-314	-119.5	-62.0	-30.9
Ivano-Frankivsk	-18.8	-12.6	-1.6	-20.0	-25.1	-22.6	-6.8	-30.6
Kiev	-35.9	-57.9	-12.0	-6.8	-50.1	-79.6	-22.2	-13.0
Kirovohrad	-30.0	-58.5	-37.9	-7.5	-44.4	-104.4	-53.9	-11.9
Luhansk	-35.4	-30.0	-23.6	-13.8	-77.3	-58.5	-38.5	-21.0
Lviv	-14.0	-19.2	-9.3	-89.2	-21.2	-30.9	-14.9	-134.0
Mykolaiv	-32.9	-39.1	-28.5	-13.0	-53.2	-73.7	-56.7	-17.6
Odessa	-16.2	-41.9	-37.8	-38.6	-32.7	-65.8	-76.9	-62.6
Poltava	-17.2	-41.5	-26.7	-2.4	-43.5	-60.3	-32.7	-9.0
Rivne	-10.1	-10.8	-7.5	-16.7	-12.1	-15.6	-12.1	-62.1
Sumy	-34.9	-50.5	-27.5	-9.1	-46.6	-63.4	-45.1	-23.3
Ternopil	-20.8	-21.0	-0.3	-21.8	-32.4	-28.5	-2.4	-35.7
Kharkiv	-23.0	-58.5	-21.7	-20.5	-52.0	-73.8	-29.8	-30.2
Kherson	-23.0	-61.3	-5.5	-40.1	-34.1	-91.5	-13.4	-55.2
Khmelnytskyi	-16.5	-12.3	-6.0	-4.3	-26.7	-18.3	-10.2	-16.4
Cherkasy	-29.4	-55.4	-21.6	-3.8	-37.8	-81.6	-32.1	-12.1
Chernivtsi	-12.1	-6.3	-5.3	-10.5	-25.8	-12.4	-9.9	-12.4
Chernihiv	-28.5	-21.5	-19.5	-2.5	-46.9	-33.7	-29.0	-10.1

Source: Author´s own research.

Table 1: Production risk measurements across Ukrainian oblasts for major crops.



Source: Author´s research.

Figure 2: Correlation of yield across oblasts in different climatic regions.

Oblast	Crop	Wheat	Barley	Maize
The Crimea	Sunflower	0.04	0.09	-
Volyn	Sunflower	-0.29	-0.07	-
Zhytomyr	Maize	-	-0.07	-
Kharkiv	Sunflower	0.13	0.08	0.11

Source: Author´s own research.

Table 2: Notable low correlations of yields in Ukrainian oblasts.

Price risk

Price volatility in Ukraine is similar to that on global markets, which the country is well integrated into. Coefficient of variation between wheat prices in Ukraine and CME Group for the past two years (2009, 2010) is around 16%, with correlation of approximately 55%. However, impact of volatility of prices on Ukrainian agricultural enterprises is greater because there are fewer instruments for price risk management. Price risk in Ukraine is less marketable than in developed economies due to unavailability of standardized futures contracts. Forward agreements are hardly enforced and only work for trusting partners. Forward contracts are used more as a crediting tool with flexible or unspecified price and are hardly suitable for price risk management.

Table 3 demonstrates price risk measures, obtained by previously described methods, for most agricultural products. Types of agricultural products are subject to a certain level of aggregation due to peculiarity of available statistical data. Nine years of yearly data were chosen as a sample, starting at 2003 up to 2011. September and February are picked as significant data points because September marks immediate sale price after harvest, as opposing to February sale price after 6 months of storage. Crops, which are easy to store, such as wheat and potatoes, are exposed to similar price risk throughout the year. Vegetables and oil crops are more problematic to store for many businesses, and their supply half a year after the harvest is uncertain. The lesser is supply, the higher the price volatility and risk overall.

Note that modeled risk measures are hypothetical and, considering recently increased volatility in commodity markets, tails of distributions drag over -100%, which simply means that price declines are likely to be very rapid and a full range drop may occur within just a few months. Even though 100% declines in price are impossible in the real world, it gives an accurate idea of a great extent of possible losses. Overall volatility has considerably increased for commodities such as wheat, rice, beef, sugar, according to Onour et al. (2011). Many examples of 70-75% drops in commodity prices have been seen during the financial crisis of 2008-2009 (CME Group…).

Under existing mathematical methods, there appears to be no feasible way to avoid modeling results below -100% without upsetting conceptual framework by vague assumptions. Widely used for limiting lognormal distribution will not work, because it generates long right tail, which may create an illusion of a positive sum game and provoke risk taking behavior (e.g. gains are greater than losses). Or vice versa, depending on how the neutral outcome is defined in the distribution. Therefore, it seems optimal to equate values around -100% to historical maximum loss.

As described before in this section, correlations are analyzed separately from coherent risk analysis methodology to facilitate risk minimization measures later on. As opposed to production risk, where correlation of yields matter most, price risk management requires measurement of price/yields correlation to determine economic effect, which decline in price should have upon a business unit.

Month/ Product	Grains and leguminous crops	Sunflower seed	Potato	Vegetables	Livestock and poultry	Milk and dairy products	Eggs
	Possible price decline, %						
Sep.	-22.73	-27.75	-35.06	-23.97	-6.13	-22.75	-11.44
Feb.*	-28.30	-126.79	-38.69	-82.79	-2.92	-22.25	-21.64
	Expected maximum decline in price, %						
Sep.	-41.64	-52.94	-48.54	-35.31	-21.86	-45.15	-28.00
Feb.*	-63.68	-157.82	-66.48	-140.06	-9.70	-38.78	-39.54

*February of the next year

Source: Author´s own research.

Table 3: Price risk measurements for crop and animal production.

	Grains and leguminous crops	Sunflower seed	Potato	Vegetables	Livestock and poultry	Milk and dairy products	Eggs
Sep. price	0.36	0.69	0.40	0.61	0.72	-0.93	0.87
Feb. price*	-0.04	0.34	0.41	0.51	0.80	-0.93	0.76

*February of the next year
Source: Author´s research.

Table 4: Correlation of price and yield.

It is typical to have negative correlation between price and yield in agriculture, which reduces revenue variability considerably. Such negative correlation is referred to by Harwood et al. (1999) as a natural hedge due to its property to passively reduce risk. However, because prices for most agricultural products are mainly formed globally, low domestic yields do not guarantee higher sale price. In Ukraine, impact of lower yield on price is even less, as a large portion of products are exported at international prices. Table 4 shows evidence of positive correlation between price and yield for all agricultural products except for milk and dairy, which are sold domestically with a small portion exported to Russian Federation. Correlation of yield with February price (after approximately six months of storage) tends to be mostly lower, as a large portion of crops have already been exported by that time and, if harvest was poor, shortages start to occur.

Fundamentals behind risks

Coherent risk analysis is purely technical and does not include fundamental factors in a model itself. It is useful to recur to fundamental factors to gain intuition of conditions, in which the model operates. Description of fundamentals should also be helpful for readers, who wonder how coherent risk analysis would work in other economic environments. Although, described methodology does not have any known limitations.

Most of the volatility in yields is caused by droughts and inability to effectively gather harvest due to weather factors and poor technical equipment. In western part of Ukraine floods are common, while droughts prevail in south-east. Technical equipment is available on the market, but capital is often too costly for many producers, as farm land cannot be used as collateral according to Ukrainian law. Borrowed capital cost often rises up to 30% and, as a result, many producers choose to sacrifice a portion of yield by avoiding purchase of new equipment.

Price risks include currency fluctuations and risks that come from currency exchange. Financial products, such as currency futures, that would allow businesses to hedge currency pairs are not available, and currency risk is left entirely to be absorbed by agricultural businesses. Currency risk technically becomes a component of a price risk. Ukrainian currency floats freely, but National Bank of Ukraine sets a very narrow corridor for fluctuation of Ukrainian currency to the United States Dollar. Such policy almost eliminates currency risk in a short term, but eventually when a financial crisis hits (such as in 2008) and National Bank's reserves become insufficient to maintain the policy, national currency may depreciate instantly by over 50%.

A lot of uncertainty comes from subsidies that businesses count on. Subsidy payments are often delayed, postponed, or declined entirely for various reasons. Share of subsidies in income is often small and the chance of receiving it is always unknown. In such conditions, some enterprises choose to discount subsidy income entirely, yet others are forced to account uncollected subsidies as losses. Regardless, uncertainty of cash flows from sales caused by subsidies counts towards price risk. Exporters also face uncertainty during value added tax return, for which the government continuously has an outstanding debt.

Conclusion

Distribution-based methods of risk assessment, specifically, value-at-risk and expected shortfall are best suited for measuring price and production risks in agricultural production. Monte Carlo simulation enables modeling under conditions of limited historical data, while autocorrelation accounts for any volatility trends even in small data samples. It is observed that production risk varies greatly for different crops in Ukrainian oblasts. Also, the risk is of systemic nature, and is highly correlated inside climatic zones of the country. Some low to negative correlations for a few crops in four out of 25 oblasts are observed. Price risk appears to follow global price volatility, except for popular in Ukraine sunflower seeds, price of which appears to fluctuate considerably. There is evidence found, that price-yield correlation is constantly positive throughout the year, except for milk products and grains after the end of the harvest season, which is explainable by export orientation of the country's agricultural producers.

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References

[1] Antón, J. Managing Risk in Agriculture: A Holistic Approach. OECD Publishing, Paris, 2009.

[2] Bollerslev, T. Generalized Autoregressive Conditional Heteroskedasticity. Journal of Econometrics. 1986, No. 3, s. 307 – 327.

[3] Cabrera, V.E., Solís, D., Baigorria, G.A., Letson, D. Managing climate variability in agricultural analysis. In: Long, J. A. and Wells, D. S. (Eds). In: Long J.A., Wells D.S. (eds.) Ocean Circulation and El Niño: New Research. 2009, s. 163 – 179.

[4] Chuan, W., Junye, Z., Min, H. Measurement of the Fluctuation Risk of the China Fruit Market Price based on VaR. Agriculture and Agricultural Science Procedia. 2010, No. 1, s. 212 – 218.

[5] CME Group Agricultural Products Futures Quotes. Available at: www.cmegroup.com/trading/agricultural (Accessed June 2011)

[6] Cotter, J., Dowd, K., Morgan, C.W. Extreme Measures of Agricultural Financial Risk. SSRN. 2008. Available at: http://ssrn.com/abstract=1517192 (Accessed April 2011).

[7] Daníelsson, J., Jorgensen, B.N., Sarma, M., De Vries, C.G. Comparing downside risk measures for heavy tailed distributions. Economic Letters. 2006, No. 92, s. 202 – 208.

[8] Harwood, J., Heifner, R., Coble, K., Perry, J., Somwaru, A., Managing Risk in Farming:Concepts, Research, and Analysis. Agricultural Economics Report No. 774, USDA, Washington, DC, 1999. Available at: www.ers.usda.gov/publications/aer774/ (Accessed May 2011)

[9] Herwartz, H. Exact inference in diagnosing Value-at-Risk estimates – A Monte Carlo device. Economics Letters. 2009, No. 103, s. 160 – 162.

[10] Iorgulescu, F., StancuTANCU, I. Value at risk: a comparative analysis. Economic computation and economic cybernetics studies and research. 2008, vol. 42, No. 3, s. 5 – 24.

[11] Jorion, P. Financial Risk Manager Handbook: 2nd edition. John Wiley & Sons Inc., New Jersey, 2003.

[12] Lukjanenko, Z. A. Crop Sector of Mykolayiv Oblast: Statistical Digest. Headquarters of Statistics in Mykolayiv Oblast. Mykolayiv, 2010. (Ukrainian)

[13] Onour, I.A., Sergi, B.S. Modeling and forecasting volatility in the global food commodity prices. Agricultural Economics – Czech. 2011, No. 57, s. 132 – 139.

[14] State Statistics Committee of Ukraine: Statistical Information. SSC of Ukraine Website. Available at www.ukrstat.gov.ua (Last accessed June 2011)

[15] Szegö, G. Measures of Risk. Journal of Banking and Finance. 2002, No. 26, s. 1253 – 1272.

[16] Wong, W. Backtesting value-at-risk based on tail losses. Journal of Empirical Finance. 2010, No. 17, s. 526–538.

[17] Yamai, Y., Yoshiba, T. Value-at-risk versus expected shortfall: A practical perspective. Journal of Banking & Finance. 2005, No. 29, s. 997–1015.

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Farmers Perception and Adaptation to Climate Change: An Estimation of Willingness to Pay

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Abstract

This paper assesses farmers' perception and adaptation to climate change to enhance policy towards tackling the challenges climate change poses to the farmers in Ghana. With regards to farmers' perception and methods of adaptation, majority of the farmers perceived increase in temperature and decrease in rainfall pattern. Farmers' level of adaptation was found to be relatively high with majority of the farmers using changing planting dates, different crop varieties, soil conservation and water harvesting as the major adaptation measures to climate change impacts. However, access to water, high cost of adaptation, lack of information, lack of knowledge on adaptation, insecure property rights, insufficient access to inputs and lack of credits were identified as the major barriers to adaptation. The probit regression estimation results indicated that the probability of willingness to pay for climate change mitigation policies increases with age, years of education and ownership of farm land.

Key words

Perception, adaptation, climate change, willingness to pay, probit regression.

Introduction

Climate change is expected to pose a serious threat on environment, agricultural production and food security of most developing countries including Ghana. In particular, rural farmers, whose livelihoods depend on the use of natural resources, are likely to bear the brunt of adverse consequences. This is largely because most developing countries experience high poverty incidence and as a result are incapable to adapt to climate change. However, the extent of climate change impacts on agriculture can be ameliorated by the perception and level of adaptation of farmers. Studies have shown that African perception and understanding of climate change are poor. For instance, Taderera (2010) reported that South African awareness of climate change was literally interpreted as "changing weather" and this may influence the extent of adaptation. Adaptation is widely recognized as a vital component of any policy response to climate change. It is a way of reducing vulnerability, increasing resilience, moderating the risk of climate impacts on lives and livelihoods, and taking advantage of opportunities posed by actual or expected climate change.

Farmers perception of climate change is crucial for their choice of adaptation and hence their willingness to pay for climate change mitigation action. However, perceptions are influenced not only by actual conditions and changes, but are also influenced by other factors. A study by Gbetibouo (2009) found that having fertile soil and access to water for irrigation decrease the likelihood that farmers will perceive climate change; however, education, experience, access to extension services increase the likelihood that farmers perceived climate change.

Despite the importance of perceptions and adaptation to climate change, in the context of Ghana, a very few studies have examined farmers perceptions and adaptation and consequent effect on their willingness to pay for climate change mitigation policy action. This study therefore analyzes how farmers perceive and adapt to climate change and their willingness to pay for climate mitigation policy. Specifically, the study seeks to (1) examine the socioeconomic characteristics of the farmers; (2) analyze their level of awareness of climate change; (3) analyze farmers perception of

climate change; (4) examine the various choice of adaptation measures among the farmers; (5) identify the barriers to adaptation among the farmers; (6) analyze the socio-economic determinants of farmers willingness to pay for climate change mitigation policy.

Literature review

In response to perceived long-term changes in climate, farm households implemented a number of adaptation measures to reduce the vulnerability of climate change impacts. Analysis of the impacts of climate change and adaptation on food production in Ethiopia (Yesuf et al., 2008) revealed changing crop variety, soil and water conservation, water harvesting, planting of trees and changing planting and harvesting periods as the choice of adaptation measures by the farmers. Among these methods of adaptation, planting trees was the dominant measure adopted by most of the farmers. However, about 42% of the farmers did not use any adaptation method for climate change impacts. Using two separate models to examine the factors influencing farmers' decision to adapt to perceived climate changes, Yesuf et al. (2008) confirmed that household wealth represented by farm and nonfarm income and livestock ownership, increases the likelihood of climate change awareness and adaptation. Deressa (2008) identified that age of household head, wealth, information on climate change, social capital and agro ecological settings have significant impact on the perception of farmers to climate change. Farmers in areas with higher annual mean temperature over the period of survey were more likely to adapt to climate change.

Numerous factors have been identified as barriers to adaptation: lack of information on choice of adaptation option, lack of financial resources, shortage of land, poor potential for irrigation and labour constraints (Deressa et al., 2008). However, lack of information on choice of adaptation option was the major barrier to adaptation. Madison (2006) and Nhemachena and Hassan (2008) showed that access to information through extension increases the chance of adapting to climate change.

Climate mitigation strategies must be seen as a collective concern for sustainability of agricultural production and livelihoods of many people especially those in developing countries. Consequently, individual willingness to contribute to climate issues is vital in such endeavour. As a result some studies have analyzed the willingness to pay for climate change mitigation policy using different models. The impact of uncertainty associated with climate change on individual decisions regarding support for climate change policy was first examined by Cameron (2005). That study used a Bayesian information updating model in a single bounded contingent valuation framework to estimate individual option price for future climate change using a convenience sample of college students. Empirical results revealed a quadratic relationship between expected future temperature changes and individual support for climate change policy. Thus, the respondents were willing to pay more with increased expected future temperature change but the amount increased at a decreasing rate.

Sonia Akter and Jeff Bennett (2009) analyzed the determinants of households' willingness to pay for Carbon Pollution Reduction Scheme (CPRS) in Australia. The willingness to pay for climate change mitigation was found to be significantly reduced by the uncertainty associated with the expectations of future temperature increases. Furthermore, the willingness to pay for Carbon Pollution Reduction Scheme was found to be negatively affected by respondents' lack of confidence in the CPRS being effective in slowing down climate change.

Analysis of the perception and willingness of graduate students to pay for gas tax (Viscusi & Zeckhauser, 2001) revealed that a major factor that may influence willingness to pay, holding risk estimates constant, is whether a respondent feels scientific uncertainty motivates a more aggressive or less aggressive approach to climate change policy. Han et al. (2010) estimated the willingness to pay for environmental conservation by tourists in China, using a contingent valuation method. The results indicated that willingness to pay increases with income, education level, and age.

Bamidele Fakayode et al. (2010) analyzed the factors affecting farmers' ability to pay for irrigation facilities in Nigeria. Empirical results from a logistic regression analysis revealed age of the farmers, education level acquired, farm household income and the size of farmers' household size as the major factors explaining farmers' ability and willingness to pay for irrigation scheme.

However, the perceptions of farmers on their choice of adaptation and willingness to pay for climate change mitigation policies in the Ghanaian context have not been extensively analyzed. Most studies on climate change concentrates on the causes and impacts of climate change with little attention on perceptions and willingness to pay for mitigation strategies. This present study examines farmers' perception and adaptation and employs a probit regression model to analyze farmers' willingness to pay for climate change mitigation policy.

Methodology

Study area description

Dunkwa lies in Shama in the Western part of Ghana and its geographical coordinates are 50 7' 0" North and 10 37' 0" West. It has an estimated population over 1500 and the main occupation in the area is farming.

Sampling and sample size

The sample for the study consists of 98 farmers in Dunkwa, a town in the Shama Ahanta East Municipality in the western region of Ghana. Random sampling technique was used to select the sample.

Data analysis

An interview schedule was the main tool of data collection while descriptive statistics and probit regression analysis were the main analytical techniques. Data was analyzed using the Statistical Product and Service Solution (SPSS) software version 15.0 and the R Statistical Programming Language. The probit regression analysis involves modeling the binary response using a cumulative standardized normal distribution. The standardized normal distribution is one with mean zero and a unit variance. The basic model of the probit estimation involves defining a variable Z that is a linear function of the variables that determine the probability:

$$Z = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k \quad (1)$$

F(Z), the cumulative standardized normal distribution, gives the probability of the event occurring for any value of Z:

$$p_i = F(Z_i) \quad (2)$$

The maximum likelihood analysis is used to obtain estimates of the parameters. The marginal effect of X_i is $\partial_p/\partial X_i$ and is computed as:

$$\frac{\partial p}{\partial X_i} = \frac{dp}{dZ}\frac{\partial Z}{\partial X_i} = f(Z)\beta_i \quad (3)$$

Since F (Z) is the cumulative standardized normal distribution, f (Z), its derivative, is just the standardized normal distribution itself:

$$f(Z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}Z^2} \quad (4)$$

This research uses information criteria as technique for providing the basis for model selection. Most widely used information criteria such as Akaike Information Criteria (AIC) and the Bayesian Information Criteria are employed. The idea of AIC (Akaike, 1973) is to select the model that minimizes the negative likelihood penalized by the number of parameters as specified in the equation (5).

$$AIC = -2\log(L) + 2p \quad (5)$$

Where L refers to the likelihood under the fitted model and p is the number of parameters in the model. Specifically, AIC is aimed at finding the best approximating model to the unknown true data generating process and its applications draws from (Akaike, 1973; Bozdogan, 1987; Zucchini, 2000).

Results and Discussions

Socioeconomic characteristics of Farmers

The socioeconomic characteristics of the farmers were investigated. Results revealed cereal, vegetables and root/tubers as the types of crops grown by the farmers in the area. However, majority (73.5%) were cereals farmers. Results also revealed that 79.6% of the farmers were males whilst 20.4% were females. The average age of the farmers was 44.92 years with 37.8% in the age range of 34-41 years; 20.4% between 42-49 years; 14.3% between 58-65 years. Only 5.1% of the farmers were in the age range of 66-73 years. 10.2% of the farmers interviewed had obtained senior high school education; 48% had obtained junior high school education; 35.7% had obtained basic education; only 6.1% had no formal education. The average annual income of the farmers was GH¢1403.0612 with 48% earning between GH¢100-GH¢1000; 33.7% between GH¢1100-GH¢2000; 10.2% between GH¢2100-GH¢3000; only 8.2% of the farmers had annual income between GH¢3100-GH¢5000. Given the relatively low annual farming incomes of the farmers, their adaptation and willingness to pay for mitigation policy may be low. The distribution of years of farming experience revealed an average of 17.82 years of farming with 33.7% having between 1-10 years of experience; 32.7% having between 11-20 years of experience; 23.5% having between 21-30 years of farming experience; and 10.2% having between 31-40 years of farming experience. The average household size of the farmers was 6.7 persons with 88.8% having a household size between 4-9 persons; 8.2% having between 10-15 persons; only 1% had a household size between 21-25 persons. However, the distribution of farm size revealed an average of 4.306 acres with majority of the farmers (69.4%) having between 1-4 acres of farmland; 16.3% having between 5-9 acres; 9.2%

between 10-14 acres: only 5.1% had between 15-19 acres of farmland.

Farmers' perception to climate change

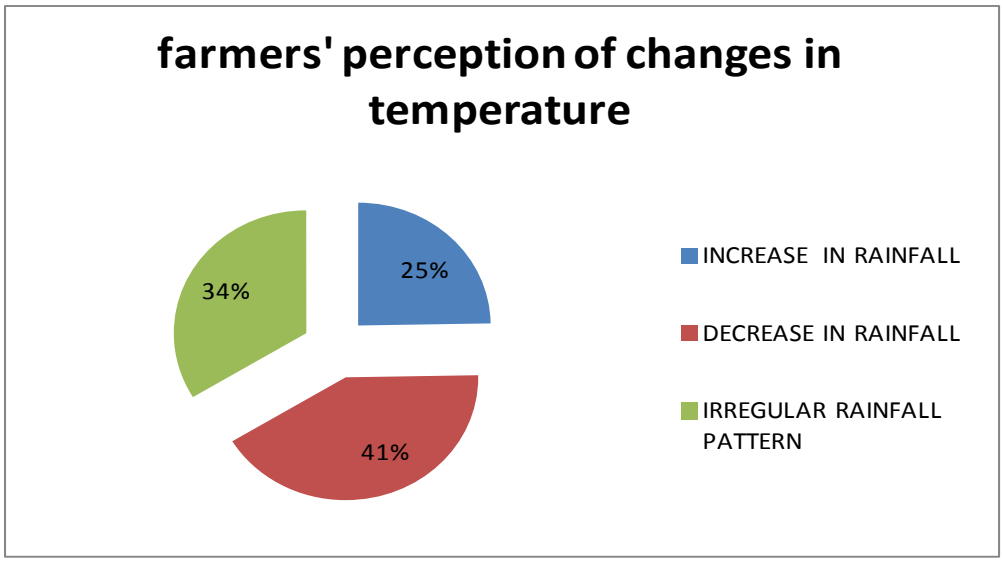
In an attempt to investigate whether the farmers perceive changes in climatic patterns, the farmers were asked questions relating to their perception of temperature and rainfall pattern. Results revealed that 84.7% of the farmers perceived climate change as a serious phenomenon; however, 15.3% did not perceive changes.

Farmers' Perception on temperature changes

About 49% of the farmers perceived increases in temperature whilst 33% of the farmers perceived a decrease in temperature. However, 18% of the farmers did not perceived any change in temperature.

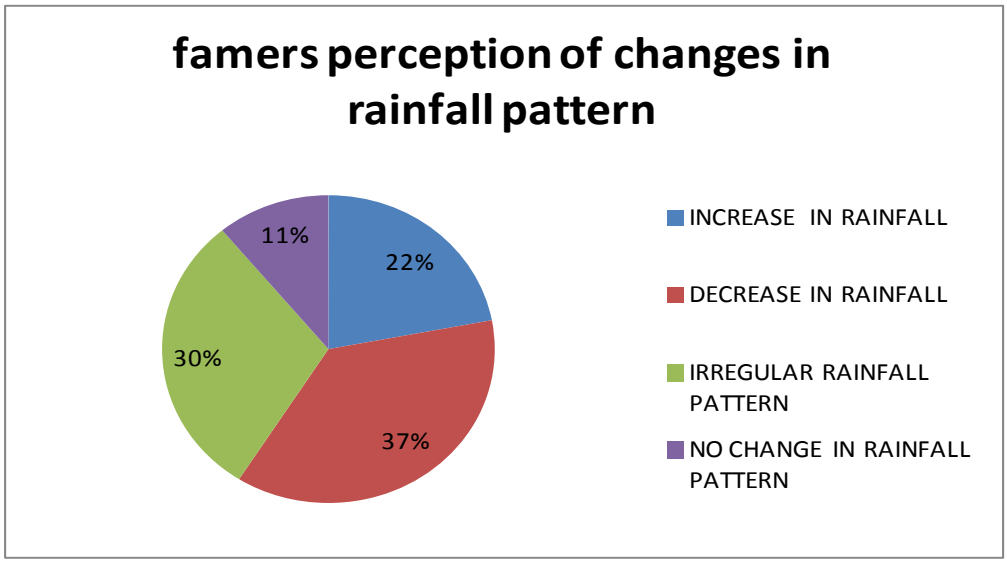
Farmers' Perception on Changes in Rainfall Pattern

The distribution of the perception of the farmers concerning changes in rainfall pattern revealed that 22% perceived an increase in precipitation; 37% perceived a decrease in precipitation; 30% perceived an irregular rainfall pattern. Despite higher perception of the farmers interviewed on changes in rainfall pattern, 11% of the farmers interviewed did not see any change in rainfall pattern.



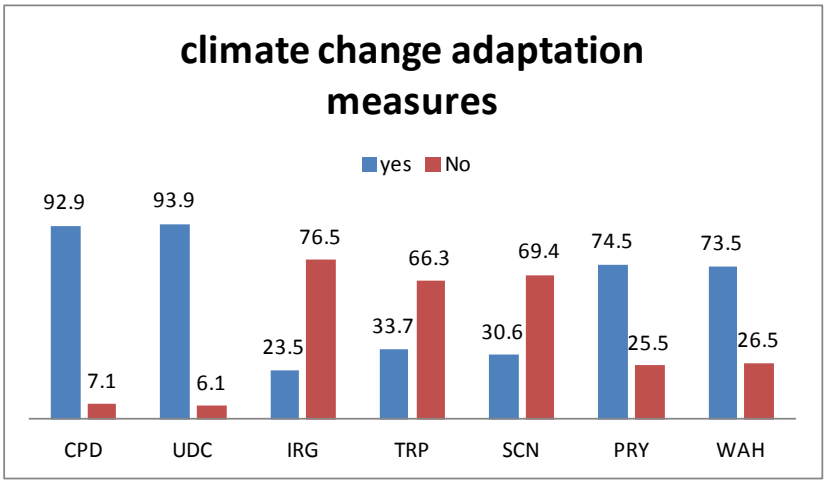
Source: Field data, 2011.

Graph 1



Source: Field data, 2011.

Graph 2



Note: CPD= Changing Planting Dates, UDC= Use of different Crop varieties, IRG= Irrigation Practices, TRP= Tree Planting, SCN= Soil Conservation, PRY= Prayers, WAH= Water Harvesting.

Source: Field data, 2011.

Graph 3

Choice of Climate Change Adaptation Measures

Attempts were made to find out whether the farmers use some climate change adaptation measures and subsequently the types and reasons for their choice of adaptation over the other options. Of the farmers interviewed, 60.2% use some form of climate change adaptation options whilst 39.8% do not use adaptation measures. Changing planting dates, using different crop varieties, tree planting, irrigation practices, soil conservation, water harvesting and prayers were the main adaptation measures used by the farmers. Of the farmers interviewed, 92.9% uses changing planting dates as their method of adaptation whilst 7.1% do not use this method. 93.9% of the farmers used different crop varieties to reduce climate change impacts whilst 6.1% have never used this measure before. 73.5% of the farmers use water harvesting as an adaptation measure whilst 26.5% do not use this method.

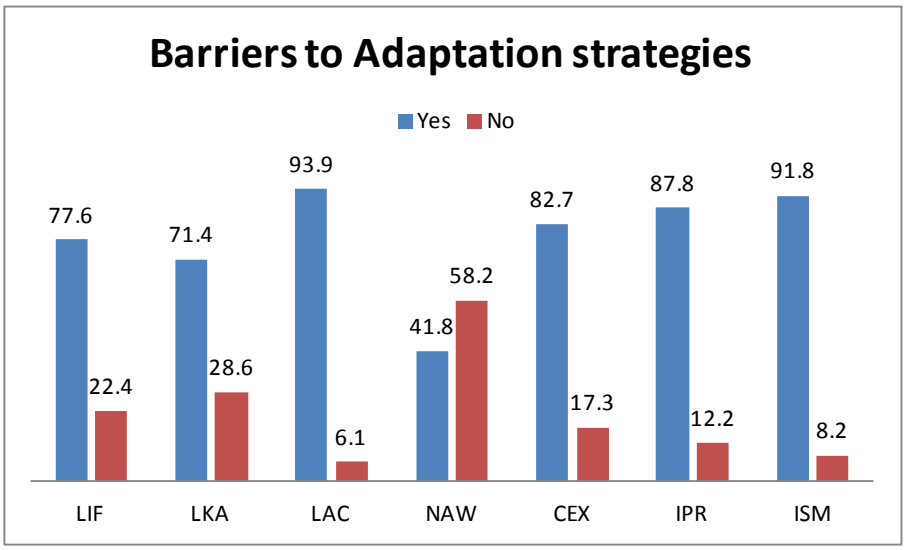
With regards to irrigation and tree planting, 23.5% of the farmers interviewed use irrigation to adapt to climate impacts whilst 76.5% do not use this method; 33.7% of the farmers use tree planting as an adaptation measure whilst 66.3% do not use this measure. Soil conservation was used by 30.6% of the farmers interviewed to adapt to climate change impacts. However, 74.5% of the farmers use prayers as a measure of adaptation and vice versa. The chart below depicts the distribution of various measures of adaptation used by farmers in Shama in the Western Region of Ghana. When asked why they preferred their choice of adaptation over the other options, 67.8% indicated that their choice of adaptation was most economical or less costly to use; 16.9% said their choice of adaptation improves the fertility of the land and prevent erosion; 10.2% said their choice was environmentally friendly; only 5.1% said their choice leads to early maturity of crops.

Barriers to Adaptation Strategies

Barriers preventing farmers from adapting to climate change was investigated. Results as shown in the graph 4 identified lack of information on climate change impacts and adaptation options; lack of knowledge about adaptation measures; lack of access to credit; no access to water, high cost of adaptation; insecure property rights and insufficient access to inputs as the major barriers inhibiting their ability to adapt to climate change impacts.

With regards to lack of information, 77.6% of the farmers identified this as the main barrier to effectively adaptation to climate change; whilst 22.4% did not think so. 71.4% of the farmers identified lack knowledge regarding adaptation measures whilst only 28.6% were aware of adaptation options. 93.9% of the farmers interviewed indicated that access to credit was very low and this had constrained many of them from effective adaptation of climate impacts.

No access to water for irrigation and other farming activities was identified by 41.8% of the farmers as a barrier to adaptation; however, 58.2% did not see access to water as a problem. Cost involved in adapting to climate change impacts was identified by 82.7% of the farmers as the reason explaining their poor adaptation ability whilst 17.3% disagreed. Insecure property rights over land constraints about 87.8% of the farmers from using any adaptation



Note: LIC= Lack of Information on Adaptation options, LKA= Lack of Knowledge on Adaptation options, LAC= Lack of Access to Credit, NAW= No Access to Water, CEX= Changes are Expensive, IPR= Insecure Property Rights, ISM= Insufficient access to Inputs

Source: Field data, 2011.

Graph 4

measure. About 91.8% of the farmers indicated that inadequate access to inputs was a barrier to adaptation. This was attributed to lack of access to credit as well as the expensive nature of adaptation measures.

Willingness to Pay for Climate Change Mitigation Policy

Climate change mitigation policies are necessary if the long term agricultural productivity, food security and the growing needs of increasing population growth are not to be compromised. As a result, the farmers were asked if they were willing to pay for climate change mitigation policies.

Of the farmers interviewed, 55.1% were willing to pay for mitigation policy whilst 44.9% were not. The study identified massive tree planting exercise, provision of irrigation facilities to farmers, training of volunteers to guard against unauthorized cutting of trees and organization of education programmes on climate change as strategies for mitigation action.

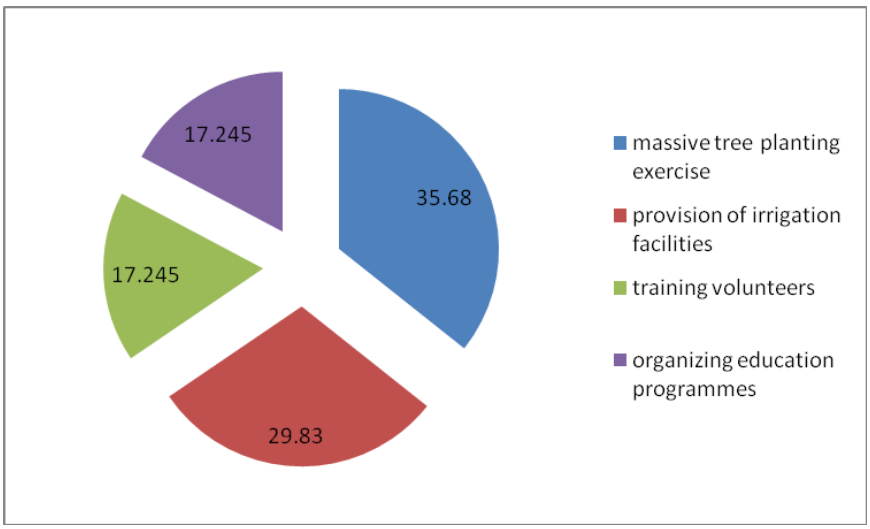
Graph 5 shows the distribution of the farmers' willingness to pay for these climates mitigation policies. From the graph, it is obvious that farmers willingness to pay for tree planting exercise was high (35.68%); followed by provision of irrigation facilities to farmers constituting about 30% of the farmers. About 17% of the farmers interviewed were willing to pay for training of volunteers whilst about 17% were willing to pay for climate change education programmes.

Table 1 shows the summary statistics of the willingness to pay responses of farmers. The mean and median were GH¢ 12.3519, GH¢9.00 respectively. The median was lower than the mean, indicating that majority of the farmers were willing to pay less than the mean willingness to pay, and that the response distribution was skewed by a limited number of high bidders.

Model Estimation Results of the Probit Regression Analysis

A probit regression analysis was employed to analyze the socio-economic factors that influence farmer's willingness to pay for climate change mitigation policies. The Akaike Information Criteria (Akaike, 1973), provided the basis for selecting the model that provided the best fit to the willingness to pay data. The model specification with willingness to pay for climate change mitigation policies as the dependent variable and gender, age, household size, years of education, years of farming experience, own farm land and other income generating activity as the covariates provided the best fit with AIC of 114.65.

The model estimation result reveals a negative relationship between willingness to pay for climate change mitigation policies and the regression covariates (i.e. gender, household size, years of farming experience and other income generating activity). A positive relationship exists between willingness to pay for climate change mitigation policies and the regression covariates (i.e. Age, years of education and Ownership of farm land).



Source: Field data, 2011.

Graph 5: Distribution of Farmers Willingness-To-Pay for Climate Change Mitigation Policies (In Percentage).

N=54	
Mean	12.3519
Median	9.00000
Std. Deviation	9.60573
Skewness	1.840 (std. error 0.325)
kurtosis	2.915 (std. error 0.639)

Source: Field data, 2011

Table 1: The Statistics of Willingness-To-Pay (WTP).

Variables	Estimates	Std. Error	z value	Pr (>I z I)
Intercept	-1.290	0.840	-1.536	0.124
GEN	-1.309	0.413	-3.169	0.001**
AGE	0.081	0.032	2.542	0.011 *
HHS	-0.029	0.082	-0.362	0.717
EDU	0.108	0.046	2.343	0.019*
EXP	-0.127	0.040	-3.114	0.001**
OFL	0.738	0.368	2.002	0.045*
OINC	-0.001	0.0001	-2.517	0.011*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Note: GEN= Gender, AGE= Age of respondent, HHS= Household size, EDU= Years of education of respondent, EXP= Farming Experience, OFL= Own farm land OINC= Other Income Activity.

Source: Field data, 2011.

Table 2: Parameter estimates of the Probit Model.

Evidence from the probit regression analysis finds the age, gender, years of education, years of farming experience, own farm land and other income generating activity as significant predictors of the willingness to pay for climate change mitigation policies. The parameters of gender and years of farming experience were negative and significant at 1% level while other income activity was also negative and significant at 5%. While the parameters of age, years of education and own farm land were positive and significant at 5% level. It should be emphasized that a negative sign of a parameter indicates that high values of the variables tends to decrease the probability of the willingness to pay for climate change mitigation policies. A positive sign implies that high values of the variables will increase the probability of the willingness to pay for climate change mitigation policies. In effect the probability of willingness to pay for climate change mitigation policies increases with age, years of education and ownership of farm land.

Conclusion

Farmer adaptation to climate change is crucial to combating food insecurity and related problems. Against this background, this paper assesses farmer's perception and adaptation to climate change. Specifically, the study investigated farmer perception of changes in temperature and precipitation, choice of adaptation methods, barriers to adaptation and socio-economic determinants of willingness to pay for climate mitigation policies.

Results from the descriptive analysis of farmers interviewed revealed that the farmers were characterized by active labour force, small farm sizes, low income distribution, high farming experience, large household size, and low level of formal education. With regards to farmers' perception and methods of adaptation, majority of the farmers perceived increase in temperature and decrease in rainfall pattern. Farmers' level of adaptation was found to be relatively high with majority of the farmers using changing planting dates, different crop varieties, soil conservation and water harvesting as the major adaptation measures to climate change impacts. However, access to water, high cost of adaptation, lack of information on climate change adaptation options, lack of knowledge on adaptation, insecure property rights, lack of credits and insufficient access to inputs were identified as the major barriers to adaptation.

Results revealed high level of willingness to pay for mitigation policies among the farmers. However, majority of the farmers supported massive tree planting exercise. The probit regression estimation results indicated that the probability of willingness to pay for climate change mitigation policies increases with age, years of education and ownership of farm land. Implications for policy will be to implement a public education program on climate change adaptation strategies. There is the need for government to embark on massive implementation of mitigation policies since most farmers are willing to pay for these policies.

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References

[1] Akaike, H. (1973). Information theory and an extension of the maximum likelihood principle. In: B.N. Petrov and F. Csaki (eds.) 2nd International symposium on information theory: 267-81 Budapest: Akademiai Kiado.

[2] Akter, S., Benett, J. (2009). Household perceptions of climate change and preferences for mitigation action: the case of the Carbon Pollution Reduction Scheme in Australia. Environmental Economics Research Hub Research Reports, ISSN 1835-9728.

[3] Bamidele Fakayode, S., Ogunlade, I., Ayinde, O., Olabode, P. (2010). Factors Affecting Farmers' Ability to Pay for Irrigation Facilities in Nigeria: A case of Oshin irrigation Scheme in Kwara State. Journal of Sustainable Development in Africa, vol. 12(1).

[4] Bozdogan, H. (1987). Model selection and Akaike's information criterion (AIC): the general theory and its analytical extensions. Psychometrika, vol 52(3):345-370.

[5] Cameron, T.A. (2005). Individual option prices for climate change mitigation. Journal of Public Economics, 89(2-3), 283-301.

[6] Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T. & Yesuf, M. (2008). Analysis of the Determinants of Farmers' choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia. International Food Policy Research Institute. Washington, DC.

[7] Gbetibouo, G.A. (2009). Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability. IFPRI Discussion Paper 00849.

[8] Han, F., Yang, Z., Xu, X. (2010). Estimating Willingness to pay for environment conservation: a contingent valuation study of Kanas Nature Reserve, Xinjiang, China.

[9] Hassan, R., Nhemachena, C. (2008). Determinants of African Farmers' strategies for adapting to climate change: Multinomial choice analysis. AFJARE Vol. 2, No. 1.

[10] Maddison, D. (2006). The perception of and adaptation to climate change in Africa. CEEPA Discussion Paper No. 10. Center for Environmental Economics and Policy in Africa, University of Pretoria, South Africa.

[11] Taderera, D. (2010). South African's Awareness of Climate Change.

[12] Viscusi, W. K., Zechauser, R. J. (2006). The Perception and Valuation of the risks of climate change: A Rational and Behavioral Blend. Climate Change 77: 151-177, DOI: 10. 1007/s 10584-006-9075-9.

[13] Yesuf, M., Di Falco, S., Deressa, T., Ringler, C., Kohlin, G. (2008). The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries: Evidence from the Nile Basin, Ethiopia. EDRI.

[14] Zucchini, W. (2000). An Introduction to model selection. Journal of Mathematical Psychology, vol 44: 41-6.

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What determines the Czech land market prices? Some regional findings.[1]

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Abstract

The paper deals with the analysis of market land prices that were collected from land purchased contracts in the Czech Republic. Regression model was used to identify determinants explaining variability of market prices between 2008 and 2009. It was found out that type of plantation, region, type of buyers, plot size, distance to regional city or number of parcels play significant role. These factors explain more than a half of variance in land price. Quality of land that was expressed through administrative price has significant effect on market price. Yet, such effect became less import in regions nearby cities (e.g. Prague and Olomouc), where the market land price is significantly influenced by the distance to the district city. Land reform, however has not been confirmed to stimulate higher prices for sellers. It is reasonable to expect that part of the remaining variation could still be accounted for by non-random variables.

Key words

Land, market price, administrative price, regression model, region.

Anotace

Příspěvek se zabývá analýzou tržních cen zemědělské půdy ve vybraných pěti okresech ČR. S využitím regresního modelu vysvětlujeme relevantní determinanty tržních cen získaných z kupních smluv v letech 2008-2009. Kromě faktorů jako je druh pozemku nebo kvalita hraje významnou roli v ceně také okres, charakter nabyvatele – zda-li se jedná o zemědělský nebo nezemědělský subjekt, obchodovaná výměra, vzdálenost pozemků do okresního města a částečně také počet převáděných parcel. Tyto faktory vysvětlují více než polovinu variability tržní ceny. Jednoznačně úřední cena půdy je ve většině regionů důležitým vodítkem pro stanovení výsledné ceny. Nicméně tento faktor je významně oslaben v regionech přilehlých k městským aglomeracím (např. Praha-východ a Olomouc), kde je cena silně ovlivněna vzdáleností do okresního města. Naopak nebylo potvrzeno, že by provedená pozemková úprava v katastrálním území ve větším rozsahu působila na kupní ceny půdy. I přes vysoký počet zkoumaných proměnných je reálné předpokládat, že stále část nevysvětlované variability je vysvětlována nenáhodným faktorem.

Klíčová slova

Zemědělská půda, tržní cena, úřední cena, regresní model, region.

Introduction

From the human perspective land is highly valuable because it provides a wide range of benefits to individuals and society at present and in future (Goverment office for Science, 2010). Land is traded like other goods, and must therefore have a price expressed in money (Němec, 2004). In the Czech Republic in the early 90´, an official (administrative) price of land has been introduced for defined purposes - determination of property taxes, transfer, exchange of land within the landscaping, etc. (Vrbová and Němec, 2004). Official price in fact replaced non-existent market price (Němec and Kučera, 2007). Administrative price is based on precisely specified factors, which are primarily based on the production potential of soil. In connection with the development of trade

[1] Results were gained in the framework of research tematic task for Ministry of Agriculture „Development of Market Land Prices and identification of factors influencing the development of Land Prices in conditions of the Cech Republic".

in agricultural land is reasonable to believe that objectivity of market price has increased. The question remains, to what extent the impact of administrative price is reflected in the market price after 20 years it was introduced.

Knowledge about the right price of land is also important in the economy of enterprises because of external financing. Land value (and buildings) significantly influences the viability of agriculture (Tsoodle and Golden, 2003) because the property including land can be used as a mortgage for a loan and thus indirectly determines how much farms can borrow. In relation with the stabilization of conditions in the agricultural enterprises on land, there has been gradually increasing the amount of own land at the expense of leasehold land. It is expected that this trend will continue at this rate in the long term. The value of the land will therefore increase in the total value of agricultural firms holdings. Currently, the share of the value of own land and permanent crops in total assets is of 10%.

Literature basically distinguishes four main components contributing to land value (Tsoodle and Golden, 2003): productivity component, the consumptive component, the speculative and transactional component. The productivity component proceeds from the ability of land to generate the income (profit), which is given on one hand by the intensity of crop growing, and on the other hand by supports, taxes and technological change.

Land productivity component is given by the expected yields from the land use, which is discounted by interest rate. Land price as a function of rent effects modelled Chavas and Shumway (1981). Consumptive component includes personal preferences of the business participants (so called intrinsic value) while sometimes there is no relevant economic reasoning behind, even though they can significantly influence the sale price or purchase price of transactions respectively. An example might be a very positive emotional relation of a purchaser to a plot (e.g. in the past the property was owned by ancestors). Similarly the sale of land could be affected by the owner‘s attempt to get rid of an unwanted property at any price according to his emotional feelings. Pope a Goodwin (1984) reported that owners buy land due to their emotional relation to the countryside. Income, population density, the rate of urbanization and characteristics concerning placement of plot are general factors influencing the perception of land value.

Speculative „component“ of land value is resulting from the expectations of buyers, that the price of land will show the expected future trend. This trend is given by the development in various aspects as commodity prices, business profitability, interest rates, inflation, the exchange rate, etc. The transaction component includes factors specific to the particular person – buyer or seller, as well as the nature of sale (its financing, a forced sale, a sale among relatives, etc.). Land price could be also influenced by environmental factors as modelled Bastian et al. (2002).

Střeleček et al. (2009) dealt with the factors that affect the agricultural land prices in the Czech Republic. The four most decisive factors were: the size of municipality, the size of a plot, distance to the edge of the collateral property and land access. Presented factors explain the variability of the market land price from 32 %. Latruffe et al. (2008) investigate impacts of the government support and others factors on the land price in the Czech Republic. They found out that the population density and the average crop yield had no significant influence on the prices, while the interest rate and the support payments had a positive effect and the average plot had a negative impact. The negative impact of the average plot size confirms that smaller plots are more expensive than larger plots. As for support authors conclude that the elasticity of land price with respect to payments based on output is 4%. Elasticity of the payments based on farm income is of similar extent – 6%. As for direct payments they had no effect on land prices. With regard to Slovakian conditions Buday and Bradáčová (2010) found out as the most significant factors the location of a plot, purpose of land use, the size of land and the amount of support. Other factors emerged in the survey as: land fragmentation, the common undivided ownership, the arrival of foreign investors, soil quality, land drainage, the possibility of irrigation or watering and social background of the landowner. A similar approach followed Tsoodle and Golden (2003) who found out, how the selected characteristics were manifested via market land prices in 8 counties in Kansas State (USA)[2]. Among the statistically relevant determinants was the size of traded land with a negative effect. Yet there was a growth of unit price on plots larger than 130 ha. As expected, irrigated soil increases land price, however grazing decreases. Other important features with negative influence on the price (lower) were as follows: transactions taking place on the „open[3]„ market, contracts between relatives or any business in a forced way (execution). The study

[2] Analysis included 67,000 sales between 1986 and 1999.

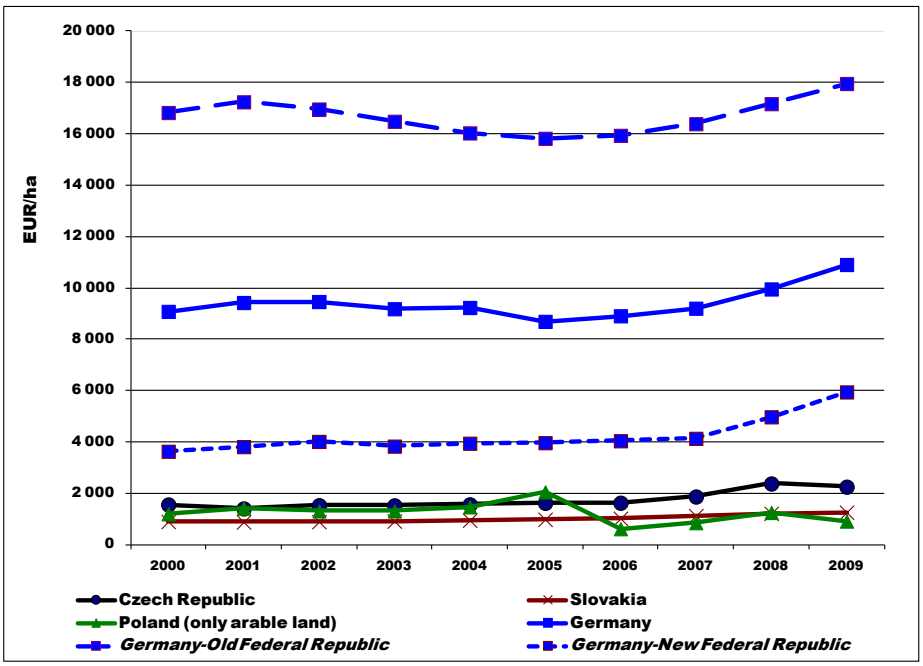
[3] This is likely related to process of contract conclusion, when seller is advertising publicly about intended sales. In contrast to a situation when two parties agree on the terms and conclude a contract without prior advertising.

also dealt with possible distinctions (elasticity of variables) among the surveyed districts in Kansas State. Their findings show that the land market is localized, so that the influence of individual factors varies significantly across the surveyed districts. Authors attribute these differences to fact that there exist different plans for land use outside of agriculture in some parts and „distort" to some extent, the market for agricultural land. According to Chicione (1981) the average per acre farmland price in surroundings of cities decreased as the parcel size increased, reflecting lower transactions costs for both the buyer and the seller.

Because agricultural land is also an investment opportunity, overall investment environment significantly affects the price of land. For example, recently in connection with the economic crisis the price of agricultural land in Germany (Agrarheute 2011) has significantly increased, because land started to represent safe investment in the environment of an unstable market, and there is no concern about the significant price fall.

The graph 1 shows the comparison of land prices in the Czech Republic (CR) and the neighbouring selected EU countries (Slovakia, Poland and Germany). In the last decade the figure does not show any significant convergence of prices of agricultural land in neighbouring countries and the CR. While in Germany there is evident a significant increase of prices, both in the new and old federal states in recent years (2008 – 2010). For example, annual change in land prices in 2010 showed the increase even by 25% compared to prices of 2009 in the new federal states (AGRARHEUTE 2011). There was a further significant price growth of agricultural land amounting to 8.7%. The situation may correspond with the economic crisis; in case of the CR and Poland it has led to reduced willingness to invest including the land, while in Germany the crisis could cause the conviction that the land is better (more secure) investment compared to other options. It has stimulated an increase in prices of agricultural land. Land prices in selected countries in the years 2000 – 2009 are shown in Graph 1.

Assigning the right administrative (unbiased) prices to agricultural land is currently hot topic in the Czech Republic that raise up several questions: (1) what factors influenced the formation of market prices of agricultural land in the Czech Republic between 2008 and 2009, (2) how important factor is the administrative price of agricultural land in the final market price, (3) what are the differences in the land prices among the Czech Republic and selected EU countries. To answer these questions at first the comparison of time series of land prices development is presented and then the application of a regression model that explains market price of land in CR is shown. The following section discusses the issue of market prices of land and to what extent specific determinants influence the price.



Source: Eurostat, Statistisches Bundesamt (Germany).

Grapg 1: Land market prices in period 2000 - 2009 for the Czech Republic, Slovakia, Poland and Germany.

Materials and Methods

Data on land market prices were collected from individual purchase contracts registered by Czech Statistical Office (CZSO) from 5 districts – Havlíčkův Brod, Klatovy, Olomouc, Praha-východ and Znojmo. These regions were designed so they could preferably represent the different conditions of local markets for agricultural land – suburban or remote region resp., the region with more or less fertile soils, with a different representation in each type of parcels, with different farm structure and distance to frontiers with other EU countries, with different levels of economic development and different pressures on agricultural land use, etc. Data on geographical location enabled to calculate the distance to centre of municipality and district towns. Socio-economic data were processed for each cadastral unit and/or on municipality level. These data come primarily from publicly accessible databases as follows: the Czech Statistical Office concerning socio-economic situation in each municipality, the Central Land Office on the status and implementation of land consolidation, the database of users and recipients of agricultural supports in the LPIS for determining the number of users in each cadastral areas.

2.1 The model of land prices formation

Variables selected for regression models can be classified according to its character as a „contract specific" (reflecting the individual nature of the contract or contractual parties, such as whether the acquirer originates in farming or not, soil quality), local (characterizing local conditions, population density or distance to the municipality) and socio-economic (characterized by social and economic nature of the region as a migration change or unemployment). The total number of observations included in the model was 306.

The dependent variable and the most independent variables are in log forms (so-called „double log model")[4] and thus the log coefficients can be interpreted as the elasticities of variables with regard to the following general exponential form of the model (1),

$$y_i = \beta_0 * x_{1i}^{\beta_1} * x_{2i}^{\beta_2} * \ldots * x_{ni}^{\beta_n} \quad (1)$$

where y_i is the endogenous variable, x_{ni} are independent variables and β_n are parameters of elasticity. After its linear transformation it is possible to find the following equation (2),

$$\ln(y_i) = \beta_0 + \beta_1 \ln(x_{1i}) + \beta_2 \ln(x_{2i}) + \ldots + \beta_n \ln(x_{ni}) \quad (2)$$

[4] This type of functional relation is often used in analogous regression models.

Specific version of the model (3) is enlarged by dummy variables which were not transformed into logarithmic form[5]. The analysis for detection of any multicolinearity[6] was performed and presence of multicolinearity by a VIF test (Variance Inflation Factor) was tested, the final model was specified as follows:

$$\ln(UnitPrice_i) = \beta_0 + \beta_1 Culture_i + \beta_2 \ln(Area_i) + \beta_3 \ln(NrParc_i) + \beta_4 Year_i + \beta_5 \ln(ALP09_i) + \beta_6 districtOC_i + \beta_7 districtPV_i + \beta_8 TransPP_i + \beta_9 TransFarm_i + \beta_{10} FutUsage_i + \beta_{11} CLR_i + \beta_{12} \ln(DistWeiMun_i) + \beta_{13} \ln(DistWeiDistr_i) + \beta_{14} \ln(NrFarms_i) + \beta_{15} \ln(PopDensity_i) + \beta_{16} ShareTI_i + \beta_{17} ShareEAI_i + \beta_{18} Unemloy_i + \beta_{19} \ln(lnhab_i) + u_i \quad (3)$$

where $ln(UnitPrice_i)$ is the logarithm of market land price in CZK/m^2 of the *i*-th contract (i = 1-N) in 2008 and 2009 gained from contracts between sellers and purchasers; dummy variable *Culture* indicates the type of property being sold: (0) represents the arable land and (1) permanent grassland, with arable land the market price should increase; $Area_i$ is logarithm of total area of traded land with expected positive relation to the price with regard to higher efficiency of larger agricultural land management and lower management costs associated with ownership; $NrParc_i$ means logarithm of the number of parcels included in sales, where the growth in the number of plots should reduce the price; *Year* is dummy variable (2009 = 1), $ALP09_i$ is logarithm of official (administrative) land price in CZK/m^2 in 2009 in a cadastral unit assuming the higher administrative prices will stimulate the growth of market land price; regional variables *districtOC* and *districtPV* mean affiliation of a parcel with district Olomouc resp. Praha-východ, and these are expected to contribute to the growing prices in both districts in relation to other districts; variables *TransPP* and *TransFarm* are dummy variables indicating the type of transfer between the seller and the buyer, so the first one represents transactions realized between physical persons, the second between physical persons and agricultural companies or agricultural cooperatives, respectively. The combination of these two dummy variables build an unstated last-group of transfers between physical persons and non-agricultural entities or if need be the seller or the buyer is other than a physical person and where it is assumed that the transfer between entities with no entrepreneurial activities in agriculture

[5] To interpret, it is necessary to put the values of these estimated coefficients off logarithm and subtract 1 from the gained value.

[6] Test of analysis of paired correlation coefficients proved the strong and statistically provable dependence among variables – total increase, inherent increase and migration increase of inhabitants in the municipality. These variables were excluded. By next variables were not indicated any strong dependences (though significant), which would ultimately lead to inaccurate estimates of spreads of parameters

will increase the land price; *FutUsage* is dummy variable explaining future use of agriculture land, where (0) means unlikely non-agricultural use and (1) represents the second lowest level of probable non-agricultural use with expected positive influence to market land price[7]; $DistWeiMun_i$ and *DistWeiDistr* are weighted distances (in km) of parcels to the centre of relevant municipality (regional city), with negative effect on the price due to higher transport costs. $NrFarms_i$ means the logarithm of the total number of farms in the relevant cadastral region, with the growing number of farmers should increase the competitiveness on the land market and so cause the growing price. $PopDensity_i$ represents the logarithm of population density per 1 km^2 in municipality, where is expected positive price effect with regard to higher demand for land for non-agricultural use with its indirect influence on the land price for agricultural use. $ShareTI_i$ indicates the overall increase in population between 1994 and 2009 composed of migration and birth population increase relatively to the number of dwellers of the village, and it indicates to a certain extent of location attractiveness, where a positive relationship to the price of land is expected. $ShareEAI_i$ represents the share of economically active inhabitants on the total population, where is expected a positive relationship to the price of land. $Unemploy_i$ expresses the rate of unemployment in the village with the expected negative impact on the price, $Inhab_i$ represents the size of the municipality with a positive influence on the price.

2.2 Estimates of Models

Models were estimated by statistical software SPSS.16 using the method of the least squares estimation (Ordinary Least Squares) and the Backwards estimation method, which suggests the inclusion of all potential explanatory variables and excludes those that contribute least to explain the total variance. The final estimate was elected the estimation of the model, which reached the highest value of an adjusted R^2, this one that can explain in the best way the course of the dependence of sold land price on explanatory variables with regard to their total number. At first the model was estimated for all 306 observations and with regard to the fact that the market for agricultural land is to a large extend also influenced by specific conditions, in the second step even regional models of market price formation introduced by individual districts have been estimated. Therefore, the system was chosen with the gradual withdrawal of variables in their own estimation.

[7] Original purpose of collecting data was to identify market prices of agricultural land primarily for agricultural use, so in the pre-selection the individual plots in a particular exchange were classified according to the degree of possible future non-agricultural use on a scale of 1 to 5 and with the help of graphic previews in cadastral pictures of LIPS and criteria which took into account the distance of land to the village, the presence of land in an urban area, the degree of built-up area, proximity to roads and paths etc. Where (1) assumes a presumable future agricultural use, and (5) most likely non-agricultural use. Prices were collected only for the scale of future land use classified as 1 and 2, i.e. with high probability to remain in agricultural use. Dummy variable with value (1) in this model therefore represents those sales that were in the origin five-point scale labelled (2).

Results and discussion

The price of agricultural land in the analyzed sample for the years 2008 and 2009 ranges between 1.07 and 48.48 CZK/m^2 at the average price of CZK 8.92 CZK/m^2 (Table 1). Significantly the highest average price was observed in the district Praha-východ, which reached 17.50 CZK/m^2. The price is positively influenced by the proximity of the capital city Praha and represents more than double of the average land price in the whole sample. The price of land in all other surveyed districts is below the average of the sample. Very low price of land has been detected mainly in district Havlíčkův Brod even 4.89 CZK/m^2.

Higher variability of the price was observed also in the classification of contracts according to the type of transfer between sellers and buyers. In the analysis transfers are divided into three groups as follows: (1) in the first group are transfers between physical persons representing 60% of all transfers with the price very close to average; (2) in the second the seller is the physical person and the buyer is agricultural enterprise, which constitutes 23% of all transfers for which the price is on average the lowest (6.20 CZK/m^2) and in the last group is formed mainly by other transfers between physical persons and legal entities with other than agricultural focus, or alternatively the sellers not physical persons but municipalities, non-agricultural enterprises (3), while in this group achieved the highest average price of 11.68 CZK/m^2 of the land.

According to the declared two types of the sold land in the whole survey sample, definitely exceeds the average price of arable land 9.48 CZK/m^2 which is higher than the average price of grassland 5.70 CZK/m^2. The conducted analysis of variance considers the difference in the price between these two types of land statistically significant at the 5% level. Sales of permanent grassland are represented in the sample survey by 15%.

From the time perspective the price rose from the average of 8.23 CZK/m^2 in 2008 to 9.86 CZK/m^2

Variables	Type	description (units)	Interval Max–Min	Min	Max	average	Std. deviation
Dependent variable							
Unit Price	continuous	Unit price (CZK/m2)	47.41	1.07	48.48	8.92	7.67
Explanatory variables							
CULTURE	discrete	0 = arable land.; 1 = grass land	1	0	1	0.15	0.355
AREA	continuous	Area of sold plots (m2)	231 260	2 133	233 393	25 143,80	31 914,50
NrPARC	discrete	Number of sold parcels	12	1	13	2.02	1.666
YEAR	discrete	0 = 2008; 1 = 2009	1	0	1	0.42	0.495
ALP09	continuous	Administrative land price in 2009 (CZK/m2)	15.1	1.31	16.41	8.29	3.95
TRANSPP	discrete	0 = remaining types of transfers; 1 = transfers between physical persons	1	0	1	0.59	0.493
TRANSFARM	discrete	0 = remaining types of transfers; 1 = transfers between physical person and agricultural company or cooperative	1	0	1	0.23	0.419
FUTUSAGE	discrete	0 = preclusive agricultural usage in future; 1 = potential non-agricultural usage in respect to relative proximity of roads or urban area	1	0	1	0.05	0.223
CLR	discrete	0 = non-realised complex land reform in cadastre area; 1 = realised CLR	1	0	1	0,25	0.433
DistWeiMun	continuous	Weighted distance among sold parcels in cadastral area and community centre (km)	23.38	0.82	24.2	7.75	4.34
DistWeiDistr	continuous	Weighted distance among sold parcels in cadastral area and district city (km)	28.5	2.5	31	16.06	7.53
NrFARMS	discrete	Total number of farms farming in cadastral area	36	1	37	10.26	6.54
NrFARMS_km2	continuous	number of farms farming in cadastral area per km2	5.74	0.52	6.26	2.25	1.39
POPDEN	continuous	Population density (number of inhab./km2)	965.48	5.86	971.34	109.94	144.87
SHAREMI	continuous	Share of population from migration increase between 1994 and 2009 in total population (%)	88.03	-30.77	57.26	7.83	12.36
SHARENI	continuous	Share of population from natural increase between 1994 and 2009 in total population (%)	36.39	-25.53	10.86	-2.03	6.09
SHARETI	continuous	Share of total population increase between 1994 and 2009 in total population (%)	100.28	-37.23	63.05	5.79	14.16
SHAREEAI	continuous	Share of economically active inhabitants in total number of inhabitants	41.68	18.9	60.58	46.52	56
UNEMPLOY	continuous	Unemployment rate in municipality where the land is sold	22.7	0	22.7	7.92	4.17
INHAB	continuous	Number of inhabitants	100 332	41	100 373	2 931.45	9 321.72

Source: Own calculation, the Czech Statistical Office, the Czech Office for Surveying and Mapping.

Table 1: Summary statistics of variables in the analysed sample of sold farmland.

in 2009. This difference between the monitored years is statistically significant at the 10% level of significance. But from two-years time series is not possible to judge whether it is a long-term trend. In the Table 1 worth mentioning the other characteristics of the sample as the average total acreage of the transferred land in a single sale, which is 2.51 hectares and ranges from 0.21 to 23.3 ha with the average number 2.02 transferred plots and the maximum number of 13 plots.

In this section follows the analysis of the individual factors influence on the agricultural land sales price. The results of the regression model comprehensively confirmed (Table 1) for all cases in the five districts that the selected variables

have the ability to explain the variance in the dependent variable (F-test results) and the model is statistically significant at 1% level. The value of the coefficient of determination (R^2 = 0.54) indicates that more than half of the variance is explained by the proposed model. From comparison with other similarly oriented studies (Tsoodle et al., 2003; Střeleček et al., 2009; Latruffe et al., 2008) this is a sufficiently high value, because R2 usually reaches values ranging from 0.3 to 0.4. In the following table are presented parameters of the explanatory variables and their statistical relevance entering into the model in the division into three groups (contract-specific, local factors and socio-economic factors).

From the original 24 explanatory variables from the final model the following variables were excluded because of their non-significant contribution in explaining of the total variance. They are dummy variable *YEAR* representing the change in time, that in case of the impact on the price in the interaction of other factors is not so significant year by year; dummy variable *BudUzit* indicating a possible higher rate of non-agricultural use is an insignificant factor due to the low 5% representation in the total sales sample; next dummy variable *CLR* represented in 25% of sales indicating a possible realization of complex land reform; variable NrFarms_km^2 is a number of users of agricultural land per km^2, because the total number of users in absolute terms better reflects the potential dependence; regional dummy variables representing two districts Klatovy and Havlíčkův Brod due to their mutual non-significant difference in the average selling price and in relation to the Znojmo district, which was as dummy variable not viewed, and was created by a combination of the previous 4 regional dummy variables.

Furthermore, most socio-economic variables based on changes in population between years 1994 and 2009, the share of economically active population and unemployment rate, which variability partly explain the regional dummy variables for two districts Praha-východ and Olomouc. Some of the discarded variables in the overall model are significant but in selected regional (district) models, as described below.

According to results presented in Table 2, the type of traded land reduces price because the price of

Model for 5 districts	Parameters	St.D.	test statistics (t)	p-value	Collinearity statistics	
					Tolerance	VIF
(constant)	**1.188**	0.434	2.735	**0.007**	-	-
Contract characteristics						
Culture	**-0.204**	0.090	-2.535	**0.012**	0.751	1.332
LnArea	**0.063**	0.036	1.724	**0.086**	0.729	1.372
LnNrParc	-0.076	0.049	-1.570	0.117	0.878	1.139
LnALP09	**0.400**	0.064	6.240	**0.000**	0.581	1.720
TransPP	**-0.255**	0.077	-3.820	**0.000**	0.531	1.884
TransFarm	**-0.386**	0.093	-5.268	**0.000**	0.509	1.964
Local factors						
DistrictOC	**0.164**	0.074	2.049	**0.041**	0.691	1.447
DistrictPV	**1.977**	0.101	10.823	**0.000**	0.531	1.884
LnDistWeiMun	0.070	0.051	1.361	*0.175*	0.745	1.342
LnDistWeiDistr	**-0.280**	0.059	-4.738	**0.000**	0.682	1.466
LnNrFarm	-0.074	0.049	-1.494	*0.136*	0.776	1.289
Socio-economic factor						
LnPopDens	0.055	0.044	1.265	*0.207*	0.546	1.831
R2	0.546					
adjusted R2	0.527					
F - value	29.357					
Model significance	0.000					

Source: Own calculation.

Table 2: Impacts of factors influencing unit market land prices.

grassland (*Culture = 1*) is lower by 20% compared to the arable land, which is consistent with the general assumption. Another provable finding is the size of traded parcels presented by variable *Area* when with their growth the price is rising. The results show that the unit price of the two hectares of land is about 6% higher than the unit price of the one ha agricultural land with the same remaining parameters. The authors Střeleček et al. (2009) came to the same direction of effect and conclusion that there is a smaller influence of the size of traded land to the realized price of land. In contrast, with the growth of the number of parcels included in the contract, their price decreases, which is probably related to greater fragmentation of land, even though in the case of the number of traded parcels conclusion has a less statistical significance (0.117). The model also clearly showed that the administrative price (*ALP09*) has had a positive and relatively strong influence on the final market price; the factor of the official land price should be understood as the quality of traded land because *de facto* it in itself reflects qualitative soil parameters, such as skeleton, grain size, slanting, slope and soil type. If the „normative" quality of land increases by 1.00 CZK/m^2, then the final selling price would be increased by 0.40 CZK/m^2. Although the quality measured by administrative price is an important factor in the market price, but not the most.

An interesting finding is the fact, how the character of the seller and buyer manifested at the market price. Purchasers as a physical person and/ or agricultural company or cooperative have a „potential" to reduce the price in comparison to a situation where the purchaser is a non-agricultural enterprise. When the transfers realised between physical persons (*TransPP=1*) then the reduction is in the range of 26%, which may be partly influenced by the family relationship between seller and buyer[8]. If the purchaser is an agricultural company or cooperative (*TransFarm=1*) then the price of sold land is even of 39% lower compared to other legal enterprise. This difference is illustrated even more markedly on the ratio of market price to the official land price in the given cadastre that reflects differences in quality of land. For transfers, when the purchaser is an agricultural company or cooperative this ratio reaches values of 0.73, at the transfer between physical persons the ratio is already 1.25 and the last group of market price takes almost double value of the official price (1.85). This finding confirmed the fact that both the agricultural companies or cooperatives and physical persons tend to focus more on rather long-term agricultural investment into land contrary to non-agricultural investors with different motives and expectations about the return from the land.

The geographical proximity of land is a well known factor that significantly determines property prices, including agricultural land. The results show that the land in both districts Olomouc and Praha-východ has definitely higher value by 16% and 198% respectively than the land in the remaining monitored districts (Klatovy, Havlíčkův Brod and Znojmo - this group as such represents soil quality a slightly below the average compare to the whole survey sample). This finding adds another factor – the average weighted distance of land from the district town (*DistWeiDistr)* – which has a negative impact as expected: whereby farther parcels are from the district town, thus the lower is the agreed price. For example, when the average distance of sold plots increases from 16 km by 10% up to almost 18 km, as a result of this change the market price ceteris paribus decreases by 2.8%. Regarding the distance to the municipality (*DistWeiMun*), there is already a slight positive dependence, which however can not be considered statistically significant. Moreover, due to the nature of plots selected in the sample, where are not reflected plots in the urban area of the village then the distance factor to the village centre does not already play a significant role. This is also an explanation of why we come to a different conclusion than the results of authors Střeleček et al. (2009), where the size of the municipality and the distance to the village belong to two the most important factors with the greatest impact on the price of land.

The number of users of agricultural land in the cadastral area (*NrFarms*) also negatively affects the explained market price, i.e. the more farmers cultivated land in the same cadastral area, the lower land price is trading. This relationship is opposite to the default assumption, because a higher number of users gives an opportunity to rent advantageously the purchased land. It is also necessary to prove this relationship further in the longer term even with the regard to its lower statistical significance and its important regional specificity – it depends not only on the number of users, but also on the acreage of land, which is cultivated by individual users. Likewise, it is necessary to proceed also in the case of the variables representing population density, despite the evidence of a positive effect (more densely populated locality „raise" prices of agricultural land) is no longer statistically significant.

According to analysis of nationwide basic model was found out that the spatial location of the land

[8] Tsoodle and Golden (2003) pointed out that transactions between related parties resulted in a 43% discount on the per acre sales prices.

has a significant impact on the market value of the land. For this reason, in the next section we look at the inter-regional differences. In order to investigate the influence of individual factors on the five local markets were created and tested on the regional models for the above mentioned five districts. Diversity of local markets is already apparent from the basic description statistics set out in Table 3.

Statistically significant differences at the 1% level of significance are not only in the case of dependent variable as the unit market price, but in many other explanatory variables and it is possible to expect substantial differences in conditions and individual factors that could explain the varying degree of influence on the market prices at the regional level. In terms of price level for district Praha-východ shows the highest price level as expected with the average price 17.5 CZK/m^2 followed by district Olomouc 9.2 CZK/m^2, next Znojmo 7.24 CZK/m^2, Klatovy 5.2 CZK/m^2 and the lowest price of 4.9 CZK/m^2 in the district Havlíčkův Brod. In a more detailed analysis of the correspondence of the average real prices of traded parcels by using Schéffe test, which is suitable for selections which do not have the same range, district Praha-východ

Variables		Havlíčkův Brod	Klatovy	Olomouc	Praha-východ	Znojmo	Total for 5 districts	ANOVA (F-value; sign.)
No. of observations		28	56	84	52	86	306	
UnitPrice	Average	4,89	5,21	9,16	17,5	7,24	8,92	31,625
	Std. deviation	1,89	3,21	6,9	10,51	5,28	7,67	0
Culture	Average	0,32	0,29	0,15	0,12	0,01	0,15	7,699
	Std. deviation	0,48	0,46	0,36	0,32	0,11	0,36	0
Area	Average	12 230	21 255	31 918	17 049	30 158	25 144	3,802
	Std. deviation	11 213	40 269	31 741	25 848	31 704	31 915	0,005
NrParc	Average	1,6	2,1	2,1	1,7	2,2	2,02	1,222
	Std. deviation	1,4	1,7	1,7	1,1	1,9	1,67	0,301
ALP09	Average	5,2	3,7	10,2	7,7	10,8	8,3	72,33
	Std. deviation	1,9	1,1	4,2	2,4	2,4	4	0
TransPP	Average	0,64	0,66	0,58	0,58	0,53	0,59	0,646
	Std. deviation	0,49	0,48	0,5	0,5	0,5	0,49	0,63
TransFarm	Average	0,14	0,2	0,27	0,06	0,33	0,23	4,098
	Std. deviation	0,36	0,4	0,45	0,24	0,47	0,42	0,003
CLR	Average	0,32	0,2	0,19	0,23	0,33	0,25	1,492
	Std. deviation	0,48	0,4	0,4	0,43	0,47	0,43	0,204
DistWeiMun	Average	6,2	7,6	9	4,7	8,9	7,7	12,089
	Std. deviation	4,4	3,9	3,8	2,1	5	4,3	0
DistWeiDistr	Average	17,5	11	14,7	22,7	16,2	16,1	22,471
	Std. deviation	7,3	5,9	7,7	2,6	7,5	7,5	0
NrFarm	Average	7,3	6,2	8	15,5	12,9	10,3	28,327
	Std. deviation	3,7	3,1	4,1	10,1	4,8	6,5	0
PopDens	Average	77,2	67,2	122,6	211,3	74,8	109,9	10,549
	Std. deviation	74,6	80,4	141,3	239,8	78,1	144,9	0
ShareTI	Average	-2,5	0,2	9,1	17,7	1,7	5,8	21,225
	Std. deviation	13,2	10,7	13,1	14,6	11,7	14,2	0
ShareEAI	Average	46,7	47,2	46,8	42,6	48,1	46,5	9,111
	Std. deviation	3,8	5	5,9	6,5	4,5	5,6	0
Unemploy	Average	7,8	6,6	8,7	3,5	10,7	7,9	40,947
	Std. deviation	3	3,1	4,8	1,8	2,7	4,2	0
Inhab	Average	2 762	3 347	3 797	3 204	1 706	2 931	0,591
	Std. deviation	4 859	6 880	15 194	5 542	5 233	9 322	0,67

Source: Own calculation, the Czech Statistical Office, the Czech Office for Surveying and Mapping.

Table 3: Summary statistics for variables incoming into 5 regional models

created an isolated group with the highest price, the second group consists of two districts Olomouc and Znojmo and third one of the other districts Znojmo, Klatovy and Havlíčkův Brod is a group with the lowest price. This grouping, among other things also explains why in the overall regional model regional variables were significant from districts Praha-východ and Olomouc, whose average prices were statistically significantly different from the remaining districts.

From the given parameters of the explanatory variables listed in Table 4 show that at the regional level the individual factors with a different intensity have some effect and in some cases are changing the direction of their effect on the purchasing land price. From the total of 17 explanatory variables entered into the overall model only 12 variables and 8 of them had an impact which was significant at 10% level. The total number of variables in the regional models was reduced by 2 regional dummy variables, where 12 of them were significant at least of 10% significance level and at least in one of the regional models. On the contrary, the influence of the following explanatory variables became evident at local markets: the number of plots (*NrParc*), conducted complex land reforms (*CLR*), weighted distance to the centre of the municipality (*DistWeiMun*), number of users of soil occurring in the one cadastral area (*NrFarms*), the share of economically active inhabitants (*ShareEAI*) and finally unemployment rate (*Unemploy*).

The most important variable representing the type of transfer between physical persons in the regional model, which in the overall model reduces the price by a quarter compared to other types of transfers, but in three districts decreases the price (Olomouc, Praha-východ and Znojmo) and in district Klatovy increases the price due to the fact that in this district transfers between individuals represent the share of 2/3 of total transfers with a minimum share of other types of transfers and the ratio of market price to the official price (1.7) is by the most common type of transfer also the highest. Another the most frequent significant variable is

	Model for 5 districts	District HB	District KT	District OC	District PV	District ZN
Number of sales	306	28	56	84	52	86
(constant)	1.188***	0,28	−2.903***	4.067***	7.302***	1.783**
Culture	−0.204**	−0.257**	−0.170	−0.370**	−0.400**	-
LnArea	0.063*	−0.194*	0,137	-	-	-
LnNrParc	−0.076	0.593***	-	-	-	−0.099
Year	-	-	−0.171	-	-	-
LnALP09	0.400***	0.369	0.764***	0.349**	-	0.465*
DistrictOC	0.164**	X	X	X	X	X
DistrictPV	1.977***	X	X	X	X	X
TransPP	−0.255***	-	0.343*	−0.472***	−0.262**	−0.398***
TransFarm	−0.386***	−0.456***	0,384	−0.494***	-	−0.457***
CLR	-	0.737*	-	-	-	-
LnDistWeiMun	0,07	0,219	0.497***	-	-	-
LnDistWeiDistr	−0.280***	-	−0.253	−0.583***	−1.315**	−0.346**
LnNrFarm	−0.074	0.343***	-	-	−0.187*	−0.137
LnPopDens	0.055	-	-	-	-	0.118
ShareTI	-	0.009	-	-	-	−0.007
ShareEAI	-	0.037**	0.035**	-	-	-
Unemploy	-	−0.050*	-	-	0.061	0.024
LnInhab	-	-	-	−0.099*	-	-
R^2	0.546	0.809	0.458	0.534	0.405	0.464
adjusted R^2	0.527	0.678	0.352	0.498	0.341	0.4
F - value	29.36	6.170	4.321	14.700	6.269	5.919
Model significance	0	0.001	0	0	0	0

Note: HB – Havlíčkův Brod, KT – Klatovy, OC – Olomouc, PV – Praha-východ, ZN – Znojmo; *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Source: Own calculation.

Table 4: Impacts of factors influencing market land prices in 5 different regions.

type of land (*Culture*), when the price of permanent grassland is in three cases significantly reduced by this factor compared to arable land and it is in the range from 25 to 40%. In the contrary the double improvement in the quality of traded land (*ALP09*) contributes to a clear increase in price by 35 – 76%. In the same way in models often occurs even the type of transfer between the physical persons and agricultural companies or cooperatives which reduces the price by 45 – 50%. Similarly when the distance to district town (*DistWeiDistr*) is increased twice then the price is reduced by 35 – 131%. Other variables are significant in the case of two or one district.

In the district Havlíčkův Brod the price of land is unusually the most affected by the implementation of the complex land reform because the resulting price increases by 74% against the cadastre where it has not been yet implemented. A higher price can be justified by the fact that such land, to which has been secured a better accessibility to parcel and the whole property has been unified, and it gives better possibilities to use this land in its renting or sell. The occurrence of land reforms (*CLR*) is significant only in the case of this district, which is however characterized by the second lowest proportion of transfers when the purchaser is an agricultural company and/or cooperatives (*TransFarm*) and the occurrence of landscaping management more significantly affects the price if the owners are at the same time investors, who are not immediate users of this land. In contrast, surprisingly in this district did not show a significantly positive impact of the quality of traded land, probably due to the lowest average price achieved in this district. Another important factor is the number of transferred parcels (*NrParc*) that by the increase from two to four plots with a constant size leads towards an increase of the price by up to 60%. In this case, the purchase of several small plots was conducted for the purpose of land consolidation. These transactions are characterized by a higher purchase price. Moreover this conclusion is also confirmed by the negative and significant elasticity of acreage of land. At the same time the size of the total acreage of transferred parcels is half portion compare to the overall average selection. Another significant shift in price is given by the fact, that agricultural land is purchasing an agricultural company or cooperative (*TransFarm*). In this case the price is lower by 45% compared to other transfers, and thus also to transfers between physical persons. By the increase of the number of users is also increasing the selling price in accordance with the assumption, because a growing number of users enables to rent land under more favourable economic conditions. In the district Havlíčkův Brod was not shown any significant effect of distance to the district town. Instead of that the socio-economic characteristics had indeed marginal but statistically significant effect, which are represented by the share of economically active population to a total population (*ShareEAI*) with a positive impact on the price and the unemployment rate (*Unemploy*) with a negative influence.

In the district Klatovy is most evident effect of a soil quality expressed by administrative land price even though the average ratio of market and official prices from all districts is the second highest after Praha-východ. This strong dependence has probably been achieved through systematic maintenance of this ratio to its average value of 1.5, with regard to the second lowest achieved market price. Only in this district was confirmed the positive impact of the transfer type between physical persons on the price increasing. It was not indicated a positive affect by the type of transfer, when purchaser was the agricultural company or cooperative (*TransFarm*) due to the low representation of other types of transfers. There is also weakened the influence of the distance to the district town (*DistWeiDistr*), where the average distance is the lowest in this district. But quite surprisingly, the price significantly increases with increasing distance from the centre of the municipality (*DistWeiMun*).

The model for the district Olomouc has the highest significance with respect to the highest number of sales. In this district, which is affected by the presence of the regional city, is the most important factor the distance to the town. The shortening by 10% of distance leads to an increase of price by 6% *ceteris paribus*. Significant influence of the distance reduces the incidence of soil quality at the price. Type of transfer, the purchaser is a physical person (*TransPP*) or an agricultural firm (*TransFarm*), nevertheless the price strongly maintains significantly lower value by almost a half.

The smallest proportion of the variance explanation of the selling price on explanatory variables succeeded in clarification by the data available in the district Praha-východ. Here the distance to capital city is absolutely the most prevalent factor which completely suppressed the influence of soil quality. This is only partly reflected in the dummy variable indicating the type of land belonging to permanent grassland. It is also because the more significant representation of permanent grass is a primarily in the peripheral parts of the southern district, already fairly far from the capital city. Here agricultural companies and cooperatives also buy agricultural land at the highest price (21 CZK/m^2) even when

the ratio of market price to administrative price for these purchasers is the lowest (2.1), compared with physical persons ratio 2.2 and other purchasers of 2.6.

In the district Znojmo is traded only 1% of land with the culture of TTP, therefore the type of land lost significant influence in explaining prices here. The most significantly is the price influenced by the type of transfer and also by the distance to district town. Soil quality has a relatively strong impact but its significance decreased up to 10% of significance level.

Conclusion

The comparison of statistical data on the development of market prices of agricultural land in the Czech Republic with neighbouring states shows between 2008 and 2009 that in our country has not been recorded any significant price growth. A similar situation stands for neighbouring Poland and Slovakia, whereas in Germany, land prices have been growing, and particularly significantly in the new federal states. Accordingly, even in the analysis of the survey sample of the market prices of agricultural land transfers from the five districts of the Czech Republic between the years 2008 and 2009 did not have any significant impact the factor of the year within the transaction.

Which value the society attaches to agricultural land depends on many factors - from the quality across the extent, location and the subjective factors to a certain degree without economic considerations. This contribution is based on the assumption that it is possible to statistically quantify the general factors that determine a relatively high variability in market prices (i.e. that the final price is not only a randomly determined variable). These determinants include the so-called contract-specific factors, such as the current type of land, soil quality, acreage of land included in the contract, but also the character of the buyer. It was confirmed that physical persons pay by a quarter lower price for the purchase of agricultural land, compare to other legal persons and to agricultural companies and cooperatives even by nearly half, with regard that part of this reduction is influenced by the different expectations of each individual investor about a future generated income from land but also due to information asymmetry between buyer and seller and a monopson position of farms on the local markets. The administratively determined price of land (which is based on soil quality) for cadastral area has the most significant impact on the final contract price and that is an equally important finding. For this there are two arguments: the quality expressed by the administrative price is generally accepted by contracting parties and thus „transferred“ into the contract, the second argument may be the fact that the contracting parties at the beginning of contractual relationship have no specific idea about the price and administrative price is the primary indicator which the parties ‚rely‘ on. The second argument, however, can not be mentioned in districts around the capital city (which is probably also valid in other regional cities), where the proximity to a big agglomeration in terms of distance to the district or regional city in these two cases, clearly dominates above the other determinant factors of market prices of agricultural land. In the case of remote rural regions with dispersed settlement structure the distance to the nearest district town becomes insignificant, but on the other hand the price affects other socioeconomic factors such as the percentage of economically active population and unemployment rate, although with a considerably minor influence.

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References

[1] AGRARHEUTE (2011): Deutlich höhere Preise für Agrarland gezahlt. Wirtschaft 17.8.2011. Available in German: http://www.agrarheute.com/agrarland

[2] Bastian, C. T., McLeod, D. M., Germino, M.J., Reiners, W.A, Blasko B.J. (2002): Environmental amenities and agricultural land values: a hedonic model using geographic information systems data. Ecological Economics. 40(3): 337-349.

[3] Buday Š., Bradáčová K. (2010): Úloha a impulzy trhu s pôdou v rozvoji vidieckej ekonomiky a jeho ďalšie smerovanie. VÚEPP Bratislava. ISBN 978-80-8058-539-6 (in Slovak).

[4] Goverment office for Science (2010): Land Use Futures: Making the most of land in the 21st century. Foresight Land Use Futures Project, Final Project Report, London.

[5] Halvorsen R., Palmquist R. (1980): The Interpretation of Dummy Variables in Semilogarithmic Equations. The American Economic Review. 70 (3).

[6] Chavas, J. P., Shumway, C. R. (1982): A pooled time series cross selection analysis of land prices. Western Journal of Agricultural Economics. 07 (01)

[7] Chicoine, D.L. (1981): Farmland values at the urban fringe: An analysis of sale prices. Land Economics. 57(3):353-362

[8] MZe (2010): Zpráva o stavu zemědělství v ČR za rok 2009. Ministerstvo zemědělství. Praha. ISBN 978-80.7084-940-8. (in Czech)

[9] Němec J. (2004): Pozemkové právo a trh půdy v České republice, VÚZE Praha. ISBN 80-86671-12-7 (in Czech)

[10] Němec, J. and Kučera J. (2007): Land market development after the accession to the EU, Agricultural Economics - Czech, Praha, 53 (04), p. 154–160. (http://www.agriculturejournals.cz/public Files/00172.pdf)

[11] Latruffe L., Doucha, T., Le Mouël, Ch., Medonos, T., Voltr, V. (2008): Capitalisation of the government support in agricultural land prices in the Czech Republic, Agricultural Economics - Czech, Praha, 54 (10), p. 451–460. (http://journals.uzpi.cz:8050/web/_generovani/agr_econ _2008.htm)

[12] Poppe Adwin C., Goodwin H.L. Jr. (1984): Impacts of Consumptive Demand on Rural Land Values. American Journal of Agricultural Economics. Vol. 66 (5), p. 750

[13] Střeleček F., Zdeněk R., Lossosová J. (2009): Faktory ovlivňující cenu půdy v České republice. In Zborník recenzovaných prác z medzinárodnej vedeckej konferencie "Aktuálne problémy finančného manažmentu v konkurenčnom a krízovom podnikateľskom prostredí agropotravinárskych podnikov". Slovenská poľnohospodárska univerzita v Nitre. s. 126 – 129. ISBN 978-80-552-0312-6. (in Slovak).

[14] Tsoodle L., Golden B. (2003): Determinants of Kansas Agricultural Land Values, Agricultural Economics Association Anual Meeting, Alabama, Feb. 1 – 5.

[15] Vrbová, E., Němec. J. (2004): Land market development in the Czech Republic. Agricultural Economics, 51 (5), 216-220.

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Disaster Recovery Planning as part of Business Continuity Management

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Abstract

Nowadays, a well functioning ICT infrastructure belongs to the most critical factors of companies across all branches of business. An importance of ensuring the continued operation of information systems, or the rapid recovery of the systems in the case of emergency, has increased. These needs require creating business continuity management plan and disaster recovery planning. This paper describes the creation of emergency and recovery plans and setting recovery objectives significantly affecting their efficiency.

Key words

Business Continuity Plan (BCP); Disaster Recovery (DR); Recovery Measures

Anotace

Fungování ICT infrastruktury je dnes pro většinu podniků kritickým faktorem a je zde kladen stále větší důraz na zajištění jejího provozu a dostupnosti, stále častěji spojovanou s plánováním rychlé obnovy chodu ICT během havarijní situace a jejího uvedení do stavu před touto událostí. Této problematice se věnuje řídící proces Řízení kontinuity činností organizace, který zahrnuje i oblast havarijního plánování ve vztahu k informačním technologiím jako kritickému zdroji v organizaci. Toto plánování je nazýváno Řízení kontinuity IT služeb (IT Service Continuity Management) nebo také Plánování obnovy ICT (Disaster Recovery Planning). Tento příspěvek popisuje tvorbu havarijních plánů a stanovení parametrů zásadně ovlivňujících jejich efektivitu.

Klíčová slova

Řízení kontinuity, havarijní plány, plány obnovy, parametry strategie obnovy.

Introduction

The operation of ICT systems is important part of most businesses. Given the increasing dependence of enterprises on IT services and information systems this part of the infrastructure becomes more critical and it is important to ensure business continuity and availability of these systems and also ensure high-quality preparation of their fast recovery in case of emergency situations. Increasing demands for availability of these resources generates requirements for the continuity of ICT (Business Continuity), and these requirements result in creating plans for Business Continuity Management, which are also part of emergency and recovery plans ICT (Disaster Recovery Planning). However, the construction and following usability and success of these plans depends on many factors. What are the prerequisites and requirements for quality recovery plans? What should the plans contain? How to test their applicability in business environment?

Methodology

During the implementation of BCM and DRP is important to pay attention to two facts. The first is of course expected knowledge of the issues and terminology, good orientation in an environment where the implementation of this style of management will be performed and finally allocating resources and determining the roles. The second important task is a plan creation itself according to individual needs of the organization or company, including setting of all key parameters.

This paper describes both the mentioned facts. According to BS 25999 standards describes and

outlines a possible way of preparing the organization before the introduction and implementation of those plans according to business continuity planning life cycle, as well as an explanation of the role and possibilities of establishing relevant functions and parameters for their implementation.

BCM

Firstly, it is important to become familiar with the concept of Business Continuity Management (BCM) and unify the meaning of related terms.

Business continuity management is the planning process and identification of potential impacts of internal and external threats and consequential losses, which could be due to disruption or loss of key business processes from the accident, attack or disaster. BCM has evolved in response to the technical and operational risks that threaten an organisation's recovery from hazards and interruptions as a form of crisis management since the 1970s (Herbane 2010). This managerial discipline establishes operational and strategic framework, adapted to the needs of the organization, ensuring continuous improvement and resistance to mentioned disruption. These disruptions can be predictable and unpredictable character. The most frequently reported incidents and emergency events could be of different nature and scale, classified as short-term interruptions such as power outages, minor faults in the network, or failure of any element in the technological chain, as well as mid serious events, which may be e.g. fire in a room, to the real accident with devastating effect in the form of floods, cyber attacks, theft of equipment or loss of sensitive data. All of these threats, including many others, have a common effect in the form of threat to the continuity of the processes of the organization. This deals with "Use of simulation in a factory for Business Continuity Planning" (Tan, Takakuwa 2011) following: "Companies can suffer significant losses as a result of unanticipated business disruptions caused by natural disasters or outbreaks of disease. In order to restore the organization's critical functions and minimize the impacts of a disruption, it is important to establish business continuity planning and recovery planning." The aim is to create a plan and an environment that ensures continuity and recovery of critical processes at a predetermined minimum level, ideally to the original level. In addition to solution and recovery consequences caused by those incidents or accidents, it is also about prevention and planning how to prevent these threats, both as a preventive actions (redundancy, virtualization, backup, spare parts and spare buildings) as well as setting policy organization and expanding awareness of these plans and procedures. In short, in the case of an accident implemented business continuity management is used for recovery operations with minimal negative impact on the performance as quickly as possible according to requirements of business plans, contractual obligations to customers or legislation.

2.1. BS 25999

The uniform standard that describing the correct procedure for incorporating BCM into the infrastructure of the organization was published in 2006 in Great Britain under the name „BS 25999 - Code of Practice for Business Continuity Management" by British standards Institute (BSI), in collaboration with the Business Continuity Institute (BCI). This standard consists of two parts, the first section labelled „BS 25999-1:2006 Code of practice for business continuity management" [1] establishes the general principles, terminology and recommendations for implementation of the BCM in an organization. The second part, published in 2007, called „BS 25999-2:2007 Specification for business continuity management" [2] describing the requirements for certification of business continuity management and requirements that can be objectively and independently audited.

2.2 Business Continuity Planning Life Cycle

Complete processing and final form of business continuity plan will vary according to the needs and nature of the organization. And this fact is essential to business continuity planning (BCP), BCM according to BS 25999-1:2006 can be implemented in all types of organizations regardless of size or area of business. It is important to compliance with the recommendations and standardized continuity. In BCM, this management process is called the business continuity life cycle. For proper functioning of business continuity management is important to its integration into all levels of an organization from top management (BCM support, set the scope and objectives, resource reservation...) to average workers through training, awareness and overall consciousness raising of its importance. The top management of the organization has responsibility of the functioning of the entire organization just as a business continuity management. There should be a designated manager responsible for the complete program of BCM.

The individual steps of BCM life cycle (Fig. 1) and subsequent implementation are as follows:

Understanding and awareness activities in the organization

This step in the process of business continuity management, primarily including an analysis of

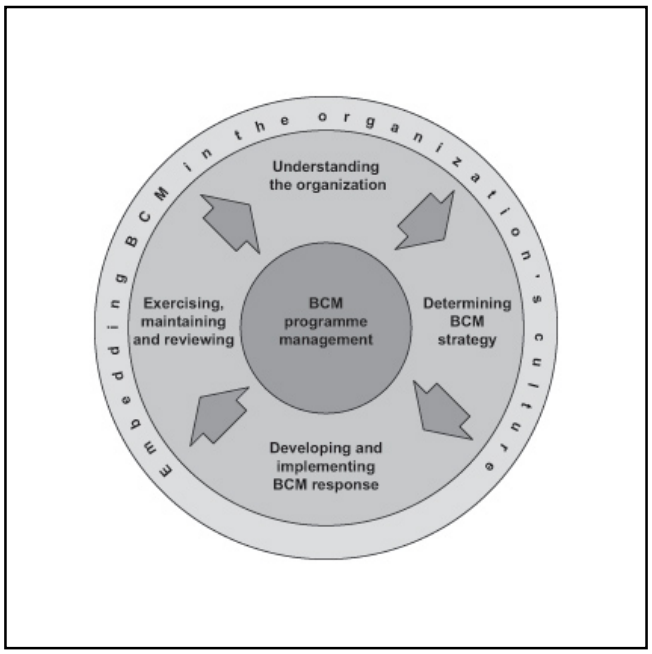

Figure 1: BCM life cycle.

the current situation, consists of several sub-steps, which have a crucial influence on the efficiency generated by the plan, and therefore is placed maximum emphasis on the consistency of their implementation. These individual steps are as follows:

- Statement and willingness of management to implement the project, determine the structure of the project and way of its leadership.
- Identification of key processes, resources and critical activities of an organization that directly affect business continuity and delivery of products or services to the customer.
- Business Impact Analyses (BIA) is intended to separate the important (critical) functions and activities of the organization from the less important (non-critical). The function can be considered important when the threat can cause unacceptable risk to the results of the organization. The function can also be considered critical if it is subject of law. Primary results of the analysis used in the next step of implementation of BCM are to set Maximum Tolerable Period of Disruption (MTPD) and Maximum Tolerable Data Loss (MTDL). For each critical function are also assigned two values - Recovery Time Objective (RTO), which represents the maximum acceptable amount of time to restore function, together with the Recovery Point Objective (RPO) indicating the maximum acceptable level of data loss. The established RPO must ensure that MTDL not exceeded for any activity. Similarly, the RTO to ensure that the MTPD is not exceeded. Process of RTO and RPO parameters setting will be given later in this article.
- Threat Analysis is the next recommended step in the form of documentation of potential threats, along with detailed specifications of the individual steps of recovery. The most frequently mentioned threats are discussed in chapter 2.
- Risk Assessment is the quantitative or qualitative determination value of risk associated with specific situations and documented threats. Quantitative risk assessment requires calculation of two components - the risk and size of potential losses, together with the probability that the loss occurs. Methods of risk assessment varies according to the defined objectives of the organization in various sectors, along with a defined financial plan and taking into account possible threats in the sense public health, environment and ecology.
- The final selection of appropriate risk management measures to reduce their probability of occurrence, time minimizing disruption and impact on critical processes of the organization.

Determination of BCM strategy

Following the previous steps an appropriate strategy should be designed at this stage to identify possible forms of incidents and responses to them. Reaction means the activation of business continuity plan (BCP) and the subsequent variations and methods of recovery of critical activities in defined times.

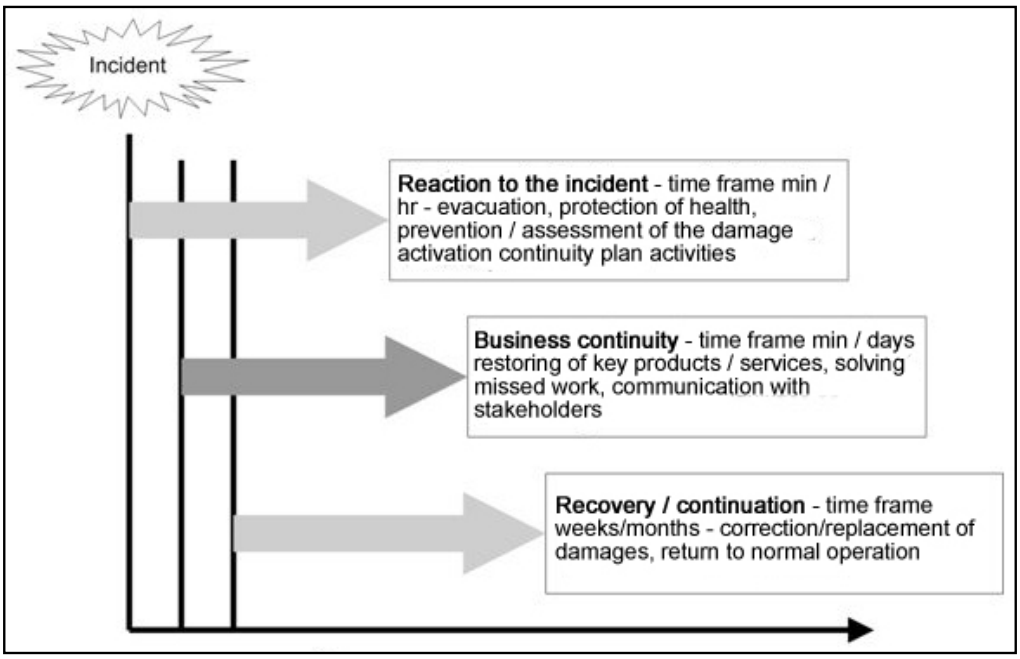

Figure 2: Timeline response to the incident.

The objective is to establish such procedures, under which an organization would be able in the shortest possible time to react to a certain incident, maintain control over the situation and ensure the required level of continuity of critical activities. To determine these strategies is essential to plan engagement, the type and amount of key resources such as people, finance, alternative energy sources and technologies, and contracted third party services.

Among other things, it is generally recommended to consider the following scenarios when creating strategies:

- Impossibility of physical presence in the building;
- Lack of human resources;
- Failure of technology and equipment necessary for the operation and provision of services;
- Failure of a key service provider.

Development and implementation of BCM

At this stage of the BCM lifecycle is a major step the establishment and implementation of the plans previously built according to analysis and strategies of organizations whose objective is to maintain, or in the shortest time possible recovery of critical processes to an acceptable level in case of their violation. For smaller organizations may be quite sufficient only one comprehensive plan of continuity, while larger organizations may prefer more interconnected plans, either because of the division of roles and responsibilities, as well as simplicity and clarity.

Another integral part of development of BCM is the definition of authorities and responsibilities of participants in the form of emergency management roles and group roles. These can be divided as follows:

- Crisis team.
- Coordination team,
    - a team leader,
    - a team member.
- Operational team,
    - a team leader,
    - a team member.

On the basis of determined roles is necessary to determine who is responsible for electing a crisis team (e.g. leadership organization for crisis management). Furthermore, to determine for what actions is coordinating team responsible, who are members and their representatives, when those representatives are taken on their roles, as well as the determination that the team leader is responsible for tasks coordination team, setting tasks for individual team members, managing the tasks of the coordinating team and ensuring conditions for the efficient performance of tasks of the coordinating team according to technological and organizational perspective. Similar definition of responsibility is necessary to provide for the operating team, its leaders and individual members.

From the perspectives of authorities is necessary to determine their purpose and scope, conditions and procedures for activating the plans, the choice of alternative sites, including the redeployment plan, order and sequence of tasks, a list of important contacts and suppliers of services provided by third parties.

Testing, maintenance and revision of BCM

The objective of this phase of the BCM life cycle is to create a testing program, which is consistent with the subject of business continuity plan. Testing helps especially revealing any discrepancies and omissions before they are used in case of accident. Also serve as a tool used to check the completeness and functionality of the business continuity plan(s), is also used for prediction and subsequent control of various forms of accidents that allows an organization to develop innovative solutions. Each operational team is responsible for testing disaster management and also for reporting the results to coordination team. Coordination team is entitled to change the scope and method of testing. Each test should have clearly defined goals and objectives. After the testing should be organized a meeting to analyse results, where the achievement of goals and objectives of testing will be discussed. After that a report containing recommendations and a timetable for implementation measures should be created. The scope and complexity of testing should be appropriate to the recovery goals of the organization activities. Business continuity plans should be tested, to ensure that they can be properly carried out and that contain the details and instructions. Testing and inspection plans should take place at regular intervals, according to the schedule approved by senior management organization or whenever significant changes occur that may affect business continuity of the organization. Testing should not cause disruption and thus endanger the organization by itself. The course of each test must be recorded in detail; all activities and test results must then be reviewed. Testing can take various forms due to the complexity, process control, and subsequent changes, as well as frequency, or. regularity of its implementation. For an idea may serve the following models:

- Basic check of continuity plan called „from the desk“ - reviewing content, raising objections to the status quo - audit / verification and subsequent updates - at least once a year;
- Mid-complex simulations of individual parts - the use of artificial situations in a lab environment designed to validate the expected results - as needed once or twice a year;
- Mid-complex testing of critical activities - causing controlled situation in a production environment that will not disrupt the normal functioning of the organization - as required annually or less frequently;
- Complex business continuity plan testing - testing across the organization, building, complex of buildings or areas - once a year.

DRP

A special chapter in the BCM is emergency planning in relation to information technology as a critical resource in the organization. This plan is called the IT Service Continuity Management and Disaster Recovery Planning as well. There are combined technological capabilities to ensure recovery of hardware and software, but also some elements from the above methodology. Indicators of Recovery Time Objectives type (RTO) and Recovery Point Objectives (RPO) help us to define the real requirements to ensure operation of our systems and propose appropriate solutions to these requirements. The expected outcome is pre-defined priority recovery of IT functions and components, critical path for their recovery, including the duration of each step.

Strategies

After the impact analysis and risk analysis is needed to build recovery strategy. This involves setting RTO and RPO parameters with regard to the analysis impacts. As mentioned, the RTO (Recovery Time Objective) represents the maximum acceptable outage time business process, RPO (recovery point objective) the maximum allowable data loss for a defined time. Both parameters can be different.

If the strategy is defined and critical business processes are identified, including links to ICT technologies, then is created a list of technical and organizational measures whose implementation costs must be balanced with the cost of impact analysis. The technical part is about investment in infrastructure, UPS, alternative locations, etc. The organizational measures are about updating of existing internal documents, users familiar with their duties and responsibilities, changes in contractual relationships with suppliers that reflect the new demands for services supplied, etc. In short, RTO and RPO therefore helps to avoid unnecessarily costly measures, e.g. is not needed nuclear cover on a server room, if there is a duplicate one in another location and RTO is set to 24 hours. Optimal expenditures are shown in figure 3.

Disaster recovery plan

Disaster recovery plan describes the activities that need to begin to implement immediately after detection of an incident for which a DRP is drawn up (e.g. air conditioning failure in the datacenter). It must be mentioned in them, who can run the emergency plan, who participates this plan, what is the purpose of the plan and what is the target state after implementation of the emergency plan. The Recovery Plan assumes completion of the disaster (emergency) plan. It is a technically oriented plan designed for ICT workers, which allows recovery of ICT business processes and return to normal operation. Emergency operation plan defines the working methods and activities that can keep critical business processes at least on a limited level until the information system is restored so that the impact on the operation of the organization is minimal. Defines alternative techniques, which perform critical activities without ICT for a specified period of time. The plans should include the approximate timeline of the sequence of events leading to fulfilment of RTO and RPO. To ensure quality, efficiency and up-to-date of business continuity management process is needed maintenance, testing and updating plans and further education of interested users focused on understanding the processes associated with the DRP.

Conclusion

As already mentioned, the dependence of enterprises on ICT infrastructure across all sectors is increasing. Many organizations did not feel the need to to deal with the DRP in the past, because the dependence on ICT was not so big and production could run for some time regardless of a data network in the organization. With the advent of new technologies for manufacturing automation and production is growing demand for cooperation with ICT. Due to the mentioned dependence is therefore necessary to plan and think about situations that may arise as a result of accident or disaster and try to avoid these situations by business continuity and DRP. For example, even in the classic and often conservative environment of agricultural holdings the trend of ICT usage is still on the rise and companies implements and uses these technologies both in production and for common use such as web browsing, e-mail, e-banking, etc. (Šimek, Vaněk, Jarolímek, 2008). Along with the implementation of these technologies and their increasing dependence (e.g. collection of data stored in the database, the implementation of ERP systems, data evaluation for future development, etc.) is thus important to protect critical data and to keep business continuity in case of disruptions or threats. Therefore, even here in the agricultural environment, is important to think about potential threats and plan for possible situations, and especially their progress and solutions using BCP and DRP. It is always important to make these plans individually to the needs of the organization and to find the optimal amount of costs and determine the maximum tolerable period of disruption and recovery time from which the specific measures will be based on. To determine the optimal amount of costs are available properly set up parameters RTO and RPO. The specific results of the chosen strategy may

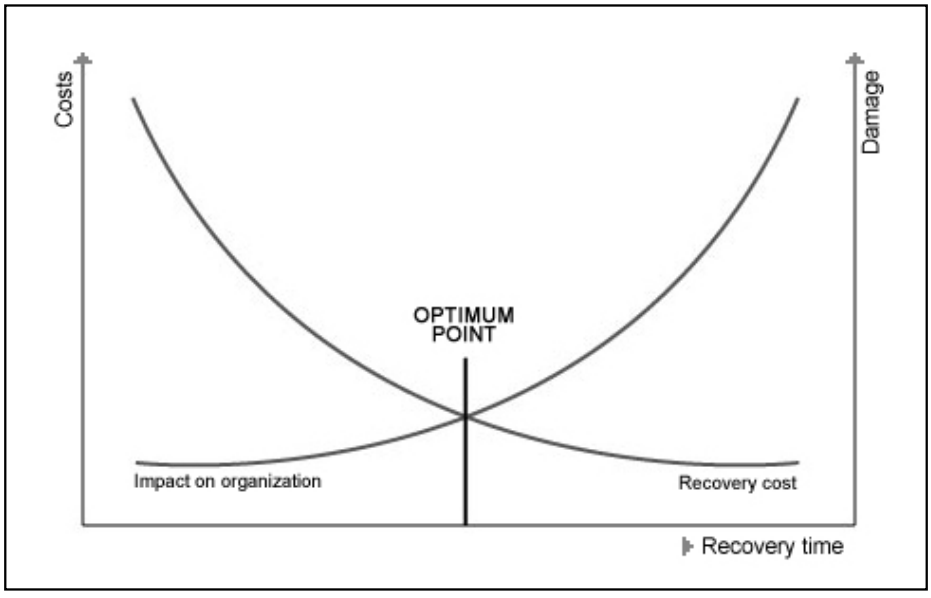

Figure 3: Optimal spending on business continuity.

include, for example, settings of backup policy, data replication, high availability systems, active and passive devices, Local mirrors of systems and/or data and use of disk protection technology such as RAID technology, implementation of surge protectors and uninterruptible power supplies and backup generator eventually, fire protection, server virtualization for easier backup and recovery (the recovery time decreases from the order of hours to order of minutes in this case), database server backup and eventually redundant instance of ERP system, suitable anti-virus and firewall protection, etc. This short list is far from definitive, and as already mentioned, it is necessary to create suitable and optimized solutions to the needs and possibilities of each particular company or business.

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References

[1] BS 25999-1:2006, Business continuity management – Part 1: Code of practice. London: British Standards Institution, 2006.

[2] BS 25999-2:2007, Business continuity management – Part 2: Specification. London: British Standards Institution, 2007.

[3] Cannon, L. David. CISA Certified Information Systems Auditor STUDY GUIDE, Second Edition. Wiley Publishing, 2008, ISBN: 978-0-470-23152-4.

[4] Herbane, B. (2010): The evolution of business continuity management: A historical review of practices and drivers. Business history. 52(6): 978-1002. ISSN: 0007-6791.

[5] Neudorfer, W. - Marinos, L. - Schaumuller-Bichl, I. (2010): Business and IT Continuity Benchmarking. Communications and multimedia security, proceedings / Lecture Notes in Computer Science. 118-129. ISSN: 0302-9743. ISBN: 978-3-642-13240-7.

[6] Office of Government Commerce (OGC). Continual Service Improvement. TSO (The Stationery Office), 2010, ISBN: 978-0-11-331049-4.

[7] Office of Government Commerce (OGC). Service Design. TSO (The Stationery Office), 2007, ISBN: 978-0-11-331047-0.

[8] Office of Government Commerce (OGC). Service Strategy. TSO (The Stationery Office), 2007, ISBN: 978-0-11-331045-6.

[9] Office of Government Commerce (OGC). The Introduction to the ITIL Service Lifecycle, 2nd Edition. TSO (The Stationery Office), 2010, ISBN: 978-0-11-331131-6.

[10] Sharp, John. Jak postupovat při řízení kontinuity činností. Praha: Risk Analysis Consultants, 2009. ISBN 978-80-254-3992-0.

[11] Tan, Y., Takakuwa, S. (2011): Use of simulation in a factory for Business Continuity Planning. International Journal of Simulation Modelling. 10(1): 17-26. ISSN: 1726-4529.

[12] Šimek, P., Vaněk, J., Jarolímek, J. Information and communication technologies and multifunctional agri-food systems in the Czech Republic. Plant, Soil and Environment, 2008, roč. 54, č. 12, s. 547 - 551. ISSN: 1214-1178.

[13] Vaněk, J., Jarolímek, J., Šimek, P. ICT technologie v českém zemědělství. Zemědělec 33/09 – Informační a komunikační technologie [online]. 2009, 9, [cit. 2011-11-28]. Available at: < http://www.agroweb.cz/ICT-technologie-v-ceskem-zemedelstvi__s403x34314.html>.

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ICT helps to overcome disabilities

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Abstract

As a result of technological progress ICT (Information and Communication Technologies) has created the so-called „digital divide“. Some people are unable to individually respond to this progress, but the proper use of ICT can help them overcome this handicap. One of the possibilities is to create accessible and usable applications depending on the character and level of disability.

In accordance with the European CertiAgri project, e-learning tools are used for integrating people with disabilities into the horticultural area. The paper specifically describes examples of simple teaching aids from the practical „green care“ course, which focus on the skills of people with mental disabilities.

Key words

ICT, mental disability, educational materials, CertiAgri, accessibility, usability.

Anotace

ICT jako výsledek technologického pokroku vytvářejí také tzv. “digitální propast”. Někteří lidé nejsou schopni na tento pokrok samostatně reagovat, avšak správné nasazení ICT jim může pomoci tento handicap překonat. Jednou z možností je vytváření přístupných a použitelných aplikací dle charakteru a úrovně handicapu.

V souladu s evropským projektem CertiAgri jsou vytvářeny učební e-learningové pomůcky pro začleňování hendicapovaných občanů v oblasti zahradnictví. V příspěvku jsou konkrétně uvedeny ukázky jednoduchých učebních pomůcek z praktického kurzu “Péče o zeleň”, který je zaměřen na zvyšování kvalifikace pro občany s mentálním postižením.

Klíčová slova

ICT, mentální postižení, výukové materiály, CertiAgri, přístupnost, použitelnost.

Introduction

The digital age continuously brings new possibilities in ICT. These possibilities lead to the increase in the competitiveness of enterprises, but also create a „digital divide“ for some people. In many cases there is a difference in the Internet usage presented by the low digital literacy. This has an impact not only on job opportunities, but also on education, creativity, commitment, confidence and guidance in the use of digital media. Problems with accessibility and usability are also felt by people with disabilities. If we cross over this „digital divide“ we can help disadvantaged social groups to participate in the digital society in a more equal way and overcome their disadvantage through better employment opportunities (Digital Agenda, 2020).

Many studies over the last 30 years have shown that technology can play a significant role in any work with specific disadvantaged groups such as the blind and those with movement disabilities. It can do so in the provision of media to facilitate communication and education, but also in other learning (Tas and Tatnall, 2008).

Material and methods

The aim is to analyze the potential of new ICT for overcoming persons` disabilities Educational materials for people with mental disabilities have

been created within the European CertiAgri project. Due to the specificity of these citizens, the main emphasis is placed on maximum usability and simplicity of the created teaching materials.

Results and discussion

Mental handicap

The term handicap, which was formulated in 1827, comes from the environment of horse racing. Handicap means „hand in cap“ and it is used to express particular disadvantages. For example, it could be a disability (physical, mental) which hampers and limits normal life. Instead of the term a „disabled person“ we usually use the term „person with a disability“ In this paper, in accordance with the aim of European CertiAgri project we focus on persons with mental disabilities.

Mental disability (mental retardation) is a developmental disorder of the integration of mental functions, affecting individuals in all aspects of their personalities - mental, physical and social. The most striking feature is a permanently impaired cognitive ability, which manifests itself primarily in the learning process. Possibilities for education are limited depending on the degree of disability (Pipeková, 2006).

Mental disability is not a disease but a state. It is estimated that people with disabilities make up about 3% of the total population and also the largest group among persons with disabilities. Most of them are of school age. They need guidance and lifelong support (Valenta and Krejčíková, 2003).

To enable handicapped individuals to move alone, orientate and flexible operate in working life outside the designated special routes, they need to obtain an individual resources that will control themselves (Bartoňová, 2005).

Status and possible solutions

Education of persons with mental disabilities

Upbringing and education of persons with mental disabilities can be understood as a lifelong process. An integral part of the complex care and support for individuals with mental disabilities are special educational centres. Their work is defined by Decree No. 72/2005Sb.

These centres provide special readiness of pupils for compulsory education, special educational needs, technical documentation for the integration of these pupils, they also provide education for students with learning disabilities, educational and psychological diagnosis, advisory services, methodical support for staff in schools, etc. (Pipeková, 2006).

A significant number of students with learning disabilities, or special needs, require assistance and support in their learning. The introduction of Information and Communications Technologies (ICT) and use of the Internet have played a major part in shaping the knowledge and skills of these students (Tas and Tatnall, 2010).

Adults with mental disabilities can attend sheltered workshops, special centres and other institutions to further develop their skills and social awareness. Retraining courses are also carried out within these centres, but without much support in the form of online materials and courses.

ICT solutions aimed at compensating for disabilities, such as memory problems and daily activities demonstrate that people with mild to moderate mental disability are capable of handling simple electronic equipment and can benefit from it in terms of more confidence and enhanced positive effect (Lauriks, 2007).

The specification of psychological processes of mentally handicapped persons

Perception - sensory cognition - the process of shaping the experience is slow and takes place with certain variations, the lack of spatial perception, imperfect perception of time, tactile sensations numbness, poor coordination of movement.

Thinking - is loaded with too high a specificity, inaccuracies and errors in the analysis and synthesis. It is unable of higher abstraction, it is inconsistent, terms are clumsy, judgments are inaccurate.

Memory - all new sensations are acquired only slowly and on multiple repetitions, these people quickly forget and recall inaccurately, they are unable to assert knowledge in practice or in time.

Attention - has a low range of reference field, is unstable and easily fatigued.

Will - a specific feature of mental retardation is a will disorder, indecisiveness, lack of will, a reduction of voluntary activities, inability to initiate activity.

Speech - one of the most characteristic symptoms of this disability is a disruption of communication skills, impaired speech development; a considerable delay is affected by the degree of mental retardation.

Emotions - imbalances, emotional instability and aggression, emotions associated with the cognitive activity of person, curiosity, cognitive interests are affected (Valenta and Műller, 2003).

Each mentally disabled person is a distinct entity

with characteristic personality traits, nevertheless, most of them manifest themselves as characteristic features in different periods of life, depending on the depth and extent of mental disability (Vítková, 2004).

Education of disabled people - the application of Mary Montesory pedagogy

Teaching of mentally disabled children and adults is almost impossible without help. It is still needed to encourage and motivate them into action. Interest of mentally disabled people in an activity during their separate search is lower. Also, preparation of tools is demanding. Didactic material must involve much smaller steps, so that a person with this condition could come to the goal unaided. The idea of integration and socialization of people with multiple disabilities provides the basis. Mary Montesory methods are suitable for both children and mentally disabled people. Students learn in a well-prepared and controlled environment. A different time scale for understanding, mastering the curriculum and various activities is respected. An uneven pace of acquiring the knowledge and skills as well as different levels will allow students to learn from each other.

Integration and inclusion

Employment of individuals with mental disabilities

Work performs a number of functions in human life. It structures the life time, brings a sense of self-fulfillment and mediates human social interactions. It can be stated that integration into the working process is seen as acknowledgment of a fully-fledged person. This has a positive effect on his or her confidence. The choice of training pathways and subsequent employment is a significant and very important milestone in the life of every person. It is not always easy to reconcile the interests, inclinations, desires, skills, mental and physical abilities with the assumptions and requirements of a particular occupation. In order for people with mental disabilities to be involved in simple work activities in sheltered workshops or other workplaces as well as adapted household chores in the family, they need to acquire a practically usable range of skills and habits of the working classes. Everything, what the students learn, increases their self-sufficiency as well as independence and helps them and their surroundings live together. The problem with mentally disabled individuals, in contrast to some of their unaffected peers, is too much free time, which they are not able to use effectively. The skills they obtain during their work in the workshop, classroom, course or in the field, help them alleviate this problem, or completely remove it (Švarcová, 2001).

Adult education is a special phenomenon of the present civilization. Mentally disabled people need the knowledge and support of lifelong learning. Although it does not seem effective its results are very helpful for the life of such individuals. Mentally disabled adults, if left without guidance, lose their hard-won knowledge, skills and habits. Education in adulthood provides important fulfillment for individuals who are not employed for various reasons. It opens new possibilities not only in their socialization. For adults with mental disability education as a goal becomes a value in itself and that is worth pursuing. It positively affects their self-concept, enhances self-confidence and thus it gives space for understanding the new social roles. In many countries, there is part of the training courses for adult mental acquisition and further development of communicative and assertive skills and skills required for independent decision making (Vítková, 2007).

Entry into the free labour market is one of the most important manifestations of social emancipation of people with intellectual disabilities. It provides them with the enhancement of self esteem and confidence, greater control over their own lives, widening the range of interests and new social contacts, social benefits, improving everyday skills, better meet their own ideas about the application of labour, better use of their own abilities at work, flexible support, adult support roles, the opportunity to gain social respect, natural integration into mainstream society and greater job certainty (Johnová, 1999 in Valenta and Műller).

Creating and implementing of support programmes for persons with mental disabilities is advantageous from an economic point of view. Long-term care is more expensive than supported independence and meaningful work. Even low-paid employment or part-time employment gives a person with mental disability status of an adult and feeling that his real work contributes to society and the work stimulates and maintains the skills and habits (Černá 2009).

Persons with serious level of mental disability are able to work under supervision - in sheltered workplaces, other options include supported employment. The basic objective is to prepare the trainee with severe disabilities for the performance of less demanding professions. These jobs are characterized by their monotony, and therefore are not sought. These include working as a kitchen helper or doing odd jobs in gardening, etc (Pipeková, 2010).

The transition from educational institutions to work can be considered a critical period of the individual with mental disabilities. Graduates often lose their habits of the school period and motivation. They may become convinced that the state must take care of them (Černá, 2009).

The CertiAgri Project

Development and maintenance of access to ICT must be driven by the needs of people with disabilities. Developments which broaden the scope, applicability and usability of the human technology interface will be driven, at least in part by the needs of people who have disabilities (Cook, 2009). Besides accessibility issues, e-learning applications have to face more general problems related to usability (Mesiti, 2011).

New web applications must reflect the current state of technology and respond to end-users, so that they can find additional value in these applications (Havlíček, 2011).

The aim of the European CertiAgri Project, which is a part of the TRANSFER OF INNOVATION, LEONARDO DA VINCI, Lifelong Learning Programme, is the creation of pedagogical supports in the form of online materials that are created with regard to the target group - mentally handicapped people. These courses should help persons with mental disabilities through retraining in horticulture. Courses are designed as simple procedures describing the required jobs. Materials are designed for people with intellectual disabilities however students need the help of an assistant in the navigation through the course. In each course there is time reserved for evaluation of the students knowledge in the form of questions, interactive paintings and drawings. Drawing is an important medium of communication. It is a specific way of language, which can replace deficiencies in the commonly used language.

The general, dealing with the situation of disabled people is expressed by the scheme of Courtay and Hoerter (2010). In this scheme, the term „Travail - Job“ emphasizes future work (employment) for citizens with disabilities and forms the apex of the pyramid. The base of the pyramid is formed by the Education (Training) and Support (Appuis) axis, which is influenced by local social resources.

For the creation of educational materials and organization of practical courses, European experience from the activities of „social enterprise“ as a French „la main verte“ have been used.

There are complex elements, concepts and structures in e-Learning, difficult to transmit to people with disabilities. (Guenaga, 2004)

The principles of education are based on practical experience teaching hours in the field, where students learn or are trained in individual jobs, as well as in the necessary theory. Learning support materials are intended as a summary of the methodological instructions for self-learning and also to repeat reminders and skills acquired through practical experience.

There are some materials of horticulture course described below, namely planting of trees. Although some images and animations may look naive, they are close to the level of understanding by students with intellectual disabilities and very well describe the feelings experienced during the actual job.

Materials are mostly visual and multimedia character with a short description. The reason is a visual reminder of perceptions, which are often enriched with icons describing each of the displayed items of information. These icons show job objects, tools and activities. These icons remain unchanged throughout the course and the students are accustomed to them.

In individual courses there are also photos and

Figure 1: Handicap employment scheme.

Figure 2: Sample animation of tree planting. This is the first frame of animation.

Figure 3: Description of main work object in known environment.

Figure 4: Tree - we put it into the excavated pit.

Figure 5: Spade - we used it to prepare the ground.

Figure 6: Implemented instruction - snapping a pillar of planted tree.

Figure 7: Pictures related to the course - visual, schematic and intellectual experiences.

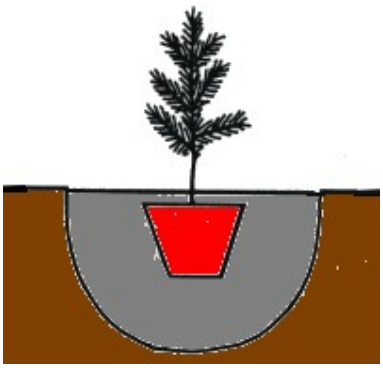

Figure 8: Pictures related to the course - visual, schematic and intellectual experiences.

Figure 9: Pictures related to the course - visual, schematic and intellectual experiences.

videos collected that experienced by the pupils themselves and relate to performed learning.

Again, by the visual information there is presented the outcome of the course to students.

Courses are currently being designed and created on the project website - certiagri.eu. There are also multimedia records, including videos, being developed. They gradually take individual students through the course. The teaching materials can also be used outside the courses. An emphasis is focused on repetition and detailed labeling of individual operations.

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Conclusion

The digital society must be balanced, ie. it also must offer support to those who must live with disability. It is necessary to use modern ICT, which allows integration of people with mental disabilities. Results to date indicate that a sensitive approach can create learning materials that can help these people to gain skills and find application in the labour market. Although the creation of courses and materials for people with mental disability is challenging we hope to help in their teaching and learning as well as in their better inclusion in society.

The solution of problems of disabled students by the help of information technology is localized on the acquisition and information processing (Benda, P. 2010). The examples and implemented practical lessons for people with mental disabilities are commended by concerned people as well as by their assistants very much. Currently prepared materials are included in the specific on-line lectures and will be repeatedly tested for appropriateness of their usage.

Existing experience confirms that this form of teaching and presentation of materials can actually lead to the improvement in education of people with mental disability and their better inclusion in the society in general and in the field of horticulture in particular.

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References

[1] Bartoňová, M., et al. Integrace handicapovaných na trhu práce v mezinárodní dimenzi. Brno: MSD, 2005, 201 s. ISBN 80-866633-31-4.

[2] Benda, P., et al. Possibilities of web-conferencing systems for disabled students. In AGRIS on-line Papers in Economics and Informatics. Prague : Information and Consulting Center of FEM CULS Prague, 2010. s. 81-86. ISSN 1804-1930.

[3] Černá, M. et al. Česká psychopedie. Speciální pedagogika osob s mentálním postižením. Praha: Karolinum, 2009. 222 s. ISBN 978-80-246-1565-3.

[4] Cook, A. M. Using the Web and ICT to Enable Persons with Disabilities : Biomedical Engineering Systems and Technologies. In Communications in Computer and Information Science. Berlin : Springer Berlin Heidelberg, 2009. s. 3-18. ISBN 978-3-540-92219-3.

[5] Courtay, M., Hoerter, P. L entreprise apprenante en agriculture au des personnes en situation de handicap. I.D. L Edition 2010. ISBN 978-2-915626-61-2.

[6] European Commission. Digital Agenda for Europe 2020[online]. 2010 [cit. 2011-10-28]. Available from WWW: <http://ec.europa.eu/information_society/digital-agenda/index_en.htm>.

[7] Guenaga, M., et al. Accessibility for e-Learning Environments. In Lecture Notes in Computer Science. Heidelberg : Springer Berlin, 2004. s. 626. ISBN 978-3-540-22334-4.

[8] Havlíček, Z., et al. WWW Applications and Regional Development. In EFITA/WCCA '11. Prague : Czech Centre for Science and Society, Prague, 2011. s. 403-409. ISBN 978-80-904830-0-2.

[9] Lauriks, S., et al. Review of ICT-based services for identified unmet needs in people with dementia. Ageing Research Reviews. 2007; 223-46. ISSN: 1568-1637.

[10] Mesiti, M., et al. Collaborative Environments: Accessibility and Usability for Users with Special Needs. In Community-Built Databases. Heidelberg : Springer Berlin, 2011. s. 319-340. ISBN 978-3-642-19047-6.

[11] Pipeková, J. Kapitoly ze speciální pedagogiky. Brno: Paido, 2006. ISBN80-7315-120-02

[12] Pipeková, J. Osoby s mentálním postižením ve světle současných edukativních trendů. Brno: MSD, 2006. ISBN 80-86633-40-3.

[13] Pipeková, J. Pracovní uplatnění osob s mentálním postižením. In Pipeková, J. (ed.) Kapitoly ze speciální pedagogiky. 3. přepr. a rozšíř. vydání. Brno : Paido brno, 2010. od s. 311-316, 6 p. ISBN 978-80-7315-198-0.

[14] Švarcová, I. Mentální retardace. Praha: Portál 2001, 378 s. ISBN 80-7178-506-7.

[15] Tas, A., Tatnall, A. Using ICT to Improve the Education of Students with Learning Disabilities. In Learning to Live in the Knowledge Society : IFIP International Federation for Information Processing. 281. Boston : Springer Boston, 2008. s. 63-70. ISBN 978-0-387-09728-2.

[16] Tas, A., Tatnall, A. Use of ICT to Assist Students with Learning Difficulties: An Actor-Network Analysis. In Key Competencies in the Knowledge Society. In IFIP Advances in Information and Communication Technology. Boston : Springer Boston, 2010. s. 1-11. ISBN 978-3-642-15377-8.

[17] Valenta, M., Krejčíková, O. Psychopedie. Olomouc: Netopejr 1997, 193 s. ISBN 80-902057-9-8.

[18] Valenta, M., Müller, O. Psychopedie. Praha: Parta, 2003. ISBN 80-7320-039-2.

[19] Vítková, M. Integrativní speciální pedagogika. Brno. Paido 2004, 463 s. ISBN 80-7315-071-9.

[20] Vítková, M. et al. Vzdělávání žáků se speciálními vzdělávacími potřebami I. / Education of Pupils with Special Needs I. VZ MSM0021622443. 1. vyd. Brno: Paido, 2007. 380 s. Edice pedagogické literatury. ISBN 978-80-7315-163.8.

[21] Česko. Ministerstvo Školství, Mládeže a Tělovýchovy. Decree no. 72/2005 Sb., from 02/17/2005 o poskytování poradenských služeb ve školách a školských poradenských zařízeních. Also available from: http://spp.ippp.cz/sites/legislativni-predpisy/pdf/vyhlaska-72-2005.pdf.

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New Version of the AGRIS Web Portal – Overcoming the Digital Divide by Providing Rural Areas with Relevant Information

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Abstract

The present paper brings the outcomes of the second stage of a complex AGRIS web portal upgrade (technological, functional, content and design upgrade) called Agris 5.0. The Agris 5.0 version is recently being tested and will be launched in January 2012 on http://www.agris.cz. Agris 5.0 is built and runs on Microsoft technologies (MS Windows Server 2008, MS IIS 7 web server, MS SQL Server 2008 Enterprise Edition, SP2) using the Model-View-Controller (MVC) SW architectural pattern version 3, .NET framework 4, programming language C#, Razor template system, XML and XHTML 1.1 markup languages, CSS 2.1 styles and JavaScript encoding with the jQuery framework. From the user point of view, the Agris portal usability and availability meeting international standards were the utmost priority of the present upgrade.

Key words

Agris, portal, MVC, digital divide, agrarian sector, rural areas, information resource.

Anotace

Příspěvek představuje výsledek řešení druhé etapy komplexní inovace agrárního WWW portálu AGRIS (technologická, funkční, obsahová, designová), která je označena jako verze Agris 5.0. Tato verze aktuálně prochází testováním a od ledna 2012 bude veřejnosti dostupná na adrese http://www.agris.cz. Portál Agris 5.0 je postaven a provozován na technologiích Microsoft (MS Windows Server 2008, webový server MS IIS 7, databáze MS SQL Server 2008 Enterprise Edition, SP2), dále využívá SW architekturu Model-View-Controller (MVC) verze 3, programového prostředí .NET Framework verze 4, programovací jazyk C# a šablonovací systém Razor, značkovací jazyky XML a XHTML verze 1.1, styly CSS 2.1, skriptovací jazyk JavaScript s frameworkem jQuery. Z uživatelského hlediska bylo při tvorbě dbáno na použitelnost a přístupnost podle nadnárodních standardů.

Klíčová slova

Agris, portál, MVC, digitální propast, agrární sektor, venkov, informační zdroj.

Introduction

The digital divide generally refers to inequalities between groups of people in terms of their access to information and communication technologies (ICT). While some groups have at least a very limited access to the ICT, the others completely lack the Internet connectivity. This is where we speak about the so-called digital exclusion that can have a multitude of social, economic or demographic explanations. It can affect different social groups such as e.g. the unemployed, indigent, less educated, unskilled, disabled or elderly people.

The geographical factor (location) brings along significant disparities not only between and among the groups of states and individual states but as well between and among urban, suburban and rural areas. It is just the location factor that can be considered the most relevant. The other factors might intensify the divide even further i.e. for example that the default situation of disabled persons in rural areas can be worse in comparison with those in urban areas.

As far as the technology is concerned, the digital exclusion, in other words the unavailability of modern ICT, stands for the availability and quality

of broadband Internet connection. In any case, the connectivity and its availability influence the supply, structure, quality and availability of information and the respective services of information society. Apart from the connectivity as such, providing quality information is a key factor of overcoming the digital divide, especially in rural areas.

While talking about information resources for the agrarian sector and rural areas, i.e. about overcoming the digital divide, the AGRIS portal (www.agris.cz) holds the leading position in the long-term. The AGRIS portal was established in 1999 as the very first portal solution - not only in the agrarian sector. It was only after the Agris portal launch when other departmental information resources, including the Ministry of Agriculture websites and other commercial portal solutions, were born.

Aims and methodology

The solution strives to enhance the information security in the regions by innovating a successful, long-run verified and positively perceived departmental information resource – the AGRIS.cz portal. As a result, the portal is sure to help overcoming the digital divide, serving as a unique source of information for the agrarian and food-processing sector, country areas and regional development.

Based on the analyses carried out, a need for a complex upgrade (technological, functional, content) of the agrarian portal AGRIS has arisen. The upgrade was aimed at complying with current user requirements (both professional and general public) and at the same time with the latest cutting edge technologies.

Nowadays, a wide range of end-devices is used. The data are no longer displayed only by means of PCs or portable computers with an Internet browser but more and more by means of various mobile devices, including smartphones, tablets, netbooks, single-purpose devices, screen readers for disabled users or full text search engines. Moreover, we can observe a tremendous development in the field of software tools designed in order to create, process and present the content.

The new AGRIS portal solution has to reflect the above-mentioned changes (even in spite of implied conservativeness of both the existing and potential users). Furthermore, it needs to reflect varied quality, relevance and structure of the existing and new information resources at the same time. In other words, it has to provide users with authenticated data and information at the shortest possible time and in the quality and format required.

The methodology primarily lies in analyzing the original (current) agrarian portal implementation at all levels, i.e. technological, content and structural analysis together with the user behaviour analysis. Subsequently, an optimal structure of the individual portal components is to be designed, meeting user requirements, habits and behaviour. At the same time, the new structure has to comply with other requirements, especially the technological ones. The latter means assessing current SW platforms and solutions while aiming at an optimal platform to be employed as the new modern solution. Moreover, implementing analytical tools is conditional for a sophisticated monitoring and output of user behaviour. Last but not least, the new version has to be tested on the development platform before it can finally be launched into full operation.

A substantial and integral solution stage consists of maintaining the existing content i.e. an archive of information resources (almost 100,000 entries). Transforming the existing content/archive in the new portal version is quite complicated and challenging.

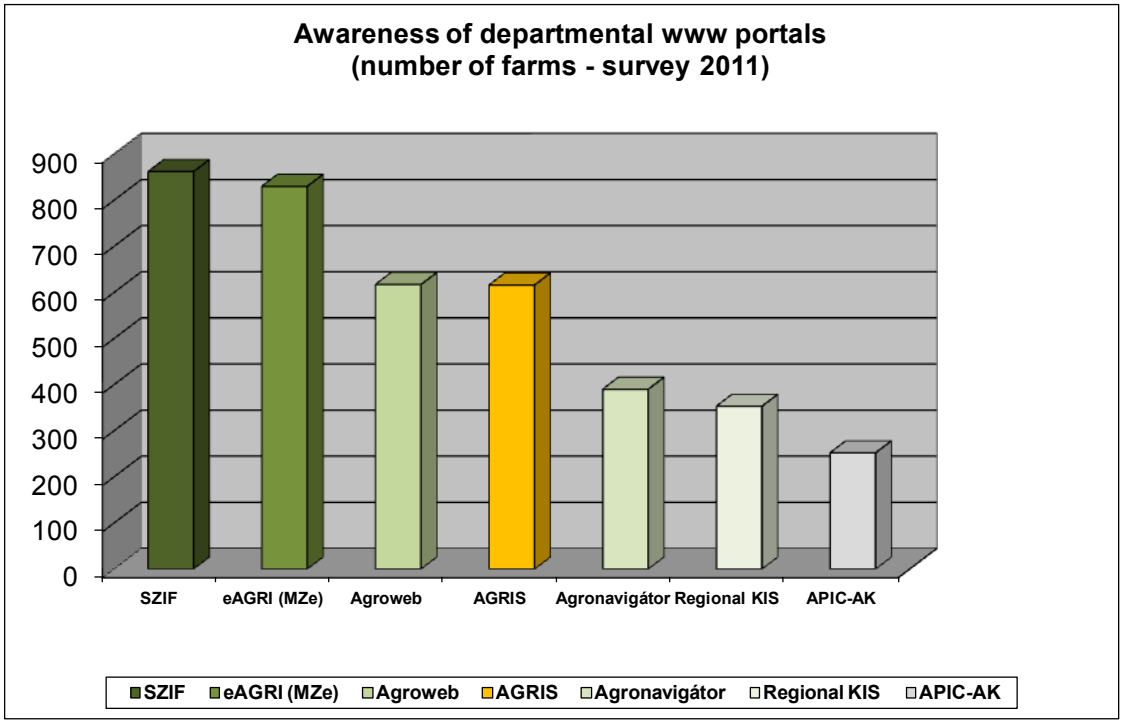
Initial state

The agrarian AGRIS portal has been created and developed by the Czech University of Life Sciences in Prague (in cooperation with the Ministry of Agriculture of the Czech Republic). It constitutes a unique on-line Internet information resource for the agrarian sector (agriculture, food industry, forestry, water management) and rural areas. The target audiences are primarily those employed in and by the agrarian sector (agricultural enterprises, farms, manufacturers, processors, traders, suppliers), state administration, local authorities, students but as well the general public that might be concerned with the respective issues (food consumers, rural areas inhabitants etc.). The agrarian web portal AGRIS provides access to relevant existing information resources, generates its own pieces of information and publishes information from the subjects that do not have their own quality Internet presentation, i.e. those that do not have e.g. enough target users, suitable technologies etc. Recently, the AGRIS database integrates almost 100,000 articles and displays tens of thousands entries concerning price reports and links. The AGRIS portal has been providing its services since 1999. In 2000 it was even awarded a prestigious Zlatý klas (Golden Spike) award at the international agricultural exhibition and fair Země Živitelka (Bread Basket)

in České Budějovice. The portal has always sought to employ innovative approaches, pioneer new cutting edge technologies, attract agrarian sector users while representing a reliable and trustworthy source of departmental information. Further information on the overall concept, solution and development of the AGRIS portal can be found e.g. in J. Vaněk, 2001 or J. Jarolímek, 2003.

In the long-term, the AGRIS portal position can be illustrated by the results of complex surveys concerned with ICT development in the Czech agricultural enterprises. The latter surveys are regularly carried out by the Department of Information Technologies FEM CULS in cooperation with the Information and Consulting Centre FEM CULS. The latest data available come from mid-2011. According to the above surveys, the AGRIS portal is positively perceived by agriculture professionals as a significant departmental information resource. Leaving apart the obviously winning portals of the state departmental institutions (State Agricultural Intervention Fund and eAgri – Ministry of Agriculture of the Czech Republic), the AGRIS portal is an important competitor of the professional commercial Agroweb system and is well ahead of all the other systems, such as the Agronavigator (Institute of Agricultural Economics and Information – ÚZEI in Czech) and portals of the Agrarian Chamber of the Czech Republic (see Fig. 1).

The technological and functional upgrade is prerequisite for maintaining high qualitative and functional standards of the portal. The upgrade was realized in line with the most modern technologies, latest information resources development, current trends and requirements of the portal users. In 2010, the first stage of the new system development was achieved – Agris 4.0. This stage was mostly concerned with complex analyses and basic technological and functional innovation. However, the existing portal functionalities and design were maintained under this stage. The fourth version of the portal - Agris 4.0 - is now fully implemented and field-tested. Recently, the second follow-up stage representing a brand new complex solution, inclusive of new functionalities and design, has been prepared. The new AGRIS portal version (AGRIS 5.0) is now being tested and will be implemented into full operation in January 2012. The fore-mentioned innovations have been realized primarily within the framework of the FEM Research Program, second stage of the University Internal Grant Agency grant, first stage of the Internal Grant Agency grant and other related projects.



Note: SZIF = State Agricultural Intervention Fund
MZe = Ministry of Agriculture of the Czech Republic
Agronavigator = portal of the Institute of Agricultural Economics and Information
Regional KIS, APIC AK = portals of the Agrarian Chamber of the Czech Republic

Figure 1: Awareness of departmental web portals – survey 2011 (DIT FEM CULS)

The current AGRIS 4.0 portal version succeeded in resolving the technical and technological upgrade in 2010 when the PHP4 (PHP, 1997 – 2011) on MS Windows Server 2003 R2 and IIS 6.0 web server was replaced by the .NET Framework on MS Windows Server 2008 and IIS 7.0 web server. In order to implement the upgrade from version 3.0 to version 4.0, the following criteria have been suggested (based on the previous analysis):

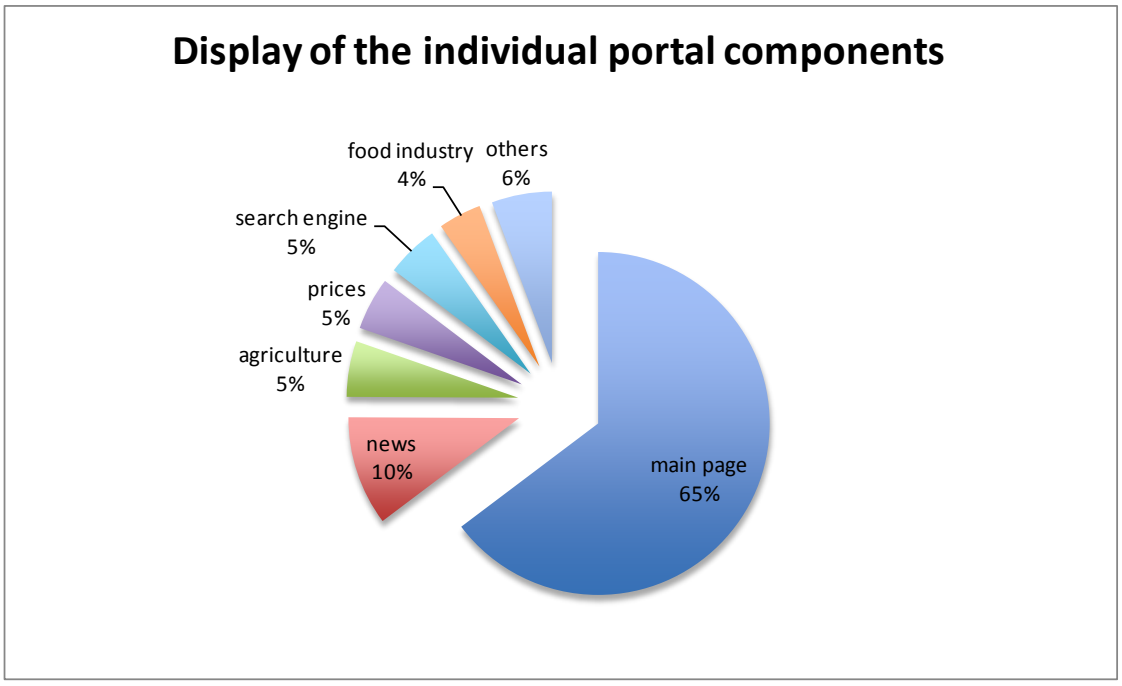
- retaining the Microsoft platform: implementation of up-to-date SW versions - IIS 7 web server and MS SQL database server (E. Whalen, 2005);
- maintaining current system functionality, independent of design;
- enhancing the overall throughput, stability and availability;
- dividing data, application and presentation layers of the system
- enhancing data throughput of the applications by innovating the relational data model;
- extending the service range provided (RSS, web services etc.).

As the number of database entries has been growing in the course of last years, significant delays have been occurring in the response of several data selection and projection procedures, especially in the news listings on the main page, news listings in the individual sections and listings of the most read/opened content. These failures were caused by the procedure construction as such, the SQL construction and partially as well by the relations database model.

Most of the AGRIS content is saved in XML files. However, the content is not saved in the Unicode standard and does not contain any metadata. As a result, exporting the content to other platforms and systems is hard, which is the main drawback of the current portal version.

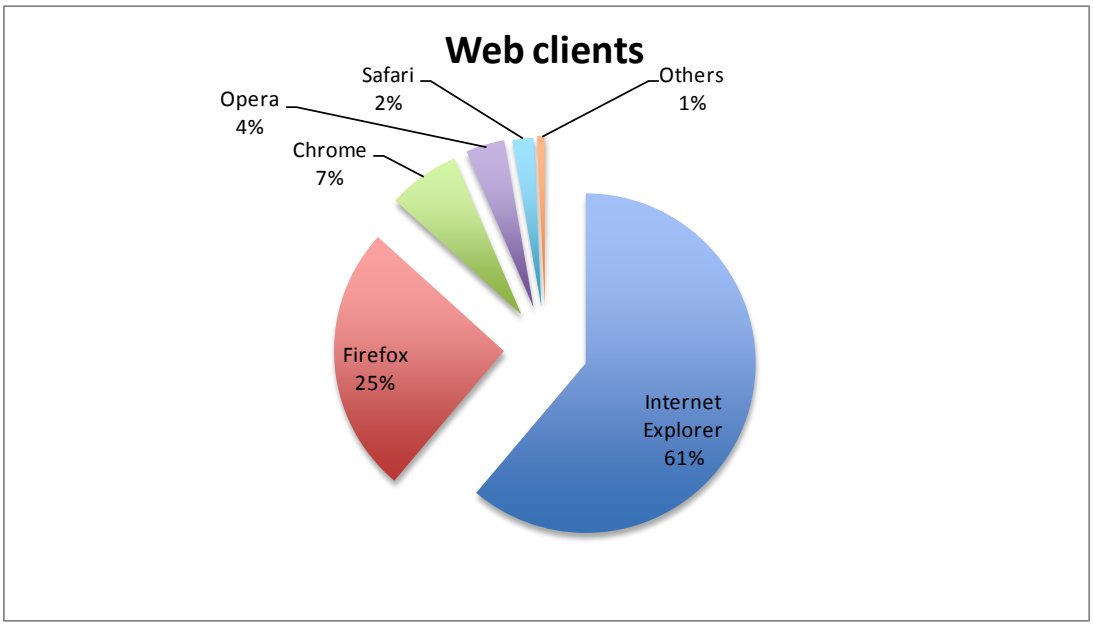
The AGRIS web portal provides complex agrarian news coverage divided into 12 sections and tens of subsections. The user behaviour analysis showed that a vast majority of users opens main page daily to access an overview of the latest news. However, users' interest in reading the thematic sections is quite marginal. While searching for a concrete piece of news or topic, the users definitely prefer an integrated fulltext search engine or the news filter. Therefore, it clearly stems from the analysis that a detailed classification into individual thematic sections is no longer needed.

Furthermore, the user behaviour analysis showed that some services provided by the AGRIS portal are hardly ever used or sometimes not even used at all. This is mostly due to a complicated navigation to the service in question or due to its „invisibility“ in the portal structure. In line with the latest web application development trends, the portal services or content should be available using as few operations as possible while hypertext links need to be apparent, clearly visible and easily available.



Source: Own research and monitoring.

Figure 2: Agris web portal – display of the individual portal components (October 2011).



Source: Own research and monitoring.

Figure 3: Agris web portal – Web Clients (October 2011).

According to the client monitoring, more than 60% of the Agris portal users use MS Internet Explorer while 25% employ Mozilla Firefox and some 7% Google Chrome. Other users tend to employ minority browsers e.g. Opera, Safari etc. The number of mobile accesses ranges from tens to hundreds per month. However, we estimate that the share of mobile accesses will be growing and thus a modern portal should be fully available and usable, including all its services and functionalities, on mobile devices too.

Four main factors affect a modern, user-centered web portal:

- Content
- User-friendliness
- Performance
- Brand power

It also stems from the analyses that the content and brand power constitute the main strengths of the AGRIS portal. The portal provides high quality information and data concerning the agrarian sector, food industry and rural areas development. The data and information quantity is remarkable too. The AGRIS brand has been used since 1999. Since then, during more than ten years of its existence, the portal has reached one of the leading positions among specialized web portals and is backed by a wide range of users.

Among portal weaknesses, we have to mention its usability and performance. These two factors are recently the main drawbacks of the portal, affecting significantly its use. The whole portal needs to be simplified and its performance requires substantial strengthening. The above situation is outlined in Fig. 4.

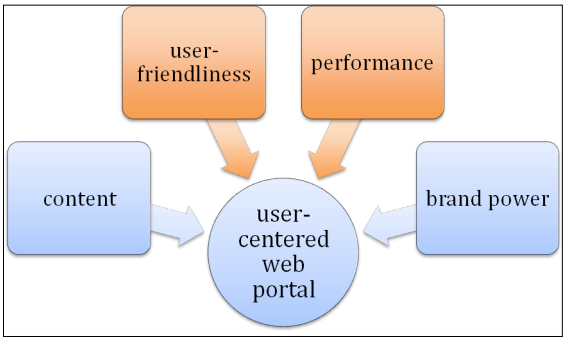


Figure 4: Factors affecting a user-centered web portal.

Results and discussion

The whole AGRIS portal underwent a complex technological upgrade in 2010 while in 2011 the main focus has been on improving the usability and performance. To optimize the platform and at the same time maximize the portal performance, the following technologies and components are used:

- Operation system: MS Windows Server 2008 retained
- Web server: MS IIS 7 retained
- Software framework: .NET Framework version 3.5 replaced by version 4, MVC version 2

upgraded to version 3; C# programming language and Razor template system retained

- Database: MS SQL Server 2008 Enterprise Edition, SP2
- Markup languages: XML retained and XHTML version 1.1 adopted
- Style: CSS 2.1
- Scripting language: JavaScript with jQuery framework

Apart from replacing the PHP by the ASP.NET, implementing the MVC (model –view - controller) software architecture constitutes the most significant change. The MVC software architecture separates the data model of the application, the user interface and the control application logic. These three components are thus quite independent and autonomous; in other words, modifying one component does not affect at all or just minimally the others. The MVC is understood as an aggregate pattern or SW architectural pattern rather than a simple architectural pattern. It is then an architectural foundation (R. F. Grove, 2011). Creating applications within the present structure or its layers is becoming more and more popular and when it comes to extending or maintaining applications, it minimizes possible negative impacts (H. Hanyan, 2011). There exist many frameworks that enable facilitating and speeding up the application development by simplifying repeated and time-consuming actions. Most of them belong to MVC patterns (S. Ahrndt, 2011).

The Model component is a domain-tight specific information representation with which the application of the web portal works. The View component obtains data from the Model and transforms them into suitable interactive data display and presentation to the user. The Controller component reacts on user actions and ensures changes in the Model and the View. The Controller and View components represent a presentation layer in the standard layers division (presentation, domain and data).

The MVC 3 principle application consists basically of the following steps:

1. The user delivers an action in the user interface, e.g. he/she clicks on a link or a button on the AGRIS portal.
2. The Controller receives the respective action information from the user interface object.
3. The Controller accesses the Model and, in case of need, brings it up-to-date according to the user action, i.e. shortlists the articles in the section
4. The domain logic processes the data changed.
5. The View uses the updated Model in order to display the updated data (content) to the user. The View component gathers data straight away from the Model.
6. The user interface waits for another user action that starts the whole cycle over

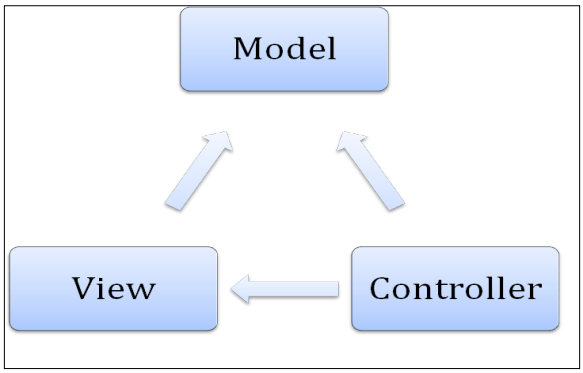


Figure 5: The principle of the MVC architecture (Microsoft, 2009).

Implementing the ASP.NET MVC Framework therefore means that the Model represents the business logic of the whole application while the View provides the application‘s user interface.

All data in the new agrarian portal version have been transformed in the Unicode UTF-8 character set (both in the XML and the database) and the database has been optimized from both the relations and procedures point of view. Unicode is a standard that enables consistent encoding, representation and handling of text in different national alphabets/ writing systems (C. J. Lu, 2008). The exposed data in the charts are indexed every 24 hours which significantly speeded their selection up. A vast majority of the procedures has been totally redone and simplified. As a result, the response on the database has been lowered and so did the database server workload (E. Whalen, 2008).

Almost all content is saved in the XML data format. XML is a markup language used for the representation of arbitrary data structures. An optimal SW structure for an effective XML files processing has been designed, having minimum HW requirements (S. Wang, 2010).

The output sent to client browsers is marked by the XHTML 1.1 markup language and is fully valid according to the W3C specifications. As a result, the Agris portal availability on a vast majority of end-use devices – not only the web browsers on the PC platform (W3C, XHTMLTM 1.1 – Module-based XHTML) - is granted. The graphic design is formatted using CSS cascading style sheets 2.1 and

3.0, fully adjusted to web browsers. It means that in case of CSS 3.0 unavailability, the 2.1 version is used to display the whole portal. Moreover, the information part and the graphic part are completely separate resulting in portal availability for clients without the CSS, such as e.g. single-purpose devices, screen readers of visually impaired users or fulltext search engine robots.

The whole portal has been made available also for the visually-impaired Internet users in accordance with the WCAG – Web Content Accessibility Guidelines 2.0 (W3C, Web Content Accessibility Guidelines 2.0). The content and widgets are presented so that they can be perceived, understood and controlled by people with disabilities. The content itself is robust enough to be accessible by means of a wide range of assisting technologies (screen-readers, Braille displays etc.).

Basic navigational tools of the portal have been highlighted and simplified in a substantial way. The content is now classified in 6 sections only and the services that provide high added value (e.g. content-based search, price reporting and development, opportunity to edit the portal content etc.) have been highlighted. The portal users can classify and sort the content by means of very simple filters or chronologically just by clicking on the date in the calendar.

Conclusion

Based on the upgrade and innovations realized, the AGRIS portal will go on serving as a unique on-line information resource for the agrarian sector, countryside development and leisure. The portal information will be available anytime, on almost any end-use device, and even minimum connectivity and response time. As a result, the portal will hold its leading position among quality information resources in the agrarian sector and rural areas.

The Agris portal content has been partially integrated in the international VOA3R project (Virtual Open Access Agriculture and Aquaculture Repository: Sharing Scientific and Scholarly Research related to Agriculture, Food and Environment). The new content is inclusive of metadata description and the metadata have been created and added to the content saved in the English language. The AGROVOC key words system, a multilingual thesaurus developed and maintained by the Food and Agriculture Organization of the United Nations (C. Caracciolo, 2011), has been used for specialist article description.

Figure 6: New graphic design of the Agris web portal.

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References

[1] Ahrndt, S., Lützenberg, M., Hessler, A., Albayrak, S. HAI – A Human agent interface for JIAC. Published in 9th German Conference on Multi-Agent System Technologies. Berlin, October 2011, p. 149 – 156. ISSN 03029743.

[2] Caracciolo, C., Morshed, A., Stellato, A., Johannsen, G., Jaques, Y., Keizer, J. Thesaurus maintenance, alignment and publication as linked data: The AGROOVOC use case. Published in 5th International Conference on Metadata and Semantic Research, Izmir, October 2011, p. 489 – 499. ISBN 978-364224730-9.

[3] Grove, R. F., Ozkan, E. The MVC web design pattern. Published in Proceedings of the 7th International Conference on Web Information Systems and Technologies. Noordwijkerhout, May 2011, p. 127 – 130. ISBN 978-989842551-5.

[4] Hanyan, H. MVC design and application for online employment. Published in Information Engineering and Application. Springer 2011, vol. 100, part 23, p. 1667 – 1672. ISBN 978-144712385-9.

[5] Jarolímek, J., Vaněk, J., Bbrázda, R. The AGRIS – www portal for agrarian sector and countryside. Agricultural Economics, 9/2003, p. 412 – 415, ISSN 0139-570X

[6] Lu, C. J., Browne, A. C., Divita, G. Using Lexical tools convert Unicode charachters to ASCII. Published in the AMIA – Annual Symposium proceedings. 2008, p. 1031. ISBN 1942597X.

[7] MICROSOFT. ASP.NET MVC Overview. January, 2009. [online]. <http://www.asp.net/mvc/tutorials/overview/asp-net-mvc-overview>.

[8] PHP. Hypertext Preprocessor. 1997 – 2011. [online]. <http://www.php.net/manual/en/>.

[9] Vaněk, J., Jarolímek, J. Agrarian www portal AGRIS.CZ – a gate to the internet in the agrarian sector. Agricultural Economics, 10/2001. p. 450 –454, ISSN 0139-570X

[10] Wang, S. D., Chen, C. W., Pan, M., HSU, C.-H. Hardware accelerated XML parsers with well form checkers and abstract classification tables. Published in Proceedings of the ICS 2010 – International Computer Symposium. Tainan, December 2010, p. 467 – 473. ISBN 978-142447640-4.

[11] Whalen, E., Garcia, M., Patel, B., Misner, S., Isakov, V. Microsoft SQL Server 2005: Velký průvodce administrátora. Praha: Computer Press, 2005. 1080 p. ISBN 9788025119495.

[12] WORLD WIDE WEB CONSORTIUM. Web Content Accessibility Guidelines (WCAG) 2.0. December 2008, [online]. <http://www.w3.org/TR/WCAG20/>.

[13] WORLD WIDE WEB CONSORTIUM. XHTMLTM 1.1 – Module-based XHTML – Second Edtion. November 2010, [online]. <http://www.w3.org/TR/2010/REC-xhtml11-20101123/xhtml11.pdf >.

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