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Farmers' strategies for adapting to climate change in Ogbomoso agricultural zone of Oyo state

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Abstract

The climate is changing and global mean temperatures have increased this is expected to have profound effects on food security. Long-term changes in climate will disproportionately affect tropical regions, meaning poor farmers in Sub-Saharan Africa will likely bear the brunt of adverse impacts. Adaptation plays an important role in reducing vulnerability to climate change and is therefore critical and of concern in developing countries, particularly in Africa where vulnerability is high because ability to adapt is low. This study examined farmers' strategies for adapting to climate change in Ogbomoso agricultural zone of Oyo State of Nigeria. One hundred and fifty farmers were interviewed to obtain information from using a multi-stage sampling procedure. The results of the study showed that the types of climate change identified in the study area were delayed on-set of rainfall (38.0 percent), higher temperature (20.0 percent) and less rain (17.3 percent). The outcome of climate change were food shortage (41.3percent), decline in livestock yield (30.7 percent), decline in crop yield (28.7 percent) and death of livestock (16.0 percent). The identified actions taken to address climate change are growing a new crop (57.4 percent), adoption of drought tolerant/resistance crop varieties (50.0 percent), diversification from crops to livestock production (40.7 percent) and using of new land management practices. The long-term improvement investments commonly adapted in the study area were tree planting/agroforestry, mulching/surface cover, improved fallowing and fallowing.

The study concluded that household size, extension visits and non-farm income significantly impact on the various strategies used in adaptation to climate change.

Key words

Climate, probit, mulchin, adaptation.

Introduction

Climate is an important factor of agricultural productivity. Given the fundamental role of agriculture in human welfare, concern has been expressed by Federal agencies and others regarding the potential effects of climate change on agriculture productivity in Nigeria. Climate change is a phenomenon due to emissions of greenhouse gases from fuel combustion, deforestation, urbanization and industrialization (Upreti, 1999) resulting in variations in solar energy, temperature and precipitation. Climate change can seriously affect agricultural production and therefore, food security (availability of food). Nigeria, at present does not enjoy food security, hence, is very vulnerable to the effects of climate change. Climate change affects agriculture in a number of ways. Extreme weather events such as thunderstorms, heavy winds, and flood devastate farmlands and can lead to crop failure. Pests and crop diseases migrate in response

to climate variation (e.g. the tsetse fly has extended its range northward) and will potentially pose a threat to livestock in the drier northern areas.

The most devastating adverse impacts of climate change in Nigeria and other subtropical countries includes frequent drought, increased environmental damage, increase infestation of crop by pests and disease, depletion of household assets, increased rural urban migration, increased biodiversity loss, increased health risks and the spread of infectious diseases, changing livelihood systems e.t.c (Reilly, 1999; Abaje and Giwa, 2007).

Studies indicate that Africa's agriculture is negatively affected by climate change (Pearce et al., 1996; McCarthy et al., 2001). Adaptation is one of the policy options for reducing the negative impact of climate change (Adger et al., 2003; Kurukulasuriya and Mendelsohn, 2008). Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected

climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). Common adaptation methods in agriculture include use of new crop varieties and livestock species that are better suited to drier conditions, irrigation, crop diversification, adoption of mixed crops and livestock farming systems, and changing planting dates (Bradshaw et al., 2004; Nhemachena and Hassan, 2007).

Although African farmers have a low capacity to adapt to such changes, they have, however, survived and coped in various ways over time. Better understanding of how they have done this is essential for designing incentives to enhance private adaptation.

Agriculture in Nigeria is a major economic sector contributing about 30 – 40% of the nation's GDP. More than 70% of the population of the country depends on agricultural sector for their livelihood. Despite its high contribution to the overall economy, this sector is challenged by many factors of which climate – related disasters like drought and flood are the major ones (Deressa, 2007).

Studies have been undertaken to analyze the impact of climate change and factors affecting the choice of adaptation methods in crop, livestock and mixed crop livestock production systems in Africa at regional level. (Maddison, 2006; Kurukulasuriya and Mendelsohn, 2008; Seo and Mendelsohn, 2008; Hassan and Nhemachena, 2008) and findings showed these studies are highly aggregated and the parameter estimates have little importance in identifying country specific impacts and adaptation methods given the heterogeneity of countries included.

Therefore, the objective of this study is to analyze farmers' strategies for adapting to climate change in Ogbomoso Agricultural Zone of Oyo State, Nigeria.

Material and Methods

The study was carried out in Ogbomoso agricultural zone of Oyo State, Nigeria. There are five local government areas in this zone namely: Ogbomoso North, Ogbomoso South, Ogo-oluwa, Surulere and Oriire local governments.

The population of the study comprises all registered farmers with the State Agricultural Development Programme in the study area. A multistage random sampling procedure was used to select the respondents. The first stage involves purposive selection of three out of the five local government areas with rural outlook. Second stage involves the random selection of five villages in each local

government area making a total of fifteen (15) villages. The last stage involves random selection of ten (10) farmers from each village making a total of one hundred and fifty farmers (150). Data were collected with the aid of a questionnaire. The analytical techniques employed include descriptive statistics and multinomial logit model.

Adaptation measures help farmers guard against losses due to increasing temperatures and decreasing precipitation. The analyses presented in this study identify the important determinants of adoption of various adaptation measures to provide policy information on which factors to target and how, so as to encourage farmers to increase their use of different adaptation measures. The analytical approaches that are commonly used in an adoption decision study involving multiple choices are the multinomial logit (MNL) and multinomial probit (MNP) models. Both the MNL and MNP are important for analyzing farmer adaptation decisions as these are usually made jointly. These approaches are also appropriate for evaluating alternative combinations of adaptation strategies, including individual strategies (Hausman and Wise, 1978; Wu and Babcock, 1998). This study used a MNL logit model to analyze the determinants of farmers' decisions because it is widely used in adoption decision studies involving multiple choices and is easier to compute than its alternative, the MNP.

The advantage of using a MNL model is its computational simplicity in calculating the choice probabilities that are expressible in analytical form (Tse, 1987). This model provides a convenient closed form for underlying choice probabilities, with no need of multivariate integration, making it simple to compute choice situations characterized by many alternatives. In addition, the computational burden of the MNL specification is made easier by its likelihood function, which is globally concave (Hausman and McFadden, 1984). The main limitation of the model is the independence of irrelevant alternatives (IIA) property, which states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set (Hausman and McFadden, 1984; Tse, 1987).

Let A_i be a random variable representing the adaptation measure chosen by any farming household. The study assumed that each farmer faces a set of discrete, mutually exclusive choices of adaptation measures. These measures are assumed to depend on a number of climate attributes, socioeconomic characteristics and other factors X . The MNL model for adaptation choice specifies the following relationship between the probability

of choosing option A_i and the set of explanatory variables X as (Greene, 2003):

$$\text{Prob}(A_i=j) = \frac{e^{\beta_j x_i}}{\sum_{k=0}^J e^{\beta_k x_i}}, j = 1, 2, \dots, J \quad (1)$$

where β_j is a vector of coefficients on each of the independent variables X . Equation (1) can be normalized to remove indeterminacy in the model by assuming that $\beta_0=0$ and the probabilities can be estimated as:

$$\text{Prob}(A_i=j/x_i) = \frac{e^{\beta_j x_i}}{1 + \sum_{k=0}^J e^{\beta_k x_i}}, j = 0, 1, \dots, J, \beta_0 = 0 \quad (2)$$

Estimating equation (2) yields the J log-odds ratios

$$\ln \left(\frac{P_j}{P_k} \right) = x_j'(\beta_j - \beta_k) = x_j' \beta_j - x_k' \beta_k, k = 0 \quad (3)$$

The dependent variable is therefore the log of one alternative relative to the base alternative.

The MNL coefficients are difficult to interpret, and associating the β_j with the j th outcome is tempting and misleading. To interpret the effects of explanatory variables on the probabilities, marginal effects are usually derived as (Greene, 2003):

$$\delta_j = \frac{\partial P_j}{\partial x_i} = P_j \left[\beta_j - \sum_{k=0}^J P_k \beta_k \right] = P_j(\beta_j - \bar{\beta}) \quad (4)$$

The marginal effects measure the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Long, 1997; Greene, 2000). The signs of the marginal effects and respective coefficients may be different, as the former depend on the sign and magnitude of all other coefficients.

Characteristics	Mean	Frequency of class	Percentage distribution
Age(year)	46.8	11	7.3
Gender	-	122	81.3
Marital Status	-	128	85.3
Religion	-	97	64.7
Household Size	6.85	27	18.0
Education(years)	8.66	83	55.3
Experience (years)	23.68	25	16.7
Farm size	4.13	41	27.3
Extension Visit	-	129	86.0

Source: Field survey, 2010

Table1: Summary of socio economic characteristics.

Variables	Mean	Standard Deviation	Description
Age of the household head	46.79	10.80	Continuous
Household size	6.85	2.63	Continuous
Years of education	8.66	4.74	Continuous
Gender of the household head	-	-	Dummy, takes the value of 1 if male and 0 otherwise
Farm size (Hectare)	4.13	3.42	Continuous
Farming experience	23.68	12.56	Continuous
Extension visit	-	-	Dummy, takes the value of 1 if visited and 0 otherwise
Information on climate change	-	-	Dummy, takes the value of 1 if thereis and 0 otherwise
Years of using adaptation options	0.88	4.56	Continuous
Non Farm income	6665.00	8817.11	Continuous
Livestock ownership	-	-	Dummy, takes the value of 1 if owned and 0 otherwise

Source: Field survey, 2010

Table 2: Description of the variables used in the empirical analysis.

Results and Discussion

Type of Climate Experienced by the Respondents

Table 3 shows some of the climate change experienced by the respondents. Some of the changes are more frequent drought, delayed on – set of rainfall, too much rain, higher temperature

and so on. The result reveals that 38% of the respondents observed delayed on – set of rainfall which has led to the importance and necessity of irrigation practice in the area in order to improve and maintain high output. The result also shows that 22% of the respondents observed earlier on-set of rainfall while 20% and 17.3% observed higher temperature and less rain respectively.

Type of climate change	Frequency	Percent (%)
More frequent drought	17	11.3
Delayed on – set of rainfall	57	38.0
Erratic rainfall pattern	19	12.7
Too much rain	4	2.7
Low rain	26	17.3
Higher temperature	30	20.0
Earlier on – set of rainfall	18	22

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 3: Type of climate change.

Result of Climate Change Noticed by the Respondents

It was observed that the climate change noticed by the respondents brought about some changes in crop and livestock production. Some of the consequences of the climate change were decline in crop yield (28.7%), decline in livestock yield

(30.7%), increase in crop yield (16%), increase in livestock production (8%) and death of livestock (16%). Majority of the respondents which are 41.3% noticed a food shortage since the climate is no longer favourable for planting condition which the majority is into.

Result of climate change	Frequency	Percent (%)
Decline in crop yield	43	28.7
Decline in livestock yield	46	30.7
Increase in crop yield	24	16
Increase in livestock production	12	8
Death of Livestock	24	16.0
Food shortage /insecurity	62	41.3
Food price increase	12	8.0

Source: Field, 2010. Response>150 due to multiple choice response

Table 4: Result of climate change.

Most affected in the household by climate change

Those there were mostly affected by the climate change was examined and it was observed that all the household members were affected but with varied degree since it had to do with reduction of productivity which led to reduction of income level of the respondents. As it is shown in table 5, some respondents felt it affected children and women with the least likelihood of elderly as the culture of taking care of the aged is well entrenched in the area.

Action Taken By Respondent to Address Climate Change

Response of farmers to climate change was examined and as noted in Table 6 reveals that majority (57.4%) of the respondents started growing new crops which could adapt to the present climate in order to increase productivity. Others went into adopting of drought tolerant crops (50%), some moved focus from crop to livestock production (40%), 22% started new land management practices, 16% started non-farm activities while 6% did nothing to address the change in climate.

Most affected	Frequency	Percent (%)
Children	9	6.0
Women	4	2.7
Men	2	1.3
Elderly	1	0.7
All	134	89.3

Source: Field survey, 2010.

Table 5: Most affected in the household.

Action taken	Frequency	Percent (%)
Did nothing	9	6.0
Started growing new crops	86	57.4
Adopted drought tolerant/ Resistance crop varieties	75	50.0
Moved focus from crops to livestock production	61	40.7
Started non – farm activities	24	16.0
Started using new land management practices	33	22.0
Received food aid	1	0.7
Bought food	8	5.3
Ate less	1	0.7
Ate different foods	14	9.3

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 6: Action taken by respondents.

Type of Long Term Improvement Investment Practiced by the Respondents

It was observed that respondents took to long term improvement investment practice which is a practice which would improve or enhance productivity over a long period of time. Most of the respondents (28%) went into tree planting and agroforestry as a long term practice. It served as

dual purpose(the cultivation of the trees crops such as oranges, mangoes and so on) and as a cover crops in shielding shrubs and herbs thereby protecting the soil from erosion and increasing fertility of the soil. The other long term improvement investment adapted in the study area were mulching/surface cover(16%), improved fallowing(10%), fallowing(8%), infiltration ditches(7.3%) and ridge and furrow (7.3%)

Long term investment	Frequency	Percent (%)
Soil bunds	7	4.7
Bench terraces	9	6
Mulching	24	16
Grass strips	9	6
Hedge rows (Shrubs)	2	1.3
Tree planting/agroforestry	42	28
Infiltration ditches	11	7.3
Ridge & Furrow	11	7.3
Fallowing	12	8
Improved fallowing	15	10
Water harvesting	9	6

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 7: Type of long – term improvement investment.

2.6 Previous Land Long Term Improvement Investment Used By Respondents

Before the long term improvement practice used by the respondents most of them has previous practice which the climate then could promote leading to increase in yield. Some of the practices used then

were tree planting/agroforestry (28%), hedge rows (18%), mulching and surface cover (15.3%), stone bunds (4.7%). The survey implies that most of the respondents (28%) were previously into fallowing which was common and widely used and also climate favoured the practice then.

Previous practice	Frequency	Percent (%)
Bench Practice	6	4.0
Stone bunds	7	4.7
Mulching/surface cover	23	15.3
Woodlots	1	0.7
Hedge rows	27	18
Tree planting/agroforestry	4	2.7
Infiltration ditches	6	4.0
Ridge & furrow	6	4.0
Fallowing	42	28.0
Improved fallowing	5	3.3
Water harvesting	1	0.7

Source: Field survey, 2010.

Table 8: Previous practiced used by respondents.

Initial Reason for Change in Land Improvement Practice

There were various reasons why most of the respondents changed from previous land improvement practice to another improvement

practice. Some of the reasons were to increase productivity (64%), increase water holding capacity(12.7%), response to climate change(10%) and to reduce erosion(8.7%).

Reason for change	Frequency	Percent (%)
To increase productivity	96	64
To increase water holding capacity	19	12.7
To increase soil fertility	7	4.7
To reduce erosion	13	8.7
To response to climate change	15	10.0
Total	150	100.0

Source: Field survey, 2010.

Table 9: Initial reasons for change in land practice.

Management Technique Used by the Respondents for Grazing

Some of the respondents' are into rearing of animal alongside crop farming. It was observed from the field survey that majority (55.3%) used removal of unwanted bush as management technique for grazing in order to reduce the risk of livestock coming in contact with harmful micro organisms and pests which could reduce the health of the animals leading to high expenses incurred to take care of the ill animals. The ill livestock if not

taken care of could die thereby increasing loss or reduction in profit margin of the farmers. The other management techniques use for grazing are periodic resting(17.3%), free range (9.3%), enclosure of land (7.3%) and so on.

Previous Management Technique for Grazing Used By Respondents

Table 11 reveals that before the respondents went into removal of unwanted bush around their livestock, majority of the respondents (86.7%)

Management techniques used	Frequency	Percent (%)
Enclosure of land	11	7.3
Restriction or livestock numbers (destroying)	2	1.3
Maintaining large stocks	7	4.7
Removal of unwanted bush	83	55.3
Periodic resting	26	17.3
Open grazing area	4	2.7
Free range grazing	14	9.3
Common watering point	3	2.0

Source: Field survey, 2010.

Table 10: Management techniques used for grazing land.

Previous management techniques	Frequency	Percent (%)
Enclosure of land	51	34
Restriction or livestock numbers (destroying)	2	1.3
Removal of unwanted bush	7	4.7
Periodic resting	1	0.7
Open grazing area	6	4
Free range grazing	130	86.7
Common watering point	1	0.7

Source: Field, 2010. Response>150 due to multiple choice response

Table 11: Previous management technique used.

were into free range grazing practice because of the low capital and labour requirement.

Multinomial Logit Model

The estimation of the multinomial logit model for this study was undertaken by normalizing one category, which is normally referred to as the “reference state,” or the “base category.” In this analysis, the first category (no adaptation) is the reference state. The estimated coefficients of the MNL model, along with the levels of significance, are presented in Table 12. The likelihood ratio statistics as indicated by χ^2 statistics are highly significant ($P < 0.02881$), suggesting the model has a strong explanatory power. As indicated earlier, the parameter estimates of the MNL model provide only the direction of the effect of the independent variables on the dependent (response) variable: estimates do not represent actual magnitude of change or probabilities. Thus, the marginal effects from the MNL, which measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable, are reported and discussed. In all cases the estimated coefficients should be compared with the base category of no adaptation. Table 13 presents the marginal effects along with the levels of statistical significance.

Age of the household head

Age of the household head affected adaptation to climate change. Age of the farmer did not seem to be of significant in influencing adaptation, as almost all marginal effect coefficients were statistically insignificant and their signs do not suggest any particular pattern. This finding followed the intuitive position as it is expected that the household head age will be closely related to the experience of how climate change overtime

Household Size

For most of the adaptation methods, increasing household size did not significantly increase the probability of adaptation, through the coefficient on the adaptation option has a positive sign and only significant in adoption of drought tolerant crop varieties. This implies that large families are able to adopt drought tolerant crop varieties whereas the smaller ones tend to adapt to nothing (no adaptation).

3.3 Education

Education of household head increases the probability of adapting to climate change. From table13 education significantly increases adopting

drought tolerant crop varieties and using of new land management practices. A unit increase in number of years of schooling would result in a 0.3% increase in the probability of adopting drought tolerant crop varieties and a 0.8% increase in change in using of new land management practices.

3.4 Gender of the household head

The results indicate that male – headed household are more likely to adopt drought tolerant crop varieties and less likely to grow new crops and use new land management practices. Male – headed households were 34.1% more likely to adopt drought tolerant crop varieties and 22.9% and 11.5% less likely to grow new crop and use new land management practices respectively. The possible reason for this is that much of the farming activities are done by male while female are more involved in the processing, this will give male an edge in terms of farming experience and information on various management practices and what needed to be done in response to the climatic instability.

3.5 Farm size

Larger farm sizes appear to be associated with adopting of drought tolerant crop varieties and moment of focus from crop to livestock. Larger farm sizes reduce the probability of growing new crops but increases the probability of adopting

drought tolerant crop varieties and moving of focus from crop to livestock production.

3.6 Experience

The more experienced farmers are more likely to adapt to drought tolerant crop varieties than the less experienced. A unit increase in the years of experience would result in a 1.2% increase in the probability of adopting drought tolerant crop varieties.

3.7 Years of using adaptation options

Farmers with more years of using adaptation options are more likely to adapt to growing of new crops and using of new land management practices. Farmers with more years of using adaptation option are less likely to adopt drought tolerant crop varieties.

3.8 Extension visit

Having access to extension visit increases the likelihood of adopting drought tolerant crop varieties and reduces the likelihood of using new land management practices.

3.9 Information on climate change

Farmer that has information on climate change (temperature and rainfall) has a significant and positive impact on the likelihood of adopting

Explanatory variable	Growing of new crops	Adopted drought tolerant/ resistant crop varieties	Moved focus from crop to livestock	Using of new land management practice
Constant	5.021(1.984)**	3.301(1.272)	5.011(1.932)*	2.950(1.013)
Age	-0.014(2.014)**	-0.025(-1.903)*	0.019(0.560)	-0.011(-0.284)
Household size	0.404(2.592)***	0.393(1.942)**	0.279(1.647)*	0.357(1.683)*
Education	-0.068(-0.842)	-0.0063(-0.720)	0.080(1.936)*	0.005(2.053)**
Gender	0.570(2.631)***	0.927(0.871)	0.057(0.057)	-0.793 (-0.844)
Farm size	0.085(2.131)**	0.058(0.413)	-0.154(-1.844)*	-0.027(-0.195)
Experience	-0.025 (-0.618)	-0.029(-1.708)*	0.006(0.154)	0.035(1.797)*
Extension	-1.606(-2.377)**	-1.293(-1.063)	-31.522(-26.897)***	-2.544(-2.018)
Years of practice	0.77(0.995)	-0.040(-0.474)	0.103(2.137)**	0.105(1.244)
Information	0.601(0.540)	0.189(0.160)	-0.461(-0.399)	-0.575(-2.482)**
Nonfarm income	0.029(2.608)***	0.011(2.367)**	0.071(1.436)	0.092(1.826)*
Livestock ownership	-3.615(-4.011)***	-3.542(-3.529)***	-4.007(-4.178)***	-3.197(-3.017)***
Diagnostic				
Base category		No Adaptation		
Number of observation		150		
Chi-square		63.465***		
Log likelihood		-190.091		

Table 12: Parameter estimates of the multinomial logit model.

Explanatory variable	Growing of new crops	Adopted drought tolerant/resistant crop varieties	Moved focus from crop to livestock	Using of new land management practice	No Adaptation
Constant	0.492(1.499)	0.492(1.499)	0.006(0.790)	-0.164(-0.642)	-0.109(-1.391)
Age	0.001(0.183)	0.001(0.183)	-0.001(-2.081)**	0.009(2.213)**	0.005(0.515)
Household size	0.011(0.400)	0.011(0.400)	0.006(-1.050)	0.004(0.162)	-0.010 (-1.879)*
Education	-0.006(-0.578)	-0.006(-0.578)	-0.02(-0.562)	0.008(2.020)**	0.002(0.689)
Gender	-0.229(-2.539)**	-0.229(-2.539)**	0.008(0.231)	-0.115(-1.933)*	0.002(0.093)
Farm size	-0.028(-1.879)*	-0.028(-1.879)*	0.007(1.688)*	-0.003(-0.030)	0.007(0.198)
Experience	0.001(0.247)	0.001(0.247)	0.012(2.248)**	-0.013(-0.398)	0.007(0.665)
Extension	0.082(0.546)	0.082(0.546)	-0.173(-4.755)	-0.123(-1.768)*	0.049(1.993)**
Year of practice	0.017(1.644)*	0.017(1.644)*	0.004(1.193)	0.010(2.471)**	-0.001(-0.510)
Information	-0.135(-2.225)**	-0.135(-2.225)**	-0.009(-0.318)	-0.042(-0.522)	0.009(0.301)
Non – farm income	-0.018(-2.724)***	-0.018(-2.724)***	0.002(0.139)	0.004(1.103)	-0.019(-2.434)**
Livestock ownership	-0.089(-0.773)	-0.089(-0.773)	-0.003(-2.372)**	0.037(0.414)	0.94(2.193)**

***, **, * significant at 1%, 5% and 10% probability level respectively

Table 13: Marginal effect from multinomial logit model.

drought tolerant crop varieties. It increases the likelihood of adopting drought tolerant crop varieties by 16.9%.

3.10 Non – farm Income

Non – farm income significantly increases the likelihood of adapting to drought tolerant crop varieties. A unit increase in non farm income increases the probability of adopting drought tolerant crop varieties by 0.2%. Non farm income showed a negative relationship with the growing of new crops.

3.11 Livestock Ownership

The ownership of livestock is negatively and significant related to movement of focus from crop to livestock.

Conclusion, Policy and Recommendation

This study analyzed the strategies use by farmers for adopting to climate change based on a cross-sectional survey of 150 farming households from Ogbomoso agricultural zone of Oyo State, Nigeria. The main practices actually followed by farmers during the survey year (2010) are mostly taken in combination with other measures and not alone. The different combinations of measures and practices are grouped into four major adaptation options: growing of new crops, adoption of drought

tolerant crop varieties, movement of focus from crop to livestock production and using of new land management practices.

A multinomial discrete choice model was used to analyze the determinants of farm-level adaptation measures. The marginal effects from the MNL, which measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable, were presented for their ease of interpretation. The results from the marginal analysis indicate that household characteristics such as age, education, household size and nonfarm incomes which could be enhanced through policy intervention have significant impact on adaptation to climate change. Thus, investment in education systems, sufficient input supply which increases farm income and creation of off-farm employment opportunities in the rural areas can be

underlined as a policy option in the reduction of the negative impacts of climate change. The study further revealed that institutional factors such as extension on crop and livestock production and access to information on climate change enhanced adaptation to climate change. Consequently, policies aiming at promoting adaptation to climate change need to emphasize the crucial role of providing information on better production techniques and on climate change (through extension) to enable farmers adapt to climate change.

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Influence of firm related factors and industrial policy regime on technology based capacity utilization in sugar industry in Nigeria

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Abstract

The study analyzed the technology based capacity utilization rate in sugar industry in Nigeria in the period 1970 to 2010. Data used in the study were obtained from the sugar firms, publications of the Central Bank of Nigeria and National Bureau of Statistics. Augmented Dicker Fuller unit root test was conducted on the specified data to ascertain their stationarity and order of integration. The result reveals that some variables were stationary at level while some were stationary at first difference. The diagnostic statistics from the multiple log linear regression on the specified variables confirmed the reliability of the model. The empirical result reveals that sugar cane price and sugar industry's real energy consumption have significant negative relationship with the technology based capacity utilization in the sugar industry in Nigeria. On the other hand, the wage rate of skill workers, industry's, real research expenditure, human capital and period of import substitution have significant positive influenced on the technology based capacity utilization rate in the industry. Our findings suggest that policy measures aim at expanding the hectares of industrial sugarcane and increase production of refined petroleum fuel in the country will promote capacity utilization in the industry. Also policies targeted on the intensification of research and improved worker's remuneration in the sub-sector is strongly advocated.

Key words

Sugar, firm, capacity, utilization, industry, technology.

Introduction

Sugar sub-sector is one of the major sources of industrial employment in Nigeria's economy (ADB and ADF, 2000 and NSDC, 2010). Sugar is a vital raw material for food and beverage, bakery and confectionery, soft drinks and pharmaceutical industries. The demand for industrial consumption remains firm and accounted for about 70% of total consumption in Nigeria (NSDC, 2010 and Michael 2010). The current domestic consumption of sugar in Nigeria is in excess of 1.5million tons per annum (CBN, 2008 and 2010). Domestic sugar production however has varied between 7,000 to 55,000 tons per annum from 1969 to 2010 (Wada et al., 20017 and PDSSC, 2010). Currently, domestic production of sugar is slightly less than 5% of the country's annual requirement (CBN, 2008 and 2010). From 2001 to 2006, domestic production has declined considerably reaching all time low value of less than 1% of sugar consumption in the country (Table I).

The dismal performance of the sub-sector has been attributed to multifarious factors including inadequate supply of sugar cane to factories, few operating sugar factories, deteriorating capacity utilization in the sub-sector, myriad of factory and field production problems, lack of improved indigenous sugar production technology as well as insufficient domestic private investment (Lafiagi, 1984 and Wada et al., 2001).

Nigeria is the largest consumer of sugar in West Africa and has a large area of cultivable land suitable for the growing of industrial sugarcane (Busari et al., 1996 and ADB and ADF, 2000). Also, over the years the government has carried out policies aimed at boosting sugar production in the country. Some of the policies are; 50% tariff on importation of white sugar, 5% levy on imported raw sugar, 5-year tax waving to sugar refineries and privatization of the major sugar firms in the country, as well as the Nigeria's sugar expansion programme in collaboration with the African

Year	Average domestic output (tons)	Average import (tons)	Average total supply (tons)	Share of domestic output in total (%)	Share of import in total (%)
1970-1972	38141	129629	167770	22.73	77.27
1973-1975	42594	322 222	364816	11.68	88.32
1976-1978	34074	514 814	548888	6.21	93.79
1979-1981	36296	644 444	680740	5.33	94.67
1982-1984	37778	851852	889630	4.25	95.75
1985-1987	51872	803763	855575	6.06	93.94
1988-1990	51080	774073	825 153	6.19	93.81
1991-1993	40735	859259	899994	4.53	95.47
1994-1996	45577	666666	712243	6.40	93.60
1997-2000	13654	801333	814987	1.68	98.32
2001-2006	6238.67	1153301.73	1159540.4	0.538	99.46

Source: NSC, 2000 and SSC, 2000.

Table 1: Sugar supply in Nigeria (1970-2000).

Development Bank and African Development Fund in 1989 and 1991 respectively. These packages were meant to stimulate local production and increase productivity as well as capacity utilization in the sub sector. In spite of these provisions, Nigeria sugar imports (i.e. the white and semi-refined sugar) have continued to rise reaching above 95% of domestic consumption (NFB, 2010). This implies that huge amount of foreign exchange is needed for sugar importation and this could have adverse effect on the country's external reserves, development of other sectors of the economy and the welfare of the industrial sugarcane farmers in the country. For instance, about N26billion or around \$250million was spent on sugar importation in 2008 (NFB, 2010).

Capacity utilization index is one of the most important measures of resource use in industrial production (Zoltan, 1999). It is an industry's performance indicator that is widely used in empirical studies to help explained investment and inventory behaviors, productivity measurement, and as indicator of the strength of aggregate demand (Kim, 1999 and Danish, 2003). In the presence of good policy environment and stable economy, calculated capacity utilization rates of sugar industry could be a reliable indicator of the extent of agriculture – industry linkage in the economy. The technology based capacity utilization is common in Nigeria and has been used by the Manufacturing Association of Nigeria (MAN) and Central Bank of Nigeria (CBN) to assess the production performance of industries in the country. In the sugar industry, estimates of capacity utilization could be the means through which the backward integration policy of

the industry to agricultural sector could be assessed. Farmer's income and welfare will be enhanced if the linkage is healthy and would also promote optimal resource flow among sectors.

The average industry capacity utilization rates in Nigeria have shown wide fluctuations between 1970 and 2008 (CBN, 2008 and 2010 and NBS, 2009). Continuous downward fluctuations in the sugar sub sector's capacity utilization might lead to increase in prices of sugar based products in the country; this has the tendency of reducing the welfare of low income earners. Sugar based firms entrepreneurs could be exposed to production uncertainties and demand shock, a situation that will be unnecessary if full capacity utilization in the sugar industry was attainable. Therefore, in an attempt to discover reasons for the trend in technology based capacity utilization in sugar industry in Nigeria, the study will provide answers to the following research questions: what is the relationship between technology-based capacity utilization rate and sugar firm related factors in the sugar industry in Nigeria? Does the trend in technology based capacity utilization in sugar industry correlates with import substitution policy period in Nigeria? To answer these questions, the study specifically analyzed the effect of firm related factors on technology based capacity utilization rates and determined the impact of import substitution policy period on technology based capacity utilization rates in the sugar industry in Nigeria.

Concept of Capacity and Capacity Utilization

Capacity utilization is the ratio of the actual or observed output to capacity or potential output

(Prior and Nelda, 2001). Various forms of capacity utilization exist depending on how the capacity output is measured. It could be physical capacity utilization, when actual output is compared to technical maximum or installed plant output (Gold, 1955 and Johansen, 1968) or it could be economic capacity utilization, when actual output is compared to optimum output (from economic point of view) of a firm (Hashim, 2003). However, measuring the rate of capacity utilization requires identifying the appropriate capacity output. Mathematically, capacity utilization rate is defined as the ratio of the actual output Y_0 to potential or capacity output Y^* i.e.

$$CUR = Y_0/Y^* \quad (1)$$

In the physical or engineering concept, the potential output may be technologically derived and hence defined relative to the maximum possible physical output that the fixed inputs are capable of supporting when the variable inputs are fully utilized (Johansen, 1968). Hickman (1964) defined economic capacity of a firm as an output level at which the short run average total cost curve reaches its minimum. Thus, the engineering or technology based measure of capacity output has found to be more operational than the economists' concept especially in the developing countries (Budhin and Paul 1961). Most managers and technical experts prefer to operate with the engineering definition of capacity and incidentally the same definition is the basis of the capacity definition of Central Bank of Nigeria, National Bureau of Statistics and Manufacturing Association of Nigeria. This notion of capacity utilization has an advantage over other methods because it is capable of producing stable indices over the years and makes comparison easier between and among firms. However this method of capacity utilization does not represent the optimum decision concerning the resource use by the firms.

Literature review

In Nigeria, few literature exist on the estimation of capacity utilization in the manufacturing sector. Soderbom et al., (2002) reported an average capacity utilization of 44% for the industrial sector. The study employed combined rapid appraisal technique in assessing capacity utilization of firms. Their report asserted that capacity utilization exhibits positive correlation with firm size and was higher in food sub sector and lower in chemical sub sector. Adeel et al., (2004) applied survey and expert opinion technique to the manufacturing sector in Nigeria and discovered an average capacity utilization rate

of 44.2% for the sector. Also, 44.74% capacity utilization rate was recorded for the food sub sector, while textile and wood/furniture had 44.53% and 41.88% respectively. Raimi (2009) studied the impact of changes in government policies on capacity utilization in the real sector of Nigeria's economy. They used descriptive statistics and ordinary least squares methods on secondary data obtained from official sources (i.e. CBN and NBS) from 1991 to 2003 to estimate and analyze capacity utilization situation in Nigeria. The findings reveal that capacity utilization trends in the real sector during the period ranges from 30% to 60%. Ukoha (2000) studied determinants of manufacturing capacity utilization rate in Nigeria in the period 1970 to 1988. He employed ordinary least squares method on secondary data derived from the Central Bank of Nigeria publications. The results reveal that real exchange rate; federal government capital expenditure on manufacturing and per capita real income have positive effects on manufacturing capacity utilization. Inflation and real loans and advances to manufacturing sector have negative effect on capacity utilization rates. Kim (1999) analyzed the determinants of economic capacity utilization rates in US manufacturing sector. Evidence shows that capital stock, price of materials, capital price have significant negative relationship with economic capacity utilization rates; while energy price, labor price and output have significant positive influence on economic capacity. On the other hand, Phillippe and Robin, (2003) provided evidence on the impact of liberalization policies on industrial performance in India and UK. They used panel data from selected firms in the two countries and adopted Schumpeterian growth model to analyze the relationship. They discovered that firm's level productivity and capacity utilization increase during the policy period. Kim (2003) analyzed investment behavior in South Korea manufacturing sector using the investment and capacity utilization indices. The estimation of investment equation relative to capacity utilization reveals that capacity utilization is a better predictor of investment. He also discovered that price of energy, labor price and rental price of capital exhibit significant negative relationship with the capacity utilization rates; whereas material price and output have significant positive influence on the capacity utilization rate in the sector. Kuman and Nitin (2009) used time series data from the period 1974 to 2005 to analyze the trends in capacity utilization in sugar industry in India. The results reveal that, the industry is operating with an excess capacity of 13 percent in each studied year. The results also show capacity

utilization decline during post reform years, and that the availability of raw material is the most significant variable explaining capacity utilization in India's sugar industry.

Materials and Methods

The study area and method of data collection. The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in the sub Saharan Africa. Nigeria lies between 40 and 140 north of the equator and between longitude 30 and 150 east of the Greenwich. Nigeria has a total land area of 923,768km² (i.e. about 98.3 million hectares) and a population of over 140 million (NPC, 2006). Sugar firm's data were used in the analysis and secondary data derived from publications of the Central Bank of Nigeria (CBN) and the National Bureau of Statistics; the data covered the period 1971 to 2010.

Empirical Model

To examine the influenced of firm related variables on the technology based capacity utilization rate, a capacity utilization equation model for the sugar industry in Nigeria is specified as follows: (Thoumi, 1972; Gokcekus, 1997; Ukoha, 2000 and Boccoardo, 2004).

$$\begin{aligned} \text{LnCUR}_t = & a_0 + a_1 \text{LnPIS}_t + a_2 \text{LnIRE}_t + a_3 \text{LnWRS}_t \\ & + a_4 \text{LnIRS}_t + a_5 \text{LnCLR}_t + a_6 \text{LnHCR}_t + a_7 \text{LnFGS}_t \\ & + a_8 \text{LnSGR}_t + a_9 D_t + U_t \end{aligned} \quad (2)$$

Where

LnCUR_t = Technology based capacity utilization in sugar industry in Nigeria

LnPIS = Price of industrial sugarcane (₦)

LnIRE_t = Sugar industry's real energy consumption

(₦)

LnWRS_t = Wage rate of skilled workers (₦)

LnREX_t = Industry's real research expenditure (₦)

LnCLR_t = Capital-labor ratio (₦)

LnHCP_t = Human capital (number)

LnFGS_t = Federal Government subvention to the industry (₦)

LnSGR_t = Sales growth (%)

D_t = Dummy variable which takes the value 1 during import substitution era and zero otherwise (1970 — 1985)

Ln = Natural logarithm

U_t = Stochastic error term.

Results and Discussion

Unit root test results for variables in equation (2)

Table (2) reports the ADF test results and order of integration of time series variables defined in equation (2). The results reveal that LnCLR_t, LnFGS_t, and LnSGR_t are stationary at level; while LnPIS_t, LnIRE_t, LnWRS_t, LnREX_t, LnHCP_t and LnCUR_t are stationary at first difference. This implies that the nature of relationship among specified variables could be determined by multiple regression at the level of the variables provided the diagnostic statistics are satisfactory and show no evidence of spurious regression (i.e. R² > D.W) or any econometric problem (Granger and Newbold 1974 and Resende, 2000).

Table (3) reports the result of the estimation of the technology based capacity utilization equation for the sugar industry in Nigeria. The R² of 0.481 denotes that about 48% of variations in the

Variables	Level	First difference	Order of integration
LnCUR	-2.626	-7.206***	1(1)
LnPIS	-1.904	-5.184***	1(1)
LnIRE	-1.615	-6.212***	1(1)
LnWRS	-2.189	-8.782***	1(1)
LnREX	-1.761	-6.771***	1(1)
LnCLS	-5.139***	—	1(0)
LnHCP	-1.669	-6.503***	1(1)
LnFGS	-5.222***	—	1(0)
LnSGR	-6.642***	—	1(0)

Note: At level, critical value at 5% = -3.52, and at 1% = -4.20; at first difference critical value at 5% = -3.53 and at 1% = -4.21. Asterisk *** represents 1% significance level. Variables are as defined in equation (2). These tests were performed by including drift and a deterministic trend in the regressions.

Table 2: Augmented Dicker Fuller unit root test results for variables in equation (2).

Variables	coefficients	Standard error	t-values
Constant	-9.436	3.322	-2.84***
LnPIS _t	-0.231	0.114	-2.03**
LnIRE _t	-0.100	0.059	-1.71*
LnWRS _t	0.446	0.184	2.43**
LnREX _t	0.152	0.055	2.77***
LnCLS _t	0.112	0.095	1.18
LnHCP _t	0.628	0.292	2.15**
LnFGS _t	0.024	0.023	1.06
LnSGR _t	0.001	0.002	0.326
Dummy	0.450	0.150	3.00***
Log likelihood = -11.95		F-cal = 3.587***	
R ² = 0.481		Adjusted R ² = 0.347	
Normality test = 32.29***		DW-test = 1.83	
Schwarz criterion = 57.09		Akaike criterion = 41.89 RESET test = 3.408***	

Note: Asterisk*, **and ***represent 10%, 5% and 1% significance level respectively. Variables are as defined in equation 2

Table 3: Technology based capacity utilization rate equations in the sugar industry in Nigeria.

technology based capacity utilization rates are caused by the specified independent variables. The F-statistic of 3.587 is significant at 1% probability level, suggesting the goodness of fit of the specified model. Durbin-Watson statistic of 1.83 indicates that auto-correlation is not a serious problem in the estimated model. Furthermore, the RESET test result is significant at 1% probability level and this indicates that the equation is not mis-specified and that the assumption of log linearity among variables is correct.

The empirical result shows that the coefficient of sugarcane price (PISt) has a significant negative effect (at 5% probability level) on the technology based capacity utilization in the sugar industry in Nigeria. This implies that, as the price of the out growers (farmers) increase, the industry's ability to acquire more industrial sugarcane for crushing decreases. The finding has been substantiated by the results of similar work done by Kim (2003).

Increase in wage rate of skill workers (WRSt) has an accelerating effect on the capacity utilization rate in the sugar industry in Nigeria. The finding implies that the capacity utilization rate is inelastic with respect to the wage rate of skill workers in the industry. This means that 10% change in the wage rate of the skill workers is greater than the same 10% change in the capacity utilization rate in the industry.

Capacity utilization rate in the sugar industry has a significant positive inelastic relationship with the real research expenditure (REX_t). The finding implies that the industry's incentive to increase

capacity utilization rate increases with increasing expenditure on research.

The coefficient of the sugar industry's real energy consumption (IRE_t) exhibited the a priori expectation. It has a significant negative influenced on the technology capacity utilization in the sugar industry in Nigeria. The result suggests that increase in the real energy consumption of the industry reduces the technology based capacity utilization rates in the industry. The reason for the result could be attributed to the high cost of imported fuel to the Nigerian economy; as more than 70% of refined fuel consumed is imported.

The slope coefficient of human capital (HCP_t) has a significant (at 5% probability level) positive relationship with the industry's capacity utilization. This implies that increasing the workforce will result in the increase in the capacity utilization rate of the industry. The result suggests that labor intensive technique of production is predominant in the industry in Nigeria. Using the magnitude of the estimated coefficient of elasticities, the result reveals that human capital (0.628) is the most important factor in the specified variable that affects capacity utilization in the industry.

The slope coefficient of import substitution policy period (D1) exerted a significant (at 1percent level) positive effect on the technology based capacity utilization rate in the sugar industry in Nigeria. The finding suggests that the industrial policy of regular government intervention and participation in production activities which were the major components of the import substitution policy favor

increased in technology based capacity utilization in the sugar industry in Nigeria. It could be that the policy promotes financial investment in the sub-sector, thereby accelerating resource utilization. The finding is similar to the results reported by (Kuman and Nitin, 2009).

Summary, Recommendations and Conclusion

The study analyzed the impact of firm related factors and import substitution policy period on the capacity utilization in the sugar industry in Nigeria for the period 1970 to 2010. Sugar industry based data and some macro-economic data derived from the publications of Central Bank of Nigeria as well as National Bureau of Statistic were used in the analysis. The unit root test was conducted on the specified variables using the Augmented Dicker Fuller statistics. The result reveals that some variables were stationary at level while some were stationary at first difference. The diagnostic statistics from the multiple double log linear regression estimates on the specified variables confirmed the relevance and reliability of the selected model. The empirical result reveals that the coefficient of sugar cane price and sugar industry's real energy consumption has a significant negative relationship with the technology based capacity utilization in sugar industry in Nigeria. On the other hand, the wage rate of skill workers, industry's real research expenditure and human capital have significant positive influenced on the technology based capacity utilization rate in the sugar industry in Nigeria. In addition, the results revealed that the policy period of import substitution has a stimulating

effect on the growth of capacity utilization in the sub sector. Furthermore, the values of elasticity for the specified variables reveal inelastic relationship of technology based capacity utilization sugar with respect to the sugarcane price, wage rate of skill workers, human labor, and industry's real research expenditure in Nigeria.

Hence, to increase capacity utilization in the sugar industry in Nigeria, the study calls for policies aims at expanding the hectares of industrial sugarcane and increase production of refined petroleum fuel in the country. Also policies targeted on the intensification of research and improved worker's remuneration in the sector is strongly advocated in Nigeria. In addition, the study recommended that the industrial policy package of import substitution should be re-defined to involve more private investor and less government participation.

Finally, our analysis has focused on influenced of firm related factors and import substitution period on the technology based capacity utilization in sugar industry in Nigeria on the assumption of constant effect of technology throughout the study period. This means that sugar firm resource utilization might not be optimized and it could violate the modern economic theory of firm production. As such, capacity utilization of firms derived following the economic optimization of resources might be more revealing, thus it is highly recommended for further research in the industry. Also factors that influenced capacity utilization should be broaden to include environmental factors and post reformed period. However the policy recommendations could form the initial framework to the policy makers and stake holders in the sub sector to build on, in their attempts to revitalize the industry in Nigeria.

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Analysis of rural credit market performance in north west region, Cameroon

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Abstract

The study was conducted to assess the performance of rural credit markets in the North West Region of Cameroon. Specifically, it identifies the various participants in credit markets, estimates and analyses the credit demand and supply functions. Data were primarily gathered through a multi-stage sampling technique involving 360 households and 60 credit institutions. Results reveal that interest, income, household size, farm size, education age and sex of respondents were determinants of credit demand while interest paid, gross income and source of loan determined credit supply. It was recommended that interest should be kept low to encourage proper functioning of credit markets.

Key words

Performance, formal, informal, credit demand, credit supply.

Introduction

One major way to improve agricultural production is through the adoption of disseminated technology. However, low adoption rate which is an impediment to this approach is mainly caused by insufficient capital. A common way to satisfy the capital needs of new technology is to provide rural people with low interest rate credits. Over the years credit has been an important policy instrument aimed at promoting production and the use of modern technologies (Mittendorf, 1986). Farm credit is a crucial factor in the development of the rural sector. According to Musugi (2002), credit is not merely a tool to increase productivity and raise farm income but is used to fulfill the social function of enhancing the lives and welfare of the rural people. Credit is a transaction in which command over resources is obtained in the present in exchange for a promise to repay in the future, normally with a payment of interest compensation to the lender (Saulnier 1982). According to Atieno (2001), the lack of an efficient credit market constitutes one of the factors responsible for the declining productivity in the rural economy.

Rural credit markets play an important role in capital formation, (Wall, 1987). In developing countries, several efforts are being made to establish

modern financial institutions to assist rural people enhance their productivity and income earning capacity, (UNDP, 1999). Rural credit markets can be described as any place where creditors and debtors are brought together. It can be regarded as any arrangement for the mobilization and purveyance of finance for investment in the rural sector, (Thorn, 1976; Awosika and Nwoko, 1983). Rural credit markets are aimed at placing credit facilities at reasonable terms within easy reach of rural dwellers, increasing productivity of rural sector, promoting and expanding the rural economy in an orderly and effective manner. In rural credit markets, there is a smooth flow of funds from surplus spending units to deficit spending units, (Hoff and Stiglitz, 1990; Von Pischke et al, 1983). Rural credit markets are made up of formal sector (banks, credit unions, cooperatives societies) and the informal sector (Rotating Credit and Savings Association, Non-Rotating Credit and Savings Associations, landlords, moneylenders, friends, and church associations). Many governments have over the years tried to reach the rural people through subsidized credit programmes. However, failure of these programmes through the formal sector has resulted in the emergence of informal institutions aimed at administering credit to meet demand, (Yaron et al, 1997).

Cameroon's credit market shows the dualistic structure of both formal and informal sectors typical of developing countries. The performance of the financial sector in Cameroon in providing loans and mobilizing savings to rural people has met with a lot of criticism, (Schrieder, 2000). Government approaches to preferential interest rates have limited the amount available to rural people. Also bureaucratic bottlenecks, criterion of credit worthiness as well as delays in loan processing and disbursement have reflected in the existing unsatisfied demand. The existing credit policy has resulted in great disparity between credit demand and supply. These problems of the formal sector have contributed to make the informal sector an alternative source of credit and means of mobilizing savings, (Angyie, 2004). Besides the problem of bank distribution or spread which is generally biased in favour of the big urban cities, the Cameroon formal financial sector equally suffers from problems of linked to foreign domination as well as stiff competition from the informal sector.

Khalilly and Meyer (1993) observed that until recently, a supply led approach has been used by many institutions to provide credit to the rural people. According to Miller and Ladman (1983), although land size is an important factor in the decision to borrow or not to borrow, it is not important in determining the loan size to borrow. Also loan delinquency and default have continued to plague credit supply. Factors that affect credit demand have been identified by Zeller, (1994) to include individual characteristics, labour assets and household events. Also due to imperfect information and fragmented markets, a number of conceptual difficulties have been identified in estimating credit demand. It is therefore difficult to identify the credit demand schedule using information on observed loan amounts since this reflects only the existing supply.

The government of Cameroon has over the years established rural credit scheme to provide credit to rural people. Despite these initiatives to bridge the financial gap in rural areas there are still indications that these attempts have limited effects and the problem of access to credit has continued. It is also argued that the government instituted some of these credit schemes because rural people lack the ability to organized self-help activities and therefore require cheap credit for their rural occupational activities. Despite government intervention in the creation of alternative institutions for credit, these have failed to drive the traditional rural market operators out of the market. However, despite these attempts at improving credit markets, credit has remained a limiting factor to improving

agricultural production. In view of these, this paper is aimed at studying the performance of rural credit markets. Therefore this study aims at accessing the performance of rural credit markets in the North West Region, Cameroon. It also aims at ;

- identifying the various participants in credit markets.
- estimating and analyzing the credit demand function for formal and informal credit users.
- estimating and analyzing the credit supply function.
- identifying the problems of the various participants and institutions
- determining factors that discriminate between users of formal and informal credit institutions.

Methodology

The study was carried out in the North West Region, Cameroon. It is one of the ten (10) regions that make up the country. It is made up of seven (7) divisions which are further divided into subdivisions. The people of the region are predominately farmers growing crops such as maize, beans, irish potatoes and vegetables. They are also engage in small scale businesses, hunting, and handicraft works. Financial institutions found in the area include commercial banks, cooperatives, credit unions (formal), RCSA, Non-RCSA, welfare associations, mutual assistance groups and moneylenders (informal).

For this study, a multi-stage sampling technique was adopted. Firstly, four divisions were purposively selected out of the seven. Secondly, two (2) subdivisions were then selected from each of the four divisions making a total of eight (8). Thirdly, from each of the subdivisions, three (3) villages were purposively selected. This was to ensure that villages selected had at least a credit institution. Finally from each village fifteen (15) respondents were randomly selected, thereby making a total of 360 respondents. The respondents were made of credit institutions, formal credit users and informal credit users.

Addressing the research questions requires an integrated approach towards credit demand, credit supply and the various sources. Well structured questionnaire were used to elicit information from the various respondents. Results were analyzed using descriptive statistics, 2 stage least square regression analysis and the discriminant analysis which was use to determine factors that discriminate between formal and informal users. Finally the

chow test was use to test if there is any significant difference between amount of credit demanded from formal and informal credit institutions.

The implicit model for credit demand was:

$$Cd = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, U) \quad (1)$$

Where:

Cd = credit demanded

X_1 = household income

X_2 = interest paid

X_3 = age

X_4 = educational level

X_5 = household size

X_6 = farm size

X_7 = years of experience

X_8 = distance to credit source

X_9 = membership of association (belong to association = 1, non membership = 0)

X_{10} = gender (1 = male, 0 = female)

The implicit model for credit supply is given as:

$$Cs = (Cd, X_{11}, X_{12}, X_{13}, X_{14}, X_{15}, X_{16}, U) \quad (2)$$

Where:

Cs = Credit supplied

Cd = Credit demand

X_{11} = years in business

X_{12} = gross income in one year

X_{13} = interest received

X_{14} = transaction cost

X_{15} = proportion of loan repaid

X_{16} = source of loan (1 = formal institutions, 0 = informal institutions)

The chow test was used to test if there was any significant difference between amount of loan repaid for both formal and informal credit institutions. This entails the computation of calculated F-values.

$$F^* = \frac{\frac{\sum e_p^2 - (\sum e_1^2 + \sum e_2^2)/K}{(\sum e_1^2 - \sum e_2^2)}}{N1} + N2 - 2k$$

Where:

$\sum e_p^2$ = residual sum of squares for pooled data

$\sum e_1^2$ = residual sum of squares for formal users

$\sum e_2^2$ = residual sum of squares for informal users

N1 = total number of formal users

N2 = total number of informal users

K = number of parameters estimates

Results

Socio-economic characteristics

The results of the socio-economic characteristics of loan recipients are shown in table 1. The mean ages were 50years for formal users and 48years for informal users. This indicates that young farmers patronize mostly informal credit institutions which are willing to offer loans to young people who are active and likely to adopt new innovations. The table shows that 56.5percent of formal users and 51.5 percent of informal users had at least a secondary school education. The level of literacy attained by borrowers suggests that they are capable of understanding the rules and procedures of acquiring and using loans. Household in the study refers to the number of people living under one roof and feeding from the same pot. The average household for formal users was 6persons and 9persons for informal users. This indicates large house hold sizes for developing countries.

Experience was measured by the number of years the respondent have been engage in farming. The mean year of experience for formal users was 8years and 11years for informal users. This indicates that most of the respondents have stayed long in their occupation and could have acquired skills to better manage their loans effectively. The mean values for farm size was 3hectares for formal users and 2.6hectares for informal users respectively. This shows the small nature of holdings which is typical of developing countries.

According to table 1 also, 39.14 percent of the respondents obtained loans from formal credit institutions while 60.86percent obtained loans from informal credit institutions. This is because informal credit institutions are readily available. According to the reasons given for participating in rural credit markets, 20.76percent of the respondents wanted to improve their farm production, 27.54percent wanted to venture into small scale businesses while 7.42percent wanted to settle debts.

The average loan obtained from formal institutions was 1,500 000 FRS and 375,000 FRS for informal institutions. This indicates that loans from informal institutions are small, popular, active and easily available. Amongst reasons given for constrains to effective credit market performance were high collateral demands, lack of guarantors, high interest rates and long disbursement lag. Also according

to table 1, the most critical institutional problems faced by credit markets were corruption among leaders (38.7%) and leadership problems (29.0%).

Credit demand and supply analysis

The estimated credit demand function for formal and informal credit users are given in table 2. According to table 2, interest payment, income of respondent, household size farm size, number of years in business (experience), distance to credit institution and sex of respondent were all statistically significant variables that affect credit demand in formal institutions. For the formal users, the R² value was 0.843 while the F-value was 63.7. The table further shows that variables that determined credit demand in informal institutions include age of respondent, farm size, interest payment, income of respondent and distance to credit institutions while the R² value was 0.853 while the F-value was 100.2.

The estimated credit supply function is presented in table 3. According to the table, the value of the R² is given as 0.969 while the F-value was 448.1 and was significant at 1 percent. The coefficients of credit demand, interest payment, gross income, and source of loan were all statistically significant and positively related to credit supply. On the other hand, number of years in business was also significant but negatively related to credit supply.

Discussion

The values of R² of 0.843 and 0.853 for formal and informal institutions respectively implies that the included variables were able to explain about 84.3% and 85.3 of total variations in the amount demanded from formal and informal institutions. The significant F-values in both cases imply that the joint effects of all included variables in credit demand were significant.

The negative significant coefficient interest for formal institutions implies that the higher the amount of credit demand, the lower the interest paid. This result is in line with that of Desai and Mellor (1993) who also reported a negative relationship between interest payment and credit demanded. The personal income of a respondent is an important variable determining the amount of credit a respondent can obtain from a credit institution. This is because the personal income acts as an assurance for the respondents ability to repay the loan whenever due. Also the positive relationship between farm size and credit demand implies that the larger the farm size, the bigger the amount of loan an individual can obtain. This is because farm size acts as collateral for security of

the loan being requested at any given point. With a higher number of years of experience, it will act as a guide in the optimal and maximum utilization of credit obtained. However the result of distance being directly related to credit was contrary to a priori expectations. This can be explained that the further a respondent has to travel to secure a loan, the higher will be the amount he/she will demand. Also the positive significant coefficient of sex implies that more males demand credit form formal institutions than females.

In the informal institutions, the indirect relationship between age and credit demand implies that as a respondent gets old, the less credit will be demanded. This is because older persons are more interested in immediate consumption and less concern with risk taking and long term investment. The coefficient of education which was positive and in line with the findings of Nwaru (2004) who reported that educated farmers in Imo state, Nigeria are more willing to take risk than non-educated ones. Also educated persons can better manage loans and most often, credit institutions prefer clients who are able to read and write. Interest payment, income of respondent and distance to source of loan were also significant.

The R² value of 0.969 for credit supply implies that the included variables are able to explain about 96.9% of the total variations in credit supplied in the study area. The positive relation ship between credit supply and credit demanded implies that lenders respond more to higher levels of loan request by adjusting upwards their supply. The positive relationship between experience and credit supply implies that old banks supply more credit than new ones. This is because they generate more income and are customer friendly. Also gross income was positively related to credit supply implying that the financial status of institutions plays an important role in credit supply. Also in agreement with a priori expectations, interest was positively related to credit supply. This implies that credit institutions are willing to supply more credit in order to generate more income from interest payment. However, Adams and Vogel (1986) noted that interest rates on loans should be kept minimal to promote development. Also Nwaru (2004) noted that low interest choke off supply of credits in credit markets. Finally the positive relationship between source of loan and credit supply implies that formal institutions supply more credits than informal institutions.

The chow test result implies that there is a significance difference between loan demanded from formal and informal credit institutions.

Conclusion

Considering the results of the study, it is concluded that most rural people have continue to patronize informal institutions more than formal ones possibly due to non-availability, bureaucratic and cumbersome nature of loan procedures. Therefore, government of Cameroon should enact credit policy programmes aimed at strengthening the informal sector to enable it contribute to the development of rural areas. Also since credit is best used when it is likely to increase returns to the user, effective management of rural credit markets in the study area will go a long way in enhancing development. Finally, it is concluded that since both supply

credit, formal and informal credit institutions can be complementary rather than competitors. In view of the findings, it is therefore recommended that:

- Education should be encouraged amongst the rural people to enable them better understand the workings of credit markets.
- Since interest rate was an important determining factor in credit demand and supply, interest rates policies that make for optimal credit provision should be encouraged.
- For effective credit use, financial institutions should put more emphasis on credit management training to assist farmers better manage their loans.

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Influence of subsidies on height and structures of farmers' incomes in EU member states

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Abstract

In a new budgetary framework for years 2014-2020, changes will be made in expenditures of financial means from the EU budget, which will significantly influence incomes of agricultural producers in all member states of the Community. Incomes of agricultural enterprises always represented a very sensitive area of economic-political approaches in the agrarian sector. At the present, the situation is the same. In a theoretical sphere and in practice of institutions, ways to monitor incomes of agricultural farms, to analyze them, and what measures on base of these analyses to realize, are searched. The submitted paper deals in this context with a question of incomes according to their origin – agricultural incomes, incomes from non-agricultural activities, subsidy means. The aim is to draw attention to the fact that the subsidiary policy towards farmers can not be base in the area of incomes only on development and height of incomes, which have their origin in agricultural activities, but that it is necessary to consider the general income situation. A special attention has to be paid than to non-agricultural incomes – which are in the attention center in connection with demanding activity diversification. Knowledge presented in this paper is the result of grant solution MSM 6046070906 "Economics of Czech agriculture resources and their efficient usage within the framework of multifunctional agri-food systems".

Key words

Agrarian sector, incomes of agricultural producers, incomes of agricultural branch, income indicators A and C, subsidy means, diversification of activities, incomes of non-agricultural activities, total incomes.

Anotace

V novém rozpočtovém rámci na roky 2014-2020 dojde ke změnám ve výdajích finančních prostředků z rozpočtu EU, které významným způsobem ovlivní příjmy zemědělských producentů ve všech členských zemích Společenství. Příjmy zemědělských podniků vždy představovaly velmi citlivou oblast ekonomicko-politických přístupů v agrárním sektoru. Není tomu jinak ani v současnosti. Ve sféře teoretické i v praxi institucí jsou hledány cesty, jak sledovat příjmy zemědělských hospodářství, jak je analyzovat a jaká opatření na základě těchto analýz realizovat. Předkládaný článek se v těchto souvislostech věnuje otázce příjmů podle jejich původu – zemědělských příjmům, příjmům z nezemědělské činnosti, subvenčním prostředkům. Cílem je upozornit na to, že nelze podpůrnou politiku vůči zemědělcům v oblasti příjmů opírat pouze o vývoj a výši příjmů, které mají svůj původ v zemědělských činnostech, ale že je nutné zohlednit celkovou příjmovou situaci. Specifickou pozornost je pak nutné věnovat příjmům nezemědělských - které jsou v centru pozornosti v souvislosti s žádoucí diverzifikací činností. Poznatky prezentované v článku jsou výsledkem řešení výzkumného záměru MŠM 6046070906 "Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů".

Klíčová slova

Agrární sektor, příjmy zemědělských producentů, příjmy zemědělského odvětví, příjmové indikátory A a C, subvenční prostředky, diverzifikace činností, příjmy z nezemědělských činností, celkové příjmy.

Introduction

A new financial frame will be hold in the EU member states in a new budget period 2014-2020. Against the present financial frame it will contain changes of annual budgets, both in their height and the expenditures structure. It is supposed that the fundamental changes will touch financing of agriculture and the country and will influence significantly incomes of agricultural producers in the EU member states.

Incomes of farmers represent a very sensitive area of economic-political approaches to agrarian sector. They were an important factor in the entire history of the Common Agrarian Policy (CAP) which influenced its orientation and content. In this context we can remember the beginnings of CAP when one of priorities was to secure living standards of agricultural inhabitants, further McSharry's reform from 1992, which introduced direct payments as a tool to maintain the income level after decrease of intervention prices. The necessity to maintain an adequate income level is mentioned also in the document Agenda 2000 which influenced financing of agriculture in the budget frame in 2000-2006. Finally, also all other reform measures including the reform from 2003 (Mid-term Review) respected maintenance of farmers' incomes height. The changes touched rather the structure.

No small role in the height of income of agricultural entrepreneurial subjects is played by endowment means. Transfers of financial means in agriculture, direct and indirect, are the subject of discussions in both the theoretical sphere and the practice.

The theoretical sphere deals above all with questions whether institutional interventions (of the EU, the state) are compatible with market mechanism (possibly to what extent) and what deformation of their existence it invokes. Theoretical reasons defending the necessity of institutional supports and interventions of the EU (the state) in market relations in agriculture stem mostly from a message of this important sector of national economies (Sanderson 1990, Šrein 1998, Rektořík 2007). First of all in the area of security of food safety, maintenance of the country settlement, the care for landscape, a positive affect on the environment, in creation of balance on agrarian markets etc. Some authors see the message of endowment in agriculture in maintenance of production function, mainly in the dimension of meeting needs of agrarian products from own resources (Šrein 1998) and in security of price and income stability (Grega 2005). Others (Rektořík 2007) hold view that the subsidies in agriculture should be concentrated on

supports of its non-production functions. Both the above mentioned approaches consider the specific character of agriculture.

Vice versa, many other economists question the EU (state) interventions in agriculture, criticize the existence of re-distribution of means in favour of enterprises or sectors (Rothbard 2007) which in final consequence does not bring the total product growth or negative influence of subsidies on self-sufficiency and entrepreneurial activity of farmers, and dependence on external financial supports (Boháčková 2006). A common denominator of these opinions is a negative impact of subsidies on economic efficiency of enterprises and the sector and on a small motivation of farmers to its growth.

In practice, the agrarian-political approach of the Community to agriculture invokes a discussion about a financial demandingness of this sector for public resources, about justification and usefulness of subsidies provided to agriculture and about future changes which are necessary in the area of agricultural supports.

An often argument substantiating the necessity of subsidies in agricultural enterprises is a statement that the agricultural activity itself (i.e. traditional plant and animal production, or perhaps forest production and productions and activities connected with agriculture or establishing with it) despite price interventions and regulatory interventions in the agrarian market connected with EU protectionist policy, has not been able already for longer time to secure prosperity and desirable living standards for farmers. This fact projects also in both strategies, the present and of the future CAP. There the emphasis is put on „restructuring“ of the present total incomes of agricultural farmers in sense of strengthening of secondary non-agricultural income activities. The Community strives so that producers would be more responsible for achieved incomes in the future, the decreasing importance of agricultural incomes would be eliminated by growing share of incomes of non-agricultural character, and the share of financial means from public resources would decrease in the total incomes structure.

Methodology

The presented paper sets following goals, regarding the above mentioned:

1. To analyze a height and a structure of agricultural incomes in EU member states
2. To quantify an influence of endowments

on the achieved income from
agricultural activity

3. To analyze activity diversification in
agricultural enterprises

The methodological procedure consists of
establishing steps:

- a definition of used economic
categories,
- a subsequent review of used
methods and
- introduction of data resources.

Following economic categories are analyzed in
the paper: the income of agricultural producers
resulting from agricultural activities (further
agricultural income), a subsidy creating a part of
agricultural incomes, and non-agricultural incomes.
In connection with the category „agricultural
income“ it is necessary to emphasize that:

- It is not dealt with a personal income of farmers
but of agricultural entrepreneurial subjects,
whereas the firm income in family agricultural
farms can be identified with the income of an
owner (possibly of a family).
- As the agricultural income it is understood only
the income coming from economic activity
„agriculture“ (plant production, vegetable
growing and horticulture, animal production),
further from agricultural breeding activity and
services (except veterinary ones), from forestry
(hunting, catching and breeding of wild
animals) and from activities connected with
agricultural enterprise (agricultural services
in form of contractual works at the level of
production, and other agricultural services).
Besides this also non-agricultural activities
belong here which can not be separated from
the main agricultural activity. Agricultural
incomes are methodologically delimited by so
called „summary agricultural account of the
Community (SAAC).
- Resulting income, defined as the income from
agricultural activity, is expressed by triplicate
way (see the scheme 1):
 - as a net added value. In its character it is
not a real firm income; it can be rather
marked as an income achieved by working
of production factors. Methodologically it
is set in a frame of the production account
when the height of semi-consumption
(expenses of external and internal
character) and the height of consumption
of fixed capital (depreciations) is deducted

from the value of agricultural activity
outputs. A correction of the really
achieved net added value is the balance of
so called other production taxes and other
production subsidies.

- as an operating surplus which is a result of
an account of creation of income achieved
from the land, the capital and unpaid
work. The methodological starting point is
a category the net added value from which
wage costs of foreign work are deducted.
The operating surplus is adjusted by a
tax balance and a subsidy of investment
character.
- As a net business income. It is close to
the conception of income from operations
(a profit), however, is not identical. In its
calculation in frame of account of business
incomes it is stemmed from the net
operating surplus from which payments
of a lease, interests and a compensation
for unpaid work is excluded, and in which
possible yields flowing to enterprises from
land lease and capital yields.

Also a construction of 3 basic indicators expressing
the level of agricultural incomes – indicators A, B
and C conforms to this segmentation. Only two of
the indicators were used in the analysis, the indicator
A (an index of real income from production factors
– the net added value relative to an annual work
unit) and the indicator C (it expresses a net business
income from agricultural activities). The indicator B
was not used because it has a very good informative
power in countries where agricultural enterprises
have a form of individuals, but is unsuitable where a
significant number of agricultural enterprises works
with paid labour force. The indicators were used in
form of indexes where the base was represented by
the height of incomes achieved in 2005 (100%).

As it results from the scheme 1, agricultural
policies having a various entrepreneurial form show
different types of business incomes. For comparison
purposes, a category „net business income“ was
used which is an income category monitored in all
entrepreneurial forms, although in some enterprises
(of individuals, of family businesses, and specific
companies of i.e. cooperative type) it is not the final
income.

Subsidies – a part of agricultural incomes

The Regulation of European Parliament and the
Council (EC) (References) defines a financial
farmers support in connection of agricultural
incomes as „subsidies“. The subsidies „are
common unilateral payments paid by governmental

institutions or EU institutions to producers with an aim to influence their level of production, price or reward to production factors². They are divided in subsidies for products (including import subsidies and other subsidies for products) and in other subsidies for production. Similarly, the particular kinds of subsidies are defined by the mentioned Regulation.

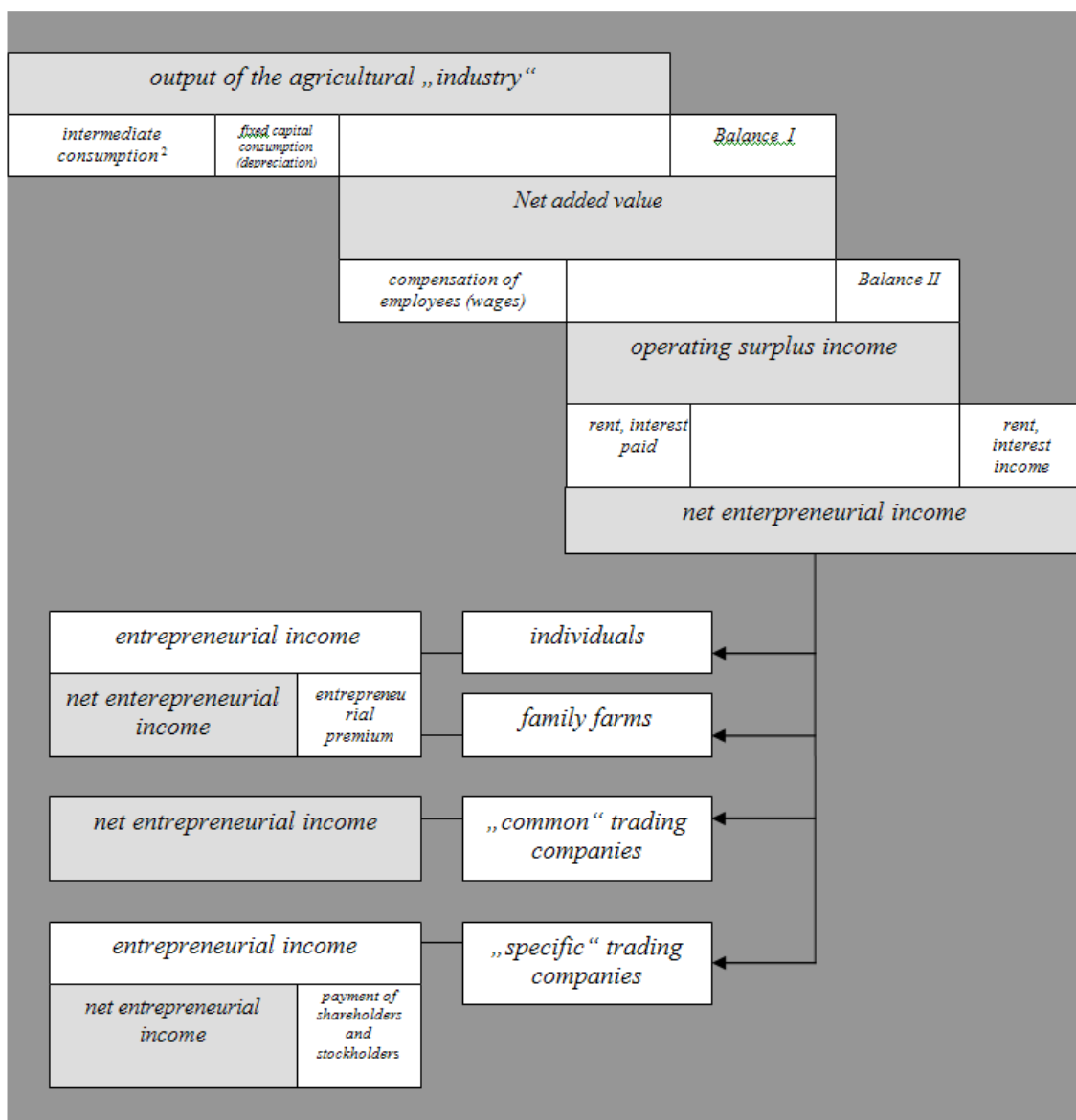
Non-agricultural activities

The term „agricultural activity“ is used in the analysis in dual way. There are differentiated partly non-agricultural inseparable activities and partly separable non-agricultural activities. Among the inseparable non/agricultural activities are ranked a processing of agricultural products and other

products in which „an agricultural enterprise and its production means are involved“. The separable non-agricultural activities have purely non-agricultural character; they neither establish with agricultural production nor complement it, and they use specific production means which can not serve, at the same time, the agricultural activity.

Basic methods used in the paper were an analysis and a comparison. In frame of the analysis, standard methods as a trend analysis and a vertical analysis (i.e. a structure analysis) were applied.

The comparison object was the situation in agrarian sectors of all 27 EU member states (a system of „agricultural accounts“). Further, valid documents of European institutions were used.



Scheme 1: Methodology of determination of agricultural activity income in relation to a form of agricultural enterprise.

Results and Discussion

1. Agricultural incomes, their development and structure

Income development of agricultural enterprises, which have their origin only in agricultural activities, was monitored by the help of indicators A and C in the period 1998-2009. Besides the development trend, also factors which influenced significantly the development trend were evaluated (except subsidies, they are dealt with separately). At the same time also differences between the „old“ (EU-15) and the „new“ (EU-12) member states were observed.

In the countries of EU-15, the income indicator A, except few exceptions, recorded almost an identical

development trend. The indicator value had grown in all countries till 2007, it means that the net added value in recount per one work unit increased; in 2007 the indicator A reached the highest value. Further, except Great Britain, it decreases. A more significant fall is obvious in countries of Benelux, France, Germany and Austria. The indicator decreased more slowly in countries of so called “south wing” (however, in Italy, a decreasing trend of the indicator is apparent already since 1998). From the following analysis of SZÚ data it resulted that one of reasons of the mentioned facts is the development of agricultural production value. It either decreased or more or less stagnated in some countries. Then, the development of agricultural production value contrasted with a high increase in intermediate

Country	1998	2000	2003	2004	2007	2008	2009
Income indicator A							
Belgium	113,6	119,3	106,3	108,3	129,5	92,5	93,0
Bulgaria	x	101,1	86,4	74,5	98,5	152,2	136,9
Czech Republic	65,1	66,5	59,2	93,2	118,7	123,5	102,5
Denmark	84,6	105,4	88,2	99,3	105,0	54,4	56,7
Germany	70,5	90,0	75,4	111,9	134,5	127,6	100,8
Estonia	50,8	40,5	57,6	94,8	143,5	113,7	93,9
Ireland	78,5	73,2	75,6	80,1	94,2	87,4	66,8
Greece	118,4	116,7	103,4	98,3	103,8	96,6	96,9
Spain	106,4	104,3	123,1	113,2	107,4	103,8	101,9
France	117,8	111,4	106,8	105,3	124,1	110,6	89,6
Italy	118,1	117,9	113,5	114,6	94,2	95,5	75,7
Cyprus	x	125,4	98,7	96,6	91,3	86,7	87,7
Latvia	54,2	41,2	57,6	95,9	134,9	115,7	98,6
Lithuania	78,9	60,8	58,7	92,5	133,4	123,5	103,3
Luxembourg	119,8	104,3	99,2	99,1	103,9	90,3	67,2
Hungary	99,2	74,3	65,1	98,2	114,8	146,2	99,2
Malta	108,2	92,8	99,4	96,8	93,8	87,8	94,6
Netherlands	133,1	124,5	108,6	101,1	121,2	98,6	90,2
Austria	83,0	90,8	97,5	102,4	124,4	119,1	95,9
Poland	69,3	61,0	58,5	110,3	134,3	127,2	126,4
Portugal	90,8	95,2	98,4	108,8	100,0	103,8	99,8
Romania	104,6	66,9	121,2	175,1	76,8	112,3	91,8
Slovenia	64,4	71,6	64,5	99,5	109,5	98,3	83,4
Slovakia	80,9	82,5	82,8	107,3	128,9	143,4	125,1
Finland	59,4	89,6	98,2	86,2	106,0	89,3	91,6
Sweden	93,7	89,6	105,7	91,1	134,3	128,2	119,8
Great Britain	85,5	80,0	94,6	101,1	112,0	144,7	137,0

Source <http://nui.epp.eurostat.ec.europa.eu> – agricultural accounts according to SZÚ 97 Rev.1.1.

Table 1: Indicator of agricultural incomes A (in index values where 100 = year 2005).

consumption value (an average increment in the monitored period amounted to 37.5 %, e.g. in Denmark 44.8 %, in Spain 81.9 %, in Luxembourg 76.6 %). Depreciations influenced the indicator A development more significantly only in Spain (an increase 70.9 %) and in Luxembourg (112 %). An exception in the whole period was represented by Great Britain when the intermediate consumption increased only by 15 % and depreciations fell by 17 %. Great Britain is the only country where the indicator A and factors influencing it developed in a different way from other countries. It is a fact that the indicator A achieved a higher value in 2009 than in the starting year 1989 only in several countries – in Germany, Austria, Portugal, Finland, Sweden, and in Great Britain, of course. Its value was lower

in other countries, at average about 75 % of the value in 1989.

In the „new“ EU member states, the indicator A showed the same development tendency after the accession in the EU as in the countries of EU-15. It means that values of the indicator had increased till 2007 (exceptions were Cyprus and Malta), after that they decreased. However, the decrease was not so significant like in the countries EU-15. A considerable increase in creation of net added value per one work unit happened in Bulgaria, Poland and Slovakia. In comparison with the countries EU-15, both the value of agricultural production and of intermediate consumptions grew faster. Also the depreciations influence was more significant.

Country	1998	2000	2001	2004	2007	2008	2009
Income indicator C							
Belgium	146,4	146,7	129,7	115,1	138,5	72,9	69,0
Bulgaria	158,4	131,3	143,5	108,4	71,8	102,4	78,8
Czech Republic	-72,8	-19,1	46,9	120,9	135,8	130,9	47,0
Denmark	117,9	216,0	343,1	72,3	11,0	-580,3	-604,0
Germany	65,3	112,6	155,5	129,3	163,0	140,2	78,0
Estonia	89,4	69,5	75,5	100,5	127,2	70,4	36,1
Ireland	89,4	98,7	98,3	82,1	87,3	73,0	49,1
Greece	134,3	127,0	123,8	100,9	99,2	90,1	90,2
Spain	192,2	116,9	127,2	121,4	106,9	94,4	90,0
France	162,9	141,2	136,7	113,6	133,1	103,3	67,4
Italy	170,6	157,5	153,5	144,4	81,2	82,4	45,6
Cyprus	9,3	x	x	104,4	79,2	74,8	76,3
Latvia	61,4	43,5	56,8	101,9	101,2	70,8	56,6
Lithuania	141,7	64,1	54,2	87,5	104,4	89,5	61,5
Luxembourg	152,8	126,6	119,8	99,3	94,3	73,3	38,2
Hungary	151,8	84,2	88,3	103,8	94,4	73,3	38,2
Malta	123,8	106,5	117,5	102,4	98,0	91,1	98,9
Netherlands	255,1	209,5	191,1	118,0	138,4	75,0	54,9
Austria	95,3	99,1	119,7	106,8	121,7	112,4	83,6
Poland	77,8	56,3	67,6	113,1	137,8	127,7	120,5
Portugal	120,2	124,3	139,7	126,4	79,1	76,8	66,1
Romania	163,9	103,7	161,6	186,0	53,7	87,1	61,7
Slovenia	76,8	79,8	69,0	100,2	106,2	92,3	74,4
Slovakia	-315,1	157,7	275,1	328,5	402,9	547,6	91,5
Finland	73,3	111,9	107,9	92,2	95,5	60,2	65,5
Sweden	97,8	89,3	97,5	74,3	95,5	60,2	65,5
Great Britain	102,4	80,8	89,0	109,1	105,5	159,0	150,9

Source <http://nui.epp.eurostat.ec.europa.eu> – agricultural accounts according to SZÚ 97 Rev.1.1.

Table 2: Indicator of agricultural incomes C (in index values where 100 = year 2005).

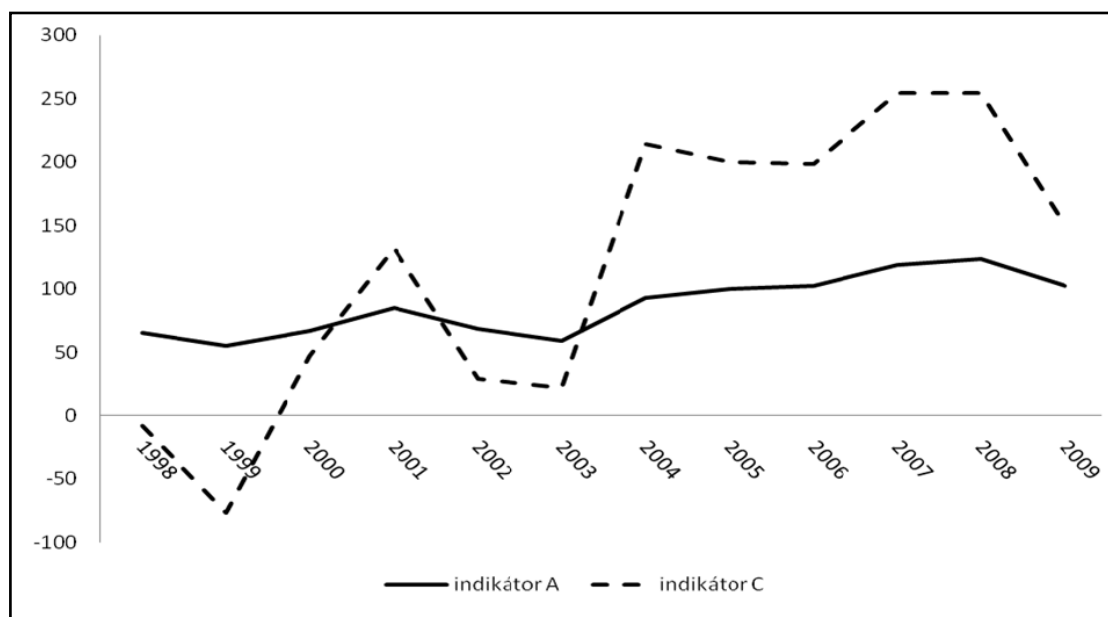
For evaluation of the level and development of incomes from agricultural activity it is preferable to monitor the indicator C which expresses a height of reached net entrepreneurial income per one work unit. Moreover, the net labour income respects also other influencing factors (see the methodology) and has a better evidence ability on efficiency of agricultural activities. Data in the table 2 unambiguously evidence that there has been a continuous decrease of entrepreneurial income in most EU-15 countries since 1998. Nevertheless, in these countries the income height in 2009 was lower than in 1998. Income significantly decreased in Greece, Spain, France, Italy, Luxembourg and above all in Denmark. Exceptions from this tendency were Germany and Great Britain.

Among influencing factors there are (besides the subsidy means) paid wages, paid interests, and paid tenancy. There was an increase in the monitored increase (measured by the basic index, a base = year 1998) in wages by 35 %, in interests by 39 %, and in tenancy by 32 %. In most of new EU member countries, the indicator C development shows a following tendency: after the accession into the EU and adoption of CAP, its value increases in most countries; in some very significantly, e.g. in Slovakia. Since 2005 the indicator values decreases. The table 2 presents differences among particular new countries. Especially interesting is the indicator development in Slovakia and Poland, where the indicator grew quickly and very significantly till 2009 (mainly Slovakia merits the attention), also in Hungary and Malta, where the net entrepreneurial income over the

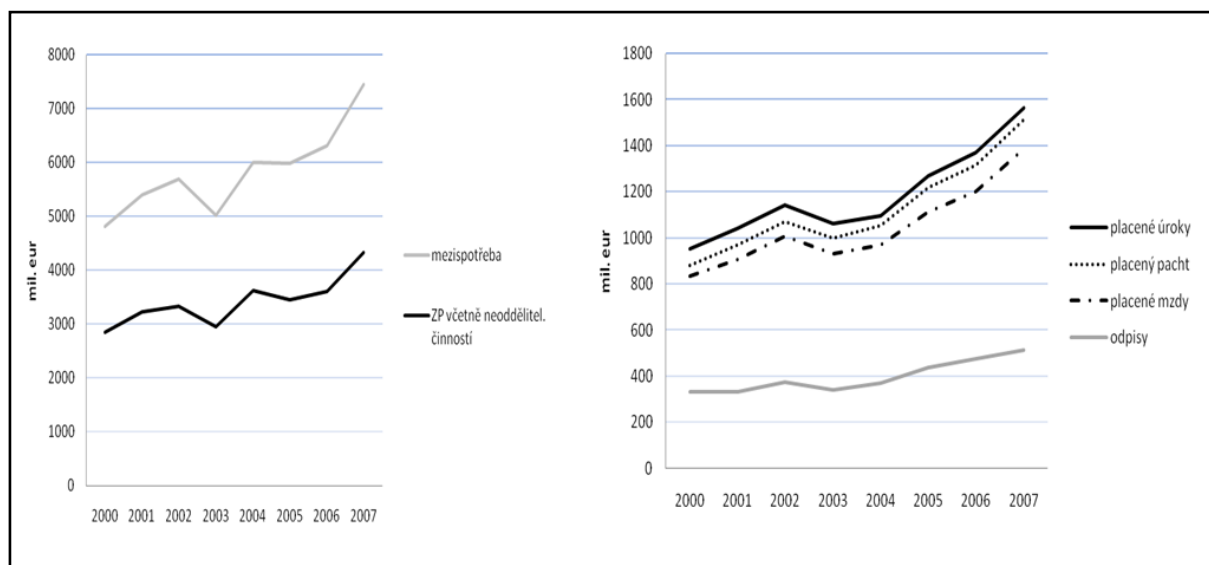
whole monitored period showed decreasing trend. Moreover, Hungary is characteristic with a deep fall of the indicator value in 2009. The mentioned indicator C development in new EU member states was influenced mainly by increase of wages and paid interests. A very high increment was recorded in Baltic republics and in Slovakia (e.g. in 2004, wages in height of 29.5 mil. Euros were paid off there; in 2008 already 442.3 Euros). The tenancy influence was not significant.

Development of indicators of agricultural incomes A and C in the CR is obvious from a graph 1. While the development of indicator A expressing efficiency of production factors can be considered as continuously growing in the monitored period, the development of indicator C, which expresses efficiency of enterprise, showed itself by strong fluctuation.

Till 2004 (the year of accession in the EU), the values of indicators moved below the basic indicator value in 2005, moreover, in the indicator C in negative values in five years (of six). From monitoring of changes (the graph 2) of selected categories influencing the indicators height by the help of the basic index 2007/2000 it resulted: the value of agricultural branch production increased by 52 %. At the same time also the intermediate consumption value increased by 58 %, depreciation by 54 %, paid wages by 75 %, paid tenancy by 166 %, and paid interest decreased by 30 %. So, the production value grew more slowly than expenditure factors. The entrepreneurial income was the most influenced by the growth of volume of paid wages.



Graph 1: Indicators A and C.



Graph 2 : Influencing Factors.

2. Influence of subsidies incomes on agricultural incomes

According to SZÚ methodology, supports influence agricultural income in two steps. At first, as a balance of „other subsidies for production and production taxes in net added value, second, as a balance of production subsidies and taxes in net operation surplus (net mixed income). Data in tables 3 and 4 evidence the significance of subsidies.

Data for making a general evaluation of subsidy influence on agricultural incomes in the EU-15 countries are missing in some member states (they are not available or time series are not complete). Nevertheless, it is possible to state that the representation of subsidies in net entrepreneurial income is very high in some countries of this group. Examples are Germany, Austria and in recent year also Luxembourg and Great Britain. A relatively low representation of subsidies is shown in Greece and Spain. Even with subsidies, the net entrepreneurial income was negative in Denmark and Nordic countries. Without them the negative values would be even higher.

The new member countries do not achieve in the net entrepreneurial income such a high per

cent of subsidies as countries of the former EU-15. An extreme exception is Slovakia where the net entrepreneurial income is negative even in spite of high subsidies. The increase of share of subsidy means is obvious, except Hungary and Cyprus, in 2004 when the countries became EU members.

There are significant differences among countries in the absolute height of subsidies provided to agricultural incomes. In count per one annual work unit, the highest value is reached by subsidies in Finland (24.4 thous. Euros), Denmark (17.6 thous. Euros), Luxembourg (17.3 thous. Euros), and Sweden (14.9 thous. Euros). The lowest subventions in frame of agricultural incomes were recorded in agricultural enterprises in Romania (0.2 thous. Euros),

Lithuania (0.6 thous. Euros) and Bulgaria (0.5 thous. Euros). At average, the country EU-15 reach per one work unit 11.2 thous. Euros, while „the new countries“ only 2.2 thous. Euros.

A situation in the Czech Republic is characterized by data in the table 5. From them it is obvious how strong dependence of incomes of agricultural branch on subsidy means is.

Country	Height of subsidies (mil Euros)				Subsidies in net entrepreneurial income (%)			
	1997	2003	2007	2008	1997	2003	2007	2008
Belgium	:	:	:	:	:	:	:	:
Denmark	123,9	140,8	985,8	995,4	12,1	x	2987	x
Germany	2191,4	1570,8	6436,0	6487,0	49,4	75,7	78,3	89,1
Ireland	391,4	659,3	1928,4	:	x	:	x	:
Greece	:	501,1	2490,5	:	:	8,7	42,8	:
Spain	956,7	2529,8	5518,9	5991,9	5,7	12,0	30,7	36,1
France	:	:	7331,0	7399,6	:	:	46,6	58,8
Italy	:	:	:	:	:	:	:	:
Luxembourg	28,9	32,1	64,9	64,4	39,8	49,0	92,8	112,9
Netherlands	:	:	719,9	:	:	:	27,7	:
Austria	903,8	1141,0	1528,8	1550,6	57,7	67,8	72,5	75,5
Portugal	317,1	430,3	525,2	:	19,2	26,1	:	:
Finland	:	:	1767,1	:	:	:	387,0	:
Sweden	:	417,6	973,2	:	:	86,1	213,1	:
Great Britain	465,2	1048,6	4267,9	3996,6	10,0	21,9	97,3	72,9

: data were not available

x unreal calculation – the value of net entrepreneurial income was negative or zero (even with subsidies) – Denmark, Ireland

Source: according to <http://nui.epp.eurostat.ec.europa.eu> – agricultural accounts according to SZÚ 97 Rev.1.1.

Table 3: Influence of subsidies in height of agricultural incomes in EU-15 countries.

Country	Height of subsidies (mil Euros)				Subsidies in net entrepreneurial income (%)			
	1997	2003	2004	2007	1997	2003	2004	2007
Bulgaria	:	:	67,3	250,5	:	:	5,0	23,2
CR	:	:	224,4	743,6	:	:	83,6	x
Estonia	7,7	6,6	52,5	107,8	15,9	11,9	39,3	50,9
Cyprus	0	3,6	42,1	38,0	0	x	16,7	18,2
Latvia	0	7,9	82,9	202,3	0	6,0	2,9	33,4
Lithuania	0,8	2,5	27,6	115,7	0,2	1,7	10,3	29,3
Hungary	:	1440,5	483,2	901,0	:	x	37,4	76,4
Malta	:	1,4	3,1	10,8	:	2,5	5,5	18,6
Poland	:	:	:	:	:	:	:	:
Romania	:	:	:	491,5	:	:	:	18,8
Slovenia	:	:	:	:	:	:	:	:
Slovakia	:	331,3	418,4	308,9	:	x	x	x

: data were not available

x unreal calculation – the value of net entrepreneurial income was negative or zero (even with subsidies) – Slovakia, Hungary, Cyprus, the CR

Source: according to <http://nui.epp.eurostat.ec.europa.eu> – agricultural accounts according to SZÚ 97 Rev.1.1.

Table 4: Influence of subsidies on height of agricultural incomes in EU-12 countries.

Mil. Euros	2000	2001	2002	2003	2004	2005	2006	2007
Subsidies	146,8	153,2	220,3	228,4	224,4	638,8	745,3	743,6
Net entrepreneurial income								
With subsidies	-21,5	79,9	-87,3	-77,4	268,4	255,5	253,3	360,5
Without subsidies	-168,3	-73,3	-307,6	-305,7	44,0	-383,3	-532,0	-383,1

Source: according to <http://nui.epp.eurostat.ec.europa.eu> – agricultural accounts according to SZÚ 97 Rev.1.1.

Table 5: Influence of subsidies on agricultural incomes in the Czech Republic.

3. Non-agricultural incomes and activity diversification

Agricultural incomes play still the most important role in the total income structure of agricultural enterprises. Namely, despite the fact that their trend is decreasing. However, at present, this kind of incomes is not able even with subvention means (which are a part of agricultural account) to secure prosperity for agricultural enterprises, and concerning family farms – to secure a desirable social standard. So, the attention is still more and more turned to other income possibilities. Undoubtedly, one of active ways of gaining other financial incomes is an implementation of non-agricultural activities.

Historically, agriculture creates inseparable part of the country. This fact is accepted by the European agricultural model in which rural development represents an integral part of the Common Agricultural Policy – it is its second pillar. One of crucial activities, on which attentions is concentrated in the second pillar in frame of development strategies of agriculture and the country, is an activity diversification both in the rural space and the agricultural enterprises. It is supposed that the activity diversification in the countryside can invoke opportunities for diversification of activities of agricultural farms. Usage of these opportunities should subsequently positively influence the income position of farmers. In frame of the 2nd pillar, the development of non-agricultural activities is supported from the European Agricultural Fund for Rural Development (EAFRD) [B]. A sense of subsidies provided for activity diversification in agriculture is:

- to invoke activities leading to increase in total incomes of agricultural enterprises;
- to change the structure of total incomes in a direction of strengthening of non-agricultural incomes;
- a growth of own responsibility of producers for their income situation;
- in dependence on the above mentioned, to decrease the dependence of agricultural farms on subsidies.

Current situation - EU

The main point in frame of the mentioned aims is a change of structure of agricultural farm incomes. A comparison of the current structure shows differences between the „old“ and the „new“ EU member countries. These differences are conditional on different entrepreneurial structure in agriculture. The income structure of farmers in the

„old“ countries is more various than the structure of agricultural farm incomes (except family farms) in most „new“ member countries including the Czech Republic.

Concerning non-agricultural activities – Eurostat presents data on representation of enterprises which operate non-agricultural activities in the total number of agricultural enterprises in particular member countries (see table 6). From the mentioned data it is obvious that there are differences among countries, both in the representation of enterprises with non-agricultural activity and the development of their number (measured by basic index 2007/2003). More than fifth of enterprises with active non-agricultural activity is showed by Denmark, Germany, France, Austria, Finland, Sweden and Great Britain. A higher representation is also in the Netherlands, Luxembourg and Romania. At the same time Romania shows the highest increase.

The Czech Republic with 12.2 % exceeds the EU-12 average. Concerning the development trend, numbers of enterprises with non-agricultural activities grow in most member countries; Bulgaria, Lithuania, Hungary and Portugal are exceptions. The situation almost does not change in France and Malta.

A certain idea on significance of non-agricultural activities for incomes of agricultural farms can be obtained by monitoring of share of non-agricultural activities in the total value of agricultural branch production.

Table 7 shows inseparable non-agricultural incomes over particular member states. As it is seen from the data, the share of non-agricultural activities in the total value created in agriculture does not exceed 10 % in any country. The highest representation on non-agricultural activities belongs to agriculture in Latvia, Estonia, Finland, Sweden, Bulgaria, but also in Romania and Malta. The non-agricultural activity is not shown by Ireland and a small exists in the Netherlands, Germany and Portugal. In other countries, the share moves from 1.1 % (Denmark) to 5.2 % (Austria). In the CR this share of non-agricultural activities in the total production value amounts to 1.9 %. In comparison of the mentioned indicators with identical indicators achieved in 1999 we can state, from data available about particular countries, that there was an increase of the non-agricultural activities in most member countries. This accrual was very significant in Portugal and Malta. An exception was only Estonia, Austria and Slovakia where the share of non-agricultural activities in the total production value over the period 1999-2007 decreased.

Country	2007	2007/2003	Country	2007	2007/2003
Belgium	3,9	1,026	Luxembourg	17,3	1,573
Bulgaria	2,0	0,488	Hungary	5,0	0,446
Czech Republic	12,2	1,506	Malta	3,9	0,975
Denmark	23,4	1,636	Netherlands	18,5	0,623
Germany	21,7	1,119	Austria	21,5	1,149
Estonia	8,3	1,107	Poland	4,8	1,455
Ireland	5,1	1,063	Portugal	7,4	0,748
Greece	1,4	1,077	Romania	15,7	3,738
Spain	3,5	1,522	Slovenia	4,1	1,108
France	23,6	0,956	Slovakia	4,1	1,108
Italy	6,4	1,391	Finland	27,6	1,091
Cyprus	6,6	1,082	Sweden	23,2	1,813
Latvia	9,1	1,071	Great Britain	23,2	1,433
Lithuania	0,7	0,412	EU -27	9,9	1,597

Source: <http://epp.eurostat.ec.europa.eu/tgm>

Table 6 : Agricultural enterprises with non-agricultural activities realized out of enterprise (% of all agricultural enterprises, 2007).

In frame of non-agricultural activities, farmers practice usually processing of agricultural products. 100 % of non-agricultural activities represent processing of agricultural production in Greece, Cyprus, Malta and Romania. Vice versa, Denmark, Germany, Ireland, Austria and Sweden give a value 0 %. The locus of their non-agricultural activities lies in sale of goods and services.

Current situation - CR

To characterize the Czech Republic situation, we can use indicators presented in the table 8. From them it is obvious that in the period 2003-2007 the share of enterprises with non-agricultural activity in the total number of enterprises increased, but at the same time there was a decrease in share of non-agricultural activities in the total production value in the branch and a decrease in share of revenues from non-agricultural activities in the total revenues (both according to the accountancy books and FADN) in enterprises of legal entities and especially in enterprises of individuals. The enterprises of legal entities in the CR have better conditions for non-agricultural activities operation, both in a capital endowment and especially in numbers and qualification of labour forces. Most non-agricultural activities aim at processing of agricultural production even if sale of goods and service operation is still more frequent in entrepreneurial structures of agricultural enterprises since 2003.

Certain differences in inseparable non-agricultural activities can be seen at the regional level. At the level NUTS II (according to Eurostat), the

highest share was shown in 2007 by South-East (2.76 %) and Moravia-Silesia (2.62 %). The least representation of non-agricultural activities was recorded in the region North-West (0.83 %). At the level NUTS III (according to Czech Statistic Office), the most inseparable non-agricultural activities were showed in Moravia-Silesia (2.58 %) and Olomouc region (2.27%), the least in the region Liberec (0.61%), Vysočina (0.71%) and Ústí (0.75%).

Activity diversification in agricultural enterprises has a long tradition in the CR. In the period of central management so called „affiliated production“ represented in their way „an entrepreneurial element“. By means of them agricultural enterprises improved its income and financial situation. There were active in operation of affiliated production both the then United Agricultural Cooperatives and later the state farms. From statistical data over the Czechoslovakian Socialistic Republic (ČSSR) it is possible to derive their significance by the help of indicator - the share of gross non-agricultural production in the total gross production. In 1985 it amounted to 23 % and in 1987 already 26 %. In the privatization (event. transformation) process in agriculture, most of affiliated productions were privatized out of the agricultural branch. The present Common Agricultural Policy unambiguously supports the non-agricultural activities. The State Agricultural Investment Fund (SZIF) provides subsidies for diversification of activities from European Agricultural Fund of Rural Development (EAFRD), the axe III, the Measure III.1. „Measure to country

Country	Non-agri activities (mil Euro)	Share of non-agri activities in production value (%)	Share of processed agri products in non-agri activities (%)	Country	Non-agri activities (mil Euro)	Share of non-agri activities in production value(%)	Share of processed agri products in non-agri activities (%)
Belgium	x	x	X	Luxembourg	14	4,9	28,6
Bulgaria	277	8,4	81,9	Hungary	187	2,9	x
Czech Republic	83	1,9	84,3	Malta	8	6,3	100,0
Denmark	101	1,1	0	Netherlands	132	0,6	32,6
Germany	172	0,4	0	Austria	346	5,2	0
Estonia	50	7,2	28,0	Poland	x	x	x
Ireland	0	0	0	Portugal	33	0,5	x
Greece	494	4,5	100,0	Romania	1 110	6,1	100,0
Spain	1 201	2,8	12,3	Slovenia	x	x	x
France	1 814	2,7	89,5	Slovakia	89	4,6	16,9
Italy	1 390	3,1	46,7	Finland	411	9,2	2,9
Cyprus	30	4,7	100,0	Sweden	384	7,3	0
Latvia	104	9,9	25,0	Great Britain	1 182	4,9	8,8
Lithuania	83	3,9	67,5				

Source: <http://nui.epp.eurostat.ec.europa.eu/nui> - calculations according to Landwirtschaftskonten nach LGR 97 Rev.1.1.

x – data not available

Table 7: Non-agricultural inseparable incomes from secondary activities in EU-27 member countries.

Indicator	2003	2007
Share of enterprises with non-agricultural activities in total number of agricultural enterprises (%)	8,1	12,2
Share of non-agriculture secondary activities in total production value in agriculture (%)	2,6	1,9
Share of processing of agricultural production in non-agricultural secondary activities (%)	96,2	84,3
Share of revenues from non-agricultural activities in total revenues according to accounting books (%) in legal entities	17,8	13,9
Share of revenues from non-agricultural activities in total revenues according to accounting books (%) in individuals	14,9	2,16
Share of revenues from non-agricultural activities in total revenues according to FADN (%) in legal entities	6,23	5,21
Share of revenues from non-agricultural activities in total revenues according to FADN (%) in individuals	13,46	2,05

Elaborated according to data provided by Eurostat and Reports on state of Czech agriculture

Table 8: Non-agricultural activities in CR agriculture.

Indicator	Intentions in frame of measure III.1.1.			
	III.1.1.a	III.1.1.b	III.1.1.c	III.1.1.d
Representation of successful projects (%)	39,7	38,7	5,2	16,4
Share of legal entities (III.1.1)	16,1	55,6	7,2	21,1
individuals (%) (III.1.1.)	86,8	4,4	1,1	7,7
Share in financing (%)	9,9	82,9	1,5	5,7

According to News service from the Rural Development Programme, SZIF, 9 rounds, 2.2.2008-8.3.2010

Note.: III.1.1.a : Diversification of activities of non-agricultural character

III.1.1.b : Building and modernizing of bio-gas station

III.1.1.c : Building and modernizing of boiler plants and heating plants for bio-mass including combined production of heat and electricity

III.1.1.d : Building and modernizing of facilities for production of formed feeds

Table 9: Project activity of farmers in frame of Measure III.1.

management diversification“. The diversification of activities in agriculture is specially treated in the measure III.1.1. „Diversification of activities of non-agricultural character“, but farmers can gain subsidy also from the measure III.1.2. „Support of small productions, crafts and services“ or the measure III.1.3. „Support of agri-tourism“.

The table 9 contains data on use of subsidies provided for introduction of non-agricultural activities in agricultural enterprises at the nationwide level. Differences are obvious at the regional level. At the level NUTS II., the highest project activity (a share in the total number of projects) is shown by South-East (26 %) and South-West (20 %), the lowest North-West (9 %). More projects are sent by legal entities (71 %) than individuals. The reason is their better capital endowment and especially labour force endowment. Individuals submit more projects in the area of introduction of non-agricultural activities in the classification according to OKEČ (Branch Classification of Economic Activities). From the view-point of matter externalization of non-agricultural activities, the most attractive title for farmers is „Building and modernizing of bio-gas station“.

Conclusion

In the present methodologies, the evaluation of incomes from agricultural enterprises is realized above all in such a way that incomes, which are agricultural by their fundamental and origin, are monitored and analyzed.

Currently the situation is following:

- according to income indicators, the development of incomes of agricultural enterprises from agricultural and inseparable activities can be evaluated as growing by the year 2007, than there is a decrease. Growing tendencies of indicators differ; while the indicator A showed a slightly growing trend in the all period, the indicator C considerably fluctuated at the same time. It means that the net added value grew but the entrepreneurial income was influenced in addition by wages, tenancy and interests;
- there are no significant differences in development trend of indicators among the countries EU-15 and EU-12;
- subsidies provided to agricultural incomes have a significant influence on incomes. They grow in the monitored period; also their representation in net entrepreneurial income increases in most countries. The dependence of producers on subsidies raises in this way;

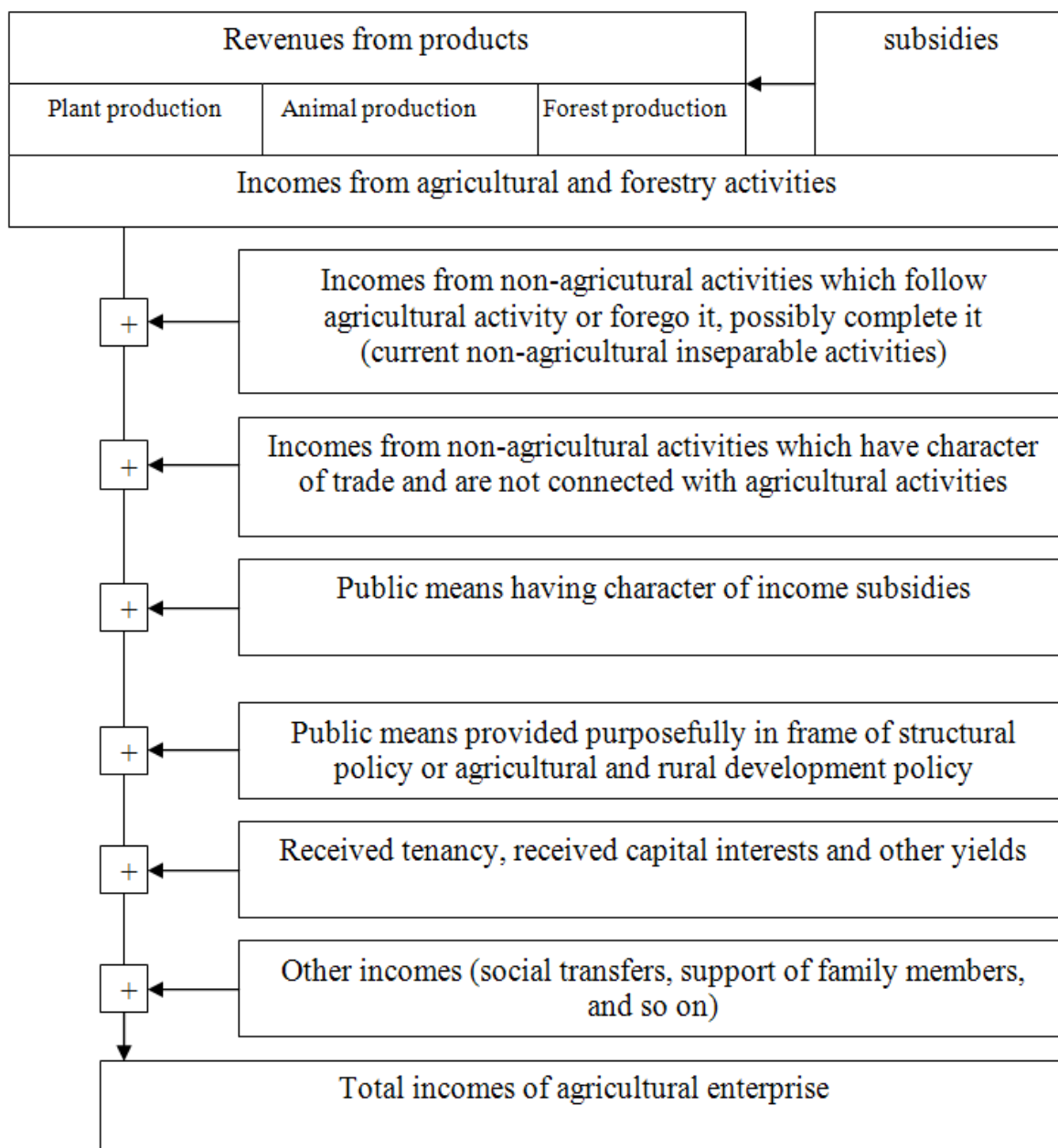
- there are significant differences in providing of subsidies among the countries EU-15 and EU-12; in the countries EU-12 the provided means are lower (in count per work unit);
- in spite of continuing and growing support of implementation of non-agricultural assets in the entrepreneurial structure, the representation of non-agricultural inseparable incomes is low in particular countries for now and differentiated (independently on whether it is dealt with a country of EU-15 or EU-12), also an activity within their introduction differs, again crosswise all EU member states;
- in non-agricultural activities not all alternatives are used, processing of agricultural production or sale of goods and services prevail;
- information on non-agricultural separable activities are limited (or none in some countries), at the same time a methodology for their finding is not elaborated.

If incomes of agricultural enterprises were evaluated only according to agricultural incomes, we would come to a conclusion that these incomes are not sufficient for economy stabilization and level of living security and this fact confirms the necessity to provide financial supports from public resources. However, on the other hand, we know only a part of incomes of the enterprises. The incomes of agricultural branch in most agricultural enterprises are not often the only kind of incomes. If we liked to obtain data on real-total incomes, it would be necessary to monitor all means which the firm gets, e.g. in the division according to the scheme 2. At the same time it would mean to create a similar methodology of their monitoring, including sort division at such a level at what agricultural incomes are now monitored now. The scheme 2 is applicable to both types of enterprises, the legal entity type and the family farms. Some items (e.g. social transfers or a value of products for needs of the owner and his/her family, etc.) concern only the family farms where the firm is financially interconnected with the owner's household. It would be useful to monitor each type of incomes separately (financial income, financial expenditures, final income). The mentioned way could provide a real depiction of income situation of agricultural enterprises and mainly – it would enable to evaluate what the income resources representation is in the total entrepreneurial income of the enterprise. The mentioned way of observation would have a special importance for non-agricultural activities. It would bring information on how non-agricultural activities of agricultural farms share in the total incomes and besides this it would enable to monitor

the efficiency of subsidiary means provided for development of non-agricultural activities.

incomes of agricultural enterprises, not only incomes of agricultural branch.

Income of agricultural enterprises is an important stabilization factor of the entire agrarian sector. Their stabilization role was respected by agrarian-political measures in the CAP history and it will be also in the future. However, to be the measures efficient and purposeful, it is necessary to have undistorted information on the real height of



Scheme 2: Structure of total incomes – proposal for monitoring.

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Social structural model and voting behaviour under the conditions of Czech rural areas

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Abstract

From a social viewpoint, Czech rural areas are defined by joint, specific interests by which they differ from the urban environment. In relation to this, this article asks the fundamental question whether class polarization is the background factor of voting results, or if political conflict is based on different factors. The aim of this article is, through a case study of Zatec region, to verify the applicability of the social structural model of voting behaviour of citizens of Czech rural areas.

Key words

Social structural model, voting behaviour, social class, rural areas, vote, right-wing, left-wing, social status.

Anotace

Český venkov bývá ze sociálního hlediska definován společnými specifickými zájmy, kterými se liší od urbánního prostoru. Článek si v této souvislosti klade základní otázku, zda v pozadí volebních výsledků stojí třídní polarizace nebo zda je politický konflikt založen na odlišných faktorech. Cílem článku je prostřednictvím případové studie žatecké oblasti ověřit uplatnitelnost sociálně strukturálního modelu volebního chování obyvatel českého venkova.

Klíčová slova

Sociálně strukturální model, volební chování, sociální třída, venkovský prostor, volba, levice, pravice, sociální status.

Abbreviations

ČSSD = Czech Social Democratic Party, KDU-ČSL = Christian and Democratic Union – Czechoslovak People's Party, KSČM = Communist Party of Bohemia and Moravia, ODS = Civic Democratic Party, SPOZ = Party of Civic Rights – Zemanovci, SUV = Sovereignty, SZ = The Green Party, VV = Public Affairs

Introduction

One of the main interests of current sociology of rural areas is rural development, meaning that sociological research is usually focused on the area of the social determinants of development. This is also applies to the research done of Czech rural areas. Examples of the themes of the research include the Program Leader and his effect on the conduct of the actors of the development (e.g. Hudečková, Balzerová 2010), and the methodological aspects of evaluating the impacts of these programs (e.g. Lošťák, Hudečková 2010), etc. Another theme is, for example, the issue of cross-border cooperation and its influence on the social development of

regions (e.g. Husák 2010). The investigated areas include the political interests of rural areas and their mediation and representation. Čmejrek (2008), for example, dealt with the task of political parties in this relation. The question of the political interests of residents of rural areas closely relates to their voting behaviour. Despite the fact that the voting decision-making of electorates in the Czech Republic is quite often a subject of research, the value stances and interests of voters in rural areas and their influence on voting behaviour has until now not received significant attention. Exceptions to this are the works of voting geographers, from which we can gather that the behaviour of residents of rural areas compared to those in urban regions

is considerably different (e.g. Kabát, Pink). Rural areas are often depicted as having a higher tendency to vote for left-wing parties, and less support for the right. However, to this point, the reasons for this have not yet been interpreted.

The behaviour of voters is formed by an inexhaustible number of factors. In the Czech environment was repeatedly investigated, among others, social class structure and its influence on voting behaviour. Social class conflict in traditional democracies is and was in the past the basis for the difference in voting behaviour. The compositional approach, which puts voting behaviour into relation with the structure of the monitored phenomenon, is fairly common in social practice. This also deals with a relationship that was in the past repeatedly proven in a traditional democratic system (e.g. Campbell, Converse, Miller, Stokes 1964, currently e.g. Van der Brug 2010). During the study of the individual levels of political orientation where the object of the investigation is the individual, we ask what this individual's position is in the social structure or his affiliation to a politically-specific group. If the object of the investigation is the population of a given region, the fundamental information is its social structure. Simply put, this approach presumes the relationship of dependence between political orientation and the structural composition of society. In relation to this, the so-called social structural model of voting behaviour is often referenced. This model explains the diverse voting behaviour of objectively-determined social groups (social classes, national or religious groups, age groups, gender etc.). Political orientation of individuals is influenced by their position in the social structure. Disproportions in voting results between regions are a reflection of the differences in the social composition of the population. This is also closely tied to the differences in voting behaviour of residents of cities and rural areas.

The social structural model held a firm position during the interpretation of voting behaviour in countries of Western Europe and North America mainly during the 1970's and 1980's. The gradual decrease in significance occurred mainly because of the decrease in disparity in social structure and unnatural voting behaviour of social classes (Achterberg, Houtman 2006).

As already mentioned, the investigation into the voting behaviour of objectively determinate social groups was the subject of interest of Czech researchers (e.g. Matějů, Vlachová 2000). From the beginning of the 1990's to 1996 when elections to the Chamber of Deputies took place, it is apparent from these results that voting behaviour

stabilized. In the subsequent period, the election was less of a newly-considered decision and more of repeated preference of the respective party. Among others, the social class identification of voters has a demonstrable influence on this, and it is demonstrated by a significant difference in the voting behaviour of the main social groups (Matějů, Vlachová 2000).

Until now, the relationship between social structure and voting behaviour in the Czech environment has been investigated in the context of the class segmentation of respondents. However, further classification did not occur, and it is therefore not precisely known what decisive factors are in the background of the differences in voting preferences of voters in rural areas and city regions. The key question from the view of social-class voting is whether the differences in voting behaviour are caused by a different social structure of rural area society when compared to that of cities. Generally speaking, it is possible. Perlín characterizes rural areas as a continually delimited area with close social contacts, the existence of informal social controls and participation, and lesser intensity of social and economic contacts (Perlín 1999), and in addition, residents of rural areas are characterized by an unfavourable educational and age structure from which arise the limitations when people assert themselves on the job market. Along with these social aspects, rural areas also differ from an economic point of view. A rural area is a place with significant activities in the areas of farming and the production of food. On the basis of demographic indicators, it is evident that rural areas have a lower population density¹. If the findings on Czech rural areas are implemented into the theory of social-class voting, the voting of the residents of rural areas fulfils the classic thesis of voting behaviour. According to this thesis, members of lower social classes tend to identify more with left-wing parties.

Material and methods

If we look at the findings on the differences in the social structure of rural areas and city residents, we can then hypothesize that the voting behaviour of rural areas and city residents differs. This hypothesis can be verified on the basis of an extensive investigation into the voting behaviour of an electorate. However, even when we confirm the validity of the hypothesis, we must still answer to what level the political behaviour of the residents of rural areas relates to social class identification, and to what level it is influenced by the specific

¹Perlín states that within the EU, rural areas tend to be perceived as areas where the population density is lower than 100 residents per 1 km² (Perlín 1999).

factors that relate to rural areas², and contribute to accepting the status of being a “villager”. This question can be partially answered through an investigation of the voting behaviour of diverse social groups of residents of rural areas. The aim of this article also arises from this question. The ambition of the contribution cannot be (in view of the available data) to describe the differences in the voting behaviour of the residents of cities and rural areas in the context of differences in social structure. The aim is, through a case study of the Žatec region, to describe the voting behaviour of objectively-defined social-economic groups of residents (social classes) and thereby contribute to the discussion on the possible applicability of the social structural model of voting behaviour under the conditions of rural areas in the Czech Republic.

There are a number of partial problems that arise from such a determined aim. Two of them are of a fundamental nature. There is a reason for measuring the relationship between social structures and voting behaviour when a society shows a predominantly consistent social status. In such a case, it is valid that the majority of the monitored population achieves a similar social status in various social groupings. The (in) consistency of the social status of individuals will be measured by the relationship between the basic social-economic characteristics of education, income and employment. In addition, the relationship will be further analysed between these individual uncertain social statuses and the subjective evaluation of the position of the individual in a social structure, the so-called subjective status. The utilized method will be an analysis of dependence. The second basic problem is of a cognitive nature. The consistency of voting behaviour on the basis of identification with a social class is only possible in cases where the voter has at least basic knowledge of the political and party system. The ability to orient oneself in the program and ideological orientation of political parties will be tested through the commonly-used continuum of left-wing – right-wing.

The selected subject of the investigation is the Žatec region. In terms of this article, this is an area that is delimited by the borough of the city of Žatec. In the system of transferred capacity of state administration, the city of Žatec is a municipality with so-called extended jurisdiction. The Žatec region is a typical rural area from an economic,

social and cultural point of view. The Žatec region typically has a high number of agricultural lands in the total area of the region, and the landscape is of a farming nature. Among other things, this is a region with a stagnant development in incomes and employment when viewed from the Czech Republic average. Other characteristics include, for example, a low population density, predominant emigration of qualified professionals, as well as young people, over their immigration, etc.

From the view of political characteristics, the residents of the Žatec region (on the basis of elections to the Chamber of Deputies) predominantly identify with left-wing values. In the past, the left-wing parties in this city always received more votes from voters than the Czech average, and in the same comparison, the right-wing parties received less. In the other municipalities of the Žatec region, voters tend to identify with left-wing parties to an even greater extent.

Data were analysed that were acquired through standard discussion with voters that participated in the elections to the Chamber of Deputies of Parliament of the Czech Republic in 2006 and 2010 in the city of Žatec and another four municipalities in this region. In 2006, 400 completed interviews took place in the form of exit-polls³ (a two-stage random selection – in the first stage of the random selection, there were twenty voting precincts, and in the second, every third voter was addressed). There were 400 interviews completed in 2010 as well. The interviews took place during the first ten days after the elections (a three-stage random selection – the first stage of the random selection, the places of the random selection of respondents were decided on, and in the second step the number of completed interviews in individual areas of the selected municipalities in the Žatec region⁴ was determined. In the third step, every third citizen was addressed).

Results and discussion

We can consider using the social structural model to explain the voting behaviour of residents of rural areas when society is internally socially fragmented. The investigation of the relation between social class pertinence and voting behaviour presumes the existence of a crystalized social structure. In this case, social class can be understood as a homogeneous social economic group with an internal feeling of solidarity and concurrent specific indicators through which it is differentiated from

² These are social-economic and demographic factors such as a relatively higher level of unemployment, lower population density, higher employment rate in the agricultural-food sphere and lower education levels, but also political factors such as identification with the thought processes of environmentalists, conservative Christian ideology, and inclination toward political parties that advocate the interests of rural areas, etc.

³ Interviews are done as soon as the voters leave the voting room

⁴ Žatec (310), Libořice (10), Staňkovice (30), Hledeč (20) and Měcholupy (30).

	2006				2010			
	Education	Job	Income	Subjective status	Education	Job	Income	Subjective status
Education	1				1			
Job	0,56	1			0,55	1		
Income	0,8	0,4	1		0,7	0,4	1	
Subjective status	0,83	0,5	0,74	1	0,84	0,46	0,66	1

Source: Kopřiva, 2010

Note: Respondents were not included in the analysis who did not respond to some of the questions aimed at the highest achieved education, employment, income and subjective status, as well as respondents who were not economically active (those who do not work, pensioners, students and trainees). N(2006) = 265, N(2010) = 284.

Table 1: Correlation matrices.

other social classes. As previously mentioned, the investigation of social structural voting behaviour typically arises from the study of the relationship between the position of the individual in a social structure and his voting decision-making (e.g. decisions made over a longer period of time). The position of the individual in a social structure stems from the social status that the individual has available. The decisive status indicators are education, employment and amount of income, etc. (detailed in Bauman 1966).

One can be convinced of the existence of the crystalized social class structure of the residents of rural areas on the basis of the results of the investigation into status consistency, and on the basis of the cohesion between the objectively-measured status of the individual and his subjective perception. If individual status variables are in a close relationship, we can then speak of a consistent social status. In the opposite case, it is then an inconsistent social status. It thus applies that a person achieves several status levels in partial status parts (Grafstein 2005). The prevailing inconsistency of social statuses, just as the discrepancy between objective status and its subjective, points to a non-crystalized social structure. In this case, the usability of the social structural model of voting behaviour of the residents of rural areas can under no circumstances be considered. It would be prevented by the fact that the relationship between belonging to a social class and voting behaviour cannot be measured when the homogeneous social class does in fact not exist in society, or its members are unable to identify with it.

The investigation into status (in) consistency and subjective perception of the position of voters in the social structure in the Žatec region was, from a methodical point view, inspired by the works of Matějů and Vlachova (2000). These are probably the most extensive works devoted to the problem of social imbalance as a variable of voting behaviour

in the Czech environment. The selected variables of social status were education, employment and income⁵. The subjective perception of the position of individuals in a social structure was also measured⁶.

The analysis of the dependence between individual variables, and then between variables and subjective status proved the existence of paired associations. In view of the fact that a linear relationship exists between the individual variables of both investigations, Pearson's Correlation Coefficient can be used to calculate the mutual dependence.

Along with subjective status, the individual dimensions of social status mutually embody a strong or mid-level of mutual dependence. Thereby, in the voting population of the Žatec region, a consistent social status prevails. In addition to this, the respondents are aware of their positions in the structure. From this view, the applicability of the social structural model of voting behaviour in the Žatec region can therefore be further considered.

It is only possible to speculate about motivated class identification if the voting behaviour is consistent with their political orientation. In practice, this means that the voter prefers the political party that is a suitable political representative of his/her social interests. In this concept, consistent voting behaviour is cognitively limited. The basic prerequisite is that the voter has at least elementary knowledge of the party spectrum and recognizes which political party is bearer of the given ideological values.

The voter's ability of orientation in the party system

⁵ Education and income were evaluated through a six-level classification. When constructing the income categories, consideration was given to the amount of the average gross monthly income in the Czech Republic and Usti nad Labem region in the respective years. Employment was classified according to the international index of social-economic statuses of employment and then further divided according to a five-level classification.

⁶ A five-point scale was used to measure subjective status. Respondents declared their positions on this scale.

Highest achieved education	ODS	ČSSD	KSČM	KDU-ČSL	SZ	Another party
Basic + no further education	1,49	3,05	20,29	0,00	4,35	21,43
Apprenticeship without leaving examination	11,94	56,49	30,43	28,57	4,35	21,43
Apprenticeship with leaving examination	5,22	14,50	26,09	0,00	17,39	28,57
High school with leaving examination	58,96	23,66	17,39	42,86	47,83	14,29
College, unfinished university	5,22	0,00	1,45	0,00	4,35	7,14
University	17,16	2,29	4,36	28,57	21,74	7,14
N	134	131	69	7	23	14

Source: Examination of elections to the Chamber of Deputies in 2006 and 2010 in the Žatec region

Note: The numbers in columns show the percentage of voters of the party with the respective highest achieved education. Answers of all respondents who answered the questions concerning their voting decision and achieved education have been included in the analysis. In 2006, 378 respondents answered both questions. The absolute majority of them stated that they had elected some of the parties that acquired MP mandates (96.03%).*

*Out of these parties, KDU-ČSL and SZ received low support. The interpretation of the results of these parties is considerably limited by the scope of the selection set of respondents. The monitored relationship between the level of the achieved education and voting support is rather indicative

Table 2: Voting support to parties according to the level of achieved education - 2006. Column percentage.

and the consistency of voting behaviour in relation to the value attitudes of the voters are usually measured by a simple testing method. One of the possibilities is to use a set of statements concerning the program orientation with the task to assign the suitable political parties. A simpler instrument for measuring the knowledge which does not lead to the loss of validity of the acquired data is the differentiation of the typical representative of right and left wings according to the basic dissociation line between the right and left wings. A stumbling block of this method is, however, the necessity to verify the existence of a value-based scale of political orientation (the left-wing - right-wing continuum) in society. In addition, a necessary prerequisite is the knowledge of the voters' basic theory on politics. In the Czech environment, the existence of a politically relevant right-wing – left-wing scale was repeatedly demonstrated (e.g. Vinopal 2006 or Matějů, Vlachová 2000). Its existence was also independently verified through the factor analysis in the Žatec region (Kopřiva 2009). Here, the voter's value attitudes were ascertained through questions correlating with the political "right-wing" or "left-wing" orientation.

By the demonstrated existence of the right-wing – left-wing continuum, and of the knowledge of right-wing and left-wing among the voters acquire the result of the test which measures the orientation of voters in the party system gains relevance. Knowledge of the party system was tested on the basis of assigning individual parties to the right or

left wings according to the rate of state distribution⁷.

The results of both examinations among respondents demonstrated the prevailing ability to differentiate the main representatives of the left and right wings⁸. Out of 400 question asked this way, 362 (90.5%) were correctly answered in 2006. In 2010, as many as 380 (95%) correct answers were recorded in an identically wide selection set. On the basis of these results, it is possible to come to the conclusion that at least the part of residents of the Žatec region that participated in the election has at least basic knowledge of the party system. It is therefore possible to state that an important majority of voters is able to express their own political orientation by their voting support to the party which is their suitable representative.

The knowledge of the crystallized social structure and of the electorate's ability to vote consistently with their value attitudes makes it possible to get back to the basic question, i.e. whether it is possible under the conditions of Czech rural areas to utilize

⁷ Both in 2006 and in 2010, ODS was selected as a typical representative of right-wing politics and ČSSD as the representative of left-wing politics.

⁸ The task of respondents was to answer the question "are the terms 'right-wing' and 'left-wing' often used in politics?" The left-wing parties are distinguished by a higher rate of redistributing revenues from the rich to the poor. On the other hand, right-wing parties consider fair the given distribution of revenues in society. The different attitudes to the redistribution of revenues in society in the Czech Republic are represented by political parties ODS and ČSSD. Which one of these parties do you consider, on the basis of the aforementioned claims, as a left-wing or right-wing?" In this case, the respondent's task was to record the only correct answer. From the viewpoint of a higher validity, negative answers were also taken as incorrect.

Highest achieved education	ČSSD	ODS	TOP09	KSČM	VV	SPOZ	SUV	Another party
Basic + no further education	13,54	7,25	5,88	11,86	6,45	5,56	11,11	6,67
Apprenticeship without leaving examination	43,75	15,94	9,80	35,59	22,58	38,89	25,93	33,33
Apprenticeship with leaving examination	13,54	5,80	7,84	20,34	12,90	16,67	11,11	13,33
High school with leaving examination	26,04	44,93	33,33	27,12	48,39	22,22	14,81	26,67
College, unfinished university	2,08	10,14	11,76	1,69	9,68	0,00	7,41	3,33
University	1,04	15,94	31,37	3,39	0,00	16,67	29,63	20,00
N	96	69	51	59	31	18	27	30

Source: Examination of the 2010 election to the Chamber of Deputies

Note: The numbers in columns show the percentage of voters of the party with the respective highest achieved education. Answers of all respondents who answered the questions concerning their voting decision and achieved education have been included in the analysis. In 2010, 382 respondents answered both questions.

Table 3: Voting support to parties according to the level of achieved education - 2010. Column percentage.

the social structural model when interpreting the voting behaviour of residents. Education is the main determining factor of a social class (Wright 1985). The demonstrated high rate of closeness of the relationship between education and subjective status documents the importance of education in the value attitudes of residents of the Žatec region. Therefore, it applies that the higher education an individual gains, the higher his position in the social structure. According to the classical thesis on voting behaviour, members of lower social classes are distinguished by their inclination to the left-wing political values and voting support of left-wing political parties. On the other hand, political orientation of members of the higher social classes has a right-wing nature. This is what the voting support of the right-wing parties comes from. Based on this, it is possible to establish a hypothesis that achieved education is an important determining factor of the voting decision. Voters with higher education tend to support right-wing parties while voters with lower education are rather more inclined in their voting decision to the left-wing political parties. Table 4 shows the relationship between voting decisions and education.

The calculated strength of association of variables - the highest achieved education and voting decision - is 0.40 when we use the Pearson's correlation coefficient. The strength of association ranging between 0.3 - 0.7 is usually considered medium (Hendl 2006). In this case, the relationship shows a rather lower dependence. Of course, the result is considerably distorted. A negligible (from the viewpoint of the intensity of the relationship, negative) distortion understandably occurs thanks to

the fact that the category of non-parliament parties (another party) was also included in the calculation. In relation to the established hypothesis, we then find another distortion if the Green Party is included in the calculation of correlation coefficient. This is a political party that declares itself a political entity deviating from the right-wing - left-wing continuum. If the electorate is further divided from the viewpoint of the highest achieved education into two categories with lower and higher achieved education⁹, it shows that 80.65% of respondents with lower achieved education voted for left-wing parties (ČSSD and KSČM) and 75.14% of respondents with higher achieved education voted for right-wing parties (ODS, KDU-ČSL). This also documents that the classical thesis on the voting behaviour applies in the conditions of the Žatec region, and it is definitely not possible to reject the established hypothesis, at least not in the case of the 2006 election.

The results of the distribution of the voting support to individual parties by different social classes differ between 2006 and 2010, which is given mainly by the variation of the two political parties represented in the Chamber of Deputies. However, in both cases it applies that the decisive part of the ODS electorate consists of voters with high school education with leaving examination. On the other hand, on the 2006 and 2010 elections ČSSD and KSČM were most supported by voters with apprenticeship without leaving examination. Table

⁹ The first category with a lower achieved education consists of respondents with basic and no education, those with apprenticeships with and without leaving examination. The second category consists of respondents with high school education, college graduates or people with unfinished university education, and university graduates.

3 shows the distribution of the voting decision in 2010 according to the level of the highest achieved education.

The combination of the specific conditions which was in the background of voting decisions does not tend to contribute to the assumption of class-oriented voting behaviour. This is given firstly by the fact that the new political parties of the Czech party system (TOP09 and VV) had not been established on the national level until that time. On the basis of its election program, voters had difficulties in localizing the VV political party in the right-wing – left-wing continuum. In the case of TOP09, its right-wing orientation was obvious from its election program. In view of the fact that this was indeed quite new party, this fact did not have to be generally known to a number of voters. In this relation, a question emerges up to what point the changes in the voting behaviour of the voters from the Žatec region were caused by the aforementioned factors, and up to what point they were affected by class identification. Although the correlation analysis used for the calculation of the strength of association between education and the voting decision demonstrates a dependence relationship, its value is relatively small. The value of the calculated Pearson's correlation coefficient is 0.35. However, it is necessary to be aware of the fact that this is a distorted result as well. Data of all respondents (N=382) were included in the calculation of the correlation coefficient regardless of what political party they had voted for. While the results of the 2006 examination showed relatively small support to other than parliament-based parties (4% overall), in the case of 2010 it was 7.86%. The rate of standardization of the interviews does not allow for differentiating whether the right-wing parties or left-wing parties prevail among other parties ("another party" in the table), or whether the voters prefer the election parties according to the expected class scheme. The value of the Pearson's correlation coefficient increases if no respondents who did not vote for any of the parliament-based parties are included in the calculation. The newly calculated correlation coefficient shows the value of 0.4. If we divide the voters in the same manner into two categories from the viewpoint of the highest achieved education, it shows that 68.78% of voters with lower education voted for left-wing parties and

73.33% of voters with higher education voted for right-wing parties. Thus, it is also not possible to reject the hypothesis in the case of 2010. However, it is apparent from the result that, in comparison with 2006, the effect of education on the value-wise consistent voting behaviour decreased. The factor influence on the voting behaviour as a dependent variable will thus be much more varied.

Conclusion

The relationship between the positions of individuals in social structure and voting behaviour in elections to the Chamber of Deputies was repeatedly proven in the past in the Czech Republic, and it is thus apparent that the social structural model has its firm place in the interpretation of the voting behaviour of Czech voters. The relevancy of applying the social structural model of voting behaviour, which is a normally utilized concept in the sociological theory when explaining the voting behaviour, was also demonstrated in the conditions of the rural area of the Czech Republic. The investigation was done from the perspective of the possible applicability of this concept in the Žatec region, which fulfils a number of attributes of rural areas.

Based on the data acquired in interviews with voters in the Žatec region, a relationship between the social class identification and voting behaviour was demonstrated. Despite the rather medium strength of association, it shows that voting decision-making of an important part of the Žatec electorate is not at variance with the classical thesis of voting behaviour. This means that the members of the social-economical groups situated on the lower levels of the social structure are distinguished by their inclination to left-wing political values and voting support of left-wing political parties. On the other hand, the political orientation of the members of higher social classes is of a right-wing nature. The voting support of right-wing parties derives from that. Of course, the results of this paper cannot be generalized into the rural areas of the Czech Republic, but they can serve as one of the indicators when we examine the voting behaviour of residents of rural areas.

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Weather derivative design in agriculture – a case study of barley in the Southern Moravia Region

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Abstract

The aim of this paper is to point out some problems of index estimation for the purposes of weather derivative valuation considering the particularities of agriculture. The assessment of the sensitivity of barley to weather over 40 years has been the basis for the design and valuation of weather derivative in the Czech Republic (The Southern Moravia Region). The analysis is based on regression modeling using temperature index and barley yield. The burn analysis based on parametric bootstrap is used as the method for the valuation of weather derivative contract. With the effective bootstrap tool, the burn analysis may easily be processed and the uncertainty about the pay-off, option price and statistics of probability distribution of revenues can be effectively determined. Nevertheless, the results of the analysis reveal a significant adverse impact of basis risk on the quality of agricultural weather derivative in the Czech growing conditions. The article outlines the scope for use of weather derivative as the reinsurance tool in regions with frequent occurrence of systematic weather risk.

Key words

Weather derivative valuation, agriculture, risk management, basis risk, burn analysis.

Anotace

Cílem příspěvku je poukázat na některé problémy spojené s odhadem indexu pro účely oceňování derivátů na počasí vzhledem ke specifickým zemědělství. Návrh derivátu na počasí v České republice (Jihomoravský kraj) je založen na analýze citlivosti výnosů ječmene na počasí v průběhu 40 let. Analýza je založena na metodě regrese analýzy s hektarovými výnosy ječmene jako závisle proměnnou a indexem teploty vzduchu jako vysvětlující proměnnou. Pro ocenění kontraktu je použita burn analýza založená na parametrickém bootstrapu. S efektivním nástrojem bootstrapu je možné snadno provést burn analýzu a určit nejistotu spojenou s výplatou a cenou opce a statistické charakteristiky rozdělení pravděpodobnosti tržeb. Výsledky nicméně odhalují výrazný nepříznivý vliv bazického rizika na kvalitu parametrických produktů v produkčních podmínkách ČR. Článek naznačuje prostor pro použití derivátů na počasí jako nástroje pro zajištění na úrovni regionů s častým výskytem systematických rizik počasí.

Klíčová slova

Oceňování derivátů na počasí, zemědělství, řízení rizik, bazické riziko, burn analýza.

Introduction

Weather hedging can be theoretically an appropriate risk management strategy for all companies whose earnings or cash flows are negatively affected by weather. A financial weather contract is a weather contingent contract whose pay-off will be determined by future weather events. The contract links payments to a weather index that is the

collection of weather variables measured at a stated location during an explicit period (Dishel et al, 2002). Underlying “asset” of weather derivative are most often air temperature, rainfall, wind speed etc.

Financial weather contracts can be traded either in the form of weather derivative in the OTC (over-the-counter) markets and exchanges or through index insurance which is currently the most common way in agriculture. Trading in weather derivatives has

been developing since the second half of the 90's of the 20th century. Dynamic growth in the number of traded contracts occurred after 2003, when the CME (Chicago Mercantile Exchange) offered clearing service center for weather derivatives. In the future, increasing interest in weather derivatives is expected, namely due to the development of energy production from renewable sources (solar power, wind, water), whose performance is dependent on weather.

Recently, weather derivatives have received considerable attention in the literature as potential risk management tools for agricultural production (Turvey, 2001; Martin, Barnett and Coble, 2001; Dishel et al, 2002; Vedenov and Barnett, 2004; Woodard and Garcia, 2008). All authors highlight both the benefits and problems of weather derivatives in comparison to conventional insurance products. Financial weather contracts that reduce transaction costs as pay-offs are based on an objectively measured index, so the farm-level loss adjustment is not needed. Weather derivatives and index insurance are free of moral hazard and adverse selection because market participants can not affect the index variable. Moreover, weather derivatives are suitable for transfer of systematic risk, because the higher spatial correlation of index variables determines the more liquid financial contract, which makes it easier to trade on the exchange market.

The major disadvantage of weather derivatives is basis risk. The basis risk refers to the potential discrepancy between actual loss and contract pay-off. Differences arising from the imperfect correlation between underlying weather variable and crop yield. The relatively larger the geographic area is, the higher basis risk can be observed. Nevertheless, weather derivatives are better to design for a relatively large area, because such contracts are easily marketable and more attractive to investors.

Weather derivatives are suitable for areas with most homogeneous production conditions, where farm income is significantly spatially correlated and spatial differences in the impact of weather on vegetation are low (Hess, 2007). The land relief affects the spatial distribution of precipitation and air temperature. The Czech Republic is characterized by heterogeneous production conditions. Relatively more homogeneous areas are the fertile lowlands of South Moravia, the Elbe valley and Haná. These areas are also most at risk of more frequent drought. On a global scale, there is greater homogeneity of the production conditions in the most intensively

agricultural region of the U.S. Corn Belt than in the EU.

This paper aims to assess the effectiveness of agricultural weather derivative in the conditions of the Czech Republic. Since various combinations of weather variables, crops and weather stations create a huge number of potential weather derivatives, the scope of this paper enables only the weather derivative design and valuation of one crop in one region. The assessment of the sensitivity of barley to weather has been the basis for the design of weather derivatives in the South Moravia which represents a relatively homogeneous agricultural region. The weather derivative is designed for barley as one of the most significant crop planted in the Czech Republic.

Material and Methods

Temperature and precipitation are most important weather factors of yield variability. Weather data were obtained from the Czech Hydrometeorological Institute (CHMI). The analysis is based on daily / monthly average air temperatures and daily / monthly rainfall. The reference period is 40 years (1970-2009), which is sufficient time series to assess the dependence of yield on the weather. Monthly weather data are spatial averages of the data from meteorological stations in the Southern Moravia Region. Daily weather data were purchased from reference meteorological station Znojmo - Kuchařovice (334 meters above the sea level).

The series of barley yield in the South Moravian Region were obtained from the Czech Statistical Office. Since 2001 there has been a new delimitation of regional boundaries in the Czech Republic, so the average yield of barley prior to 2001 has to be adjusted to reflect the new regions. Adjustment of yield time series to the new territorial self-government structure is made using the data at the district level.

In order to account for temporal component, a simple detrending procedure is implemented by fitting the most suitable trend model (quadratic trend). We reveal the dependence between the barley yield and past weather using Pearson correlation coefficient. To avoid the possible omission of non-linear dependence between yield and weather variables, we also use Spearman rank correlation coefficient as an alternative indicator. Statistically significant correlation coefficients help to determine the critical month for yield formation of barley.

We adopt the following weather indices – air

temperature (°C), rainfall (mm) and drought index¹ Si (combination of air temperature and rainfall). The underlying weather index with the highest correlation coefficient is the best index of weather derivative because it effectively reduces the basis risk.

In order to achieve the highest possible correlation between yield and weather variables, we set weights to the critical month of vegetation. The weights are optimized using the MS Excel Solver to find the highest value of correlation coefficient between yield and weather variable during the critical period of vegetation. So, the final index is a weighted average of the weather variables in the critical months of vegetation.

The weather derivative contract triggers (starts to pay) whenever the index gets below (rainfall) or above (temperature) a specified strike level. To clearly find the strike, we analyze the relationship between yield and index using simple linear regression. We set the strike as an expected post-harvest price (P) and regression coefficient (β). In order to choose multiple linear regression or polynomial regression, the strike cannot be clearly determined as it varies in different parts of the non-linear regression curve.

The regression function needs to be tested for autocorrelation (Durbin-Watson test at the significance level of 0.05, 40 observations, 2 predictors in the regression including a constant) and heteroskedasticity (parametric Goldfeld-Quandt test at the significance level of 0.05, Spearman rank correlation between independent variable and squared residuals).

In order to formally evaluate the efficiency of weather derivatives in reducing production risk, a particular contract layering and contract value must be set. Contract layering is based on the frequency and severity of risks which the farmer is not willing to accept and which he intends to share with other market participants. Firstly, we assume that farmer is willing to accept the decline in barley yield by 10% compared to the expected value (five-year average excluding the maximum and minimum).

In most cases, weather derivative pricing is based on actuarial method. Easy but effective actuarial method is burn analysis (or simply “burn”). Burn is based on the idea of evaluating how a contract would have performed in previous years (Jewson,

¹ Since agricultural drought is a complex of many factors that cannot be included in one indicator, we use a drought index Si as an indicator of meteorological drought. The index S_i can be formulated as $S_i = \Delta_T / \sigma_T - \Delta_R / \sigma_R$. It presents a difference of monthly anomalies of temperature ($\Delta_T = t - tn$) and precipitation ($\Delta_R = r - rn$) to their standard deviations σ_T and σ_R (Potop, Türkott and Kožnarová, 2008).

Brix and Ziehmman, 2005). Burn analysis in this paper is enhanced by distribution fitting and Monte Carlo simulation.

The probability distribution of the independent variable (index) is estimated from the real data (1970 – 2009) using MLE method (Maximum Likelihood Estimation). As defined by Vose (2008), the maximum likelihood estimators of a distribution type are the values of its parameters that produce the maximum joint probability density for the observed dataset x . Consider a probability distribution type defined by a single parameter (α). The likelihood function $L(\alpha)$ that a set of n data points (x_i) could be generated from the distribution with probability density $f(x)$.

$$L(x|\alpha) = \prod_i f(x_i, \alpha), \text{ i.e. } L(\alpha) = f(x_1, \alpha) f(x_2, \alpha) \dots f(x_{n-1}, \alpha) f(x_n, \alpha) \quad (1)$$

The MLE is then the value of α that maximizes $L(\alpha)$. It is determined by taking the partial derivative of $L(\alpha)$ with respect to α and setting it zero:

$$\left. \frac{\partial L(\alpha)}{\partial \alpha} \right|_{\hat{\alpha}} = 0 \quad (2)$$

Distribution fitting using MLE method is processed automatically². The probability distribution is tested simultaneously with three goodness-of-fit tests at the significance level of 0.05 - Anderson-Darling test (A-D), Kolmogorov-Smirnov test (K-S) and χ^2 test.

It is very helpful to use the bootstrap tool (Efron, 1979) for improving burn analysis. Bootstrapping allows for easier estimation of uncertainty surrounding the estimate of mean and standard deviation of pay-off. We estimate the payoff uncertainty using the parametric bootstrap that requires the extra information about the probability distribution. The procedure of parametric bootstrap is as follows (Vose, 2008):

Collect the dataset of n samples (x_1, x_2, \dots, x_n).

Determine the parameter(s) of the distribution that best fit(s) the data from the known distribution family using maximum likelihood estimators (MLE).

Generate B bootstrap samples ($x_1^*, x_2^*, \dots, x_n^*$) by randomly sampling from this fitted distribution.

For each bootstrap sample ($x_1^*, x_2^*, \dots, x_n^*$), calculate the required statistic θ . The distribution

² The probability distribution of risk factors is estimated using the software module BatchFit Oracle Crystal Ball 11.1.

of these B estimates of θ represents the bootstrap estimate of uncertainty about the true value of θ .

Contract pricing is based on an estimate of a "fair" price, i.e. price at which the expected profit for both contracting parties is zero. The contract price (in this case of an option) is the average expected contract pay-off. Nevertheless, the seller of the option would probably expect a reward for taking on the risk of having to pay out, and hence the premium would probably be slightly higher than the expected payoff by a risk loading. We set the risk loading as 20 % of the standard deviation of the payoff of the contract (Jewson, Brix and Ziehmann, 2005)

Efficiency of weather derivative to reduce risk is quantified by comparing the distribution of revenues from barley sales including hedging and without hedging. If the farmer does not buy a weather derivative contract, he would realize the revenues R_0 .

$$R_0 = \frac{\int Q_T(I_T)P}{(1+r_f)^n} \quad (3)$$

Q_T denotes barley yield (t/ha) being a function of stochastic variable I_T . P is expected postharvest crop price (CZK/t). Since the expected pay-off ($Q_T \cdot P$) is related to the beginning of the contract period (usually 1 year), it should be discounted by using risk free rate r_f (e. g. 1-year PRIBOR rate at 30th June 2010 was 1.76 %).

If the farmer buys a weather derivative contract per 1 ha of crop, he has to pay the premium to the

seller (F_0). On the other hand, farmer may collect a pay-off from the contract (F_T) if a weather variable exceeds the strike (Weber et al, 2008). The payment is a function of underlying weather index I_T .

$$R_1 = R_0 + \frac{\int F_T(I_T)}{(1+r_f)^n} - F_0 \quad (4)$$

The effectiveness of hedging is assessed by comparing the coefficient of variation of revenues with and without using derivatives. Calculation is performed by using Monte Carlo simulation method with 10 000 iterations at the significance level of 0.05. The degree of basis risk is quantified by comparing simulation without standard error (without basis risk) and including standard error in regression estimate (including basis risk).

Results and Discussion

Table 1 presents the results of correlation analysis between barley yield and weather. The table lists the most significant correlation coefficients, including the test of statistical significance. As might be expected, a statistically significant moderate relationship had occurred between the yield of barley and air temperature in April, May, June (and July). Precipitations are local, so the risk of lack or, conversely, excessive rainfall has a systematic character. In addition to the sensitivity of barley due to the lack of precipitation in spring, inverse relationship is shown between yield and rainfall during the pre-sowing soil preparation. The correlation between barley yield and precipitation at the regional level is rather weak.

Region/station	Temperature (°C)	Precipitation (mm)	Drought index Si
South Moravia	-0.64 (6, p < 0.0001)	0.36 (4-6, p = 0.0218)	-0.60 (4-6, p < 0.0001)
	-0.64 (5-6, p < 0.0001)	0.33 (4-5, p = 0.0387)	-0.56 (5-6, p = 0.0002)
	-0.63 (4-6, p < 0.0001)	-0.32 (3, p = 0.0439)	-0.49 (4-5, p = 0.0012)
	-0.55 (4-7, p = 0.0002)		-0.47 (6, p = 0.0020)
	-0.54 (5-7, p = 0.0003)		-0.47 (5, p = 0.0021)
Station Znojmo-Kuchařovice	-0.60 (6, p < 0.0001)	X	-0.61 (4-6, p < 0.0001)
	-0.59 (5-6, p < 0.0001)		-0.57 (5-6, p = 0.0001)
	-0.58 (4-6, p < 0.0001)		-0.53 (6, p = 0.0005)
	-0.51 (4-7, p = 0.0008)		-0.48 (4-7, p = 0.0015)
	-0.50 (5-7, p = 0.0010)		-0.47 (4-5, p = 0.0021)

Notes: The data in front of round brackets are correlation coefficients. The figures in brackets denote critical months for yield formation, and p-values test the two-tailed statistical significance of the correlation coefficient. The term „X“ indicates no statistically significant correlation (Pearson, Spearman) at significance level 0.05. We put a maximum of 5 most statistically significant correlation coefficients.

Source: Author.

Table 1: The most significant correlation coefficients between barley yield per hectare and the average characteristics of weather in the Southern Moravia Region (1970 – 2009).

Due to the systematic effect of air temperature and drought on barley yield at the regional level, the following weather indexes were put to the regression analysis:

- weighted average air temperature from May to June (T 2)
- weighted average air temperature from

April to June (T 3)

- weighted drought index Si from May to June (Si 3)
- weighted drought index Si from April to June (Si 3)

Table 2 summarizes the results of testing the effect of various weather indices on barley yield. The

Example	T 2	T 3	S _i 2	S _i 3
Month (weights)	5 (0.264)	4 (0.194)	5 (0.500)	4 (0.271)
	6 (0.736)	5 (0.149)	6 (0.500)	5 (0.307)
		6 (0.657)		6 (0.422)
Pearson r	-0.666	-0.688	-0.592	-0.645
	(p < 0.0001)	(p < 0.0001)	(p < 0.0001)	(p < 0.0001)
R ²	0.443	0.473	0.350	0.416
	(p < 0.0001)	(p < 0.0001)	(p < 0.0001)	(p < 0.0001)

Source: Author.

Table 2: Relationship between the barley yield and weather indices in the South Moravia.

Region/station	Linear fit	R ²	Adjusted R ²	D-W test	p-value
South Moravia	$y = -0.3623x + 9.5613$	0.473	0.460	1.840	< 0.0001
Station Znojmo-Kuchařovice	$y = -0.3052x + 8.7431$	0.405	0.390	1.840	< 0.0001

Source: Author.

Table 3: Results of the regression analysis for barley.

results of correlation analysis indicate that the most appropriate index (i.e. index with minimum basis risk and highest correlation) for the weather derivative in the Southern Region is weighted average temperature from April to June. The largest weight (65.7%) is assigned to the average air temperature in June, the smallest weight to the month of May (14.9%). Dependence is statistically significant both at the 0.05 and 0.01 significance levels.

The relationship between barley yield and selected index is expressed by the regression functions in table 3.

Linear trend explains fluctuations in barley yield in the critical months of the year of around 47%. Choosing non-linear trend does not dramatically improve the quality of fit (e. g. 4-order polynomial trend has the R² of only 0,483). Neither Spearman rank correlation nor Goldfeld-Quandt test revealed the existence of heteroscedasticity.

According to Anderson-Darling goodness-of-fit test, residuals come from the normal distribution³. Standard error is 0.442. This information is used

to quantify the effectiveness of contract involving basis risk.

Three goodness-of-fit tests of weather index (A-D, K-S, χ^2) indicate that the selected weather index comes from the logistic distribution with mean 15.02 and scale 0.62. P-value of Anderson-Darling test (0.776) is satisfactory.

Considering the above mentioned regression equation for the contract to barley, the expected yield of barley 4.1 t/ha can be achieved when the weighted average air temperature in April-June exceeds 15.07°C. We also suppose that farm is willing to accept the decline in barley yield by 10% compared to the expected value. The critical value of yield is then 3.7 t/ha which can be reached at the critical temperature of 16.18°C. The probability of exceeding this critical temperature (strike) is approximately 14%. So, this weather derivative will cover high-risk low-probability systematic event of high air temperatures.

Option price is set by burn analysis using parametric bootstrap. The average pay-off ranges from 109 to 117 CZK per contract (the mean is 113 CZK) with a probability of 95%. The standard deviation of

³ Anderson-Darling test = 0.15, p-value = 0.957.

the pay-off ranges between 359 and 383 CZK per contract (the mean is 371 CZK) with a probability of 95%. The price of option contract is thus possible to set of CZK 113 + 20% (risk loading) of 371 CZK, i. e. ca 190 CZK.

Based on the results of correlation and regression

analysis and following the selection and testing of an appropriate index, it is possible to determine the structure of the contract. Table 4 contains the specification of weather derivative for barley in South Moravia. Table 5 presents statistics of the probability distribution of barley revenues.

	Specification
Contract type	Call option
Contract size	1 ha of barley
Index	Weighted average air temperature (°C)
Location/station	South Moravia/average of stations (CHMI)
Accumulation period (Weights)	April (0.194). May (0.149). June (0.657)
Strike	16.18°C
Fixed price	3 700 CZK per tonne of barley
Tick	1 341 CZK per 1°C above strike
Contract period	1 year (July 1 st 2010 – June 30 th 2011)
Premium	190 CZK per contract incl. risk loading

Source: Author.

Table 4: Structure for specific-event contract (barley. South Moravia) – call option. long without capping.

	Without basis risk		Including basis risk	
	Without hedging	Hedging	Without hedging	Hedging
Trials	10 000	10 000	10 000	10 000
Mean	14 946	14 876	15 006	14 932
Median	14 958	14 768	15 007	14 866
Standard Deviation	1 478	1 269	2 181	2 046
Skewness	0.0540	0.8545	0.0087	0.1921
Kurtosis	4.25	4.17	3.18	3.12
<i>Coeff. of Variability</i>	<i>0.0989</i>	<i>0.0900</i>	<i>0.1453</i>	<i>0.1370</i>
Minimum	7 361	13 259	6 858	7 948
Mean Std. Error	15	13	22	20

Source: Author.

Table 5: Statistics of the probability distribution of revenues (barley. CZK per 1 contract).

In case of hedging, the effectiveness of weather derivative contract is relatively low - farmers could reduce the variability of revenues only by 5.7 % if we take the basis risk into account. The analysis revealed a very high basis risk, which may result in both excessive and poor pay-off. If we consider no basis risk, the contract could help reduce the variability of revenues by 13.8 %. However, the basis risk really exists.

These results confirm the findings by Vedenov and Barnett (2004), Weber et al (2008), Manfredo and Richards (2009) emphasizing in particular the disadvantages of weather derivatives as primary

crop insurance instruments. Nevertheless, the aggregation effect suggests that the potential for weather derivatives in agriculture may be greater than previously thought, particularly for aggregators of risk, such as reinsurers (Woodard and Garcia, 2008).

Conclusion

The results revealed a significant adverse impact of the basis risk on the quality of parametric products. The effectiveness of weather derivatives as the risk management instruments could be higher in areas

with more homogeneous production conditions (than in the Czech Republic) and more light sandy soils, where rainfall directly determines the flow of water to plant roots and water gets quickly into the lower soil layers being out of reach for plant roots.

The main limitation on the use of weather derivatives in the Czech Republic are heterogeneous production conditions that reduce the correlation between rainfall and crop yields at regional level. Unavailability of data at the district level makes impossible to make in-depth analysis of the smaller territorial units. Conversely, the main opportunity for use of weather derivatives in the Czech Republic is a dense, high-quality network of meteorological stations with long-term data availability, which creates an appropriate basis for further research of other crops and regions.

The use of weather derivatives should be of interest mainly to the regional agricultural organizations and associations through which they can manage the systemic risks of weather. If we assume the potential of weather derivatives as the reinsurance instrument, it is important to clarify the legal and institutional aspect of the income risk management in agriculture using weather derivatives, especially regulation and possible areas of cooperation between the public and private sector.

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NASYP: Online expert tool on the control of major-accident hazards involving dangerous substances

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Abstract

NASYP is an online Geoportal tool being developed in cooperation with state and regional authorities to improve insufficient practices based on implementation of Directive nr. 2003/105/ES on the control of major-accident hazards involving dangerous substances. The tool is applicable for managing the permits, reporting and regular monitoring issues. Furthermore, it's applicable for a risk assessment and a rapid management of disasters in the initial phase. There're simple modeling tools included to simulate early stages of the contamination caused by disasters occurred to be used for decision making and effective use of emergency services. In this manner, there're low atmospheric and surface water pollutions taken into account. For the study area, Liberec region was chosen covering the area of 3,163km² and containing 533 potentially dangerous objects categorized accordingly to the Directive nr. 2003/105/ES. The model simulations are responding to daily hydrological and meteorological situation, a capability of automated updates from databases operated by the Czech Hydro Meteorological Institute, and communicate with databases of substances operated by the regional authorities. NASYP is suitable especially for the "N" class of the operators defined in the Directive, where because of smaller amounts of stored dangerous substances the safety measures and regular inspections are limited.

Key words

Spatial data, geoportal, risk management, modelling.

Anotace

NASYP je soubor online nástrojů pro Geoportál, který je vyvíjený ve spolupráci se státními a regionálními orgány s cílem zlepšit postupy související s implementací směrnice č. 2003/105/ES o kontrole nebezpečí závažných havárií s přítomností nebezpečných látek. Tento nástroj je použitelný pro řízení procesu udělování povolení, podávání zpráv a pravidelného sledování problémů. Dále je použitelný pro vyhodnocování rizik a rychlé řízení záchranných prací v počáteční fázi nehod. Jedná se o jednoduché nástroje pro modelování, které umožňují simulovat počáteční fáze kontaminace způsobené katastrofami, a proto je vhodná jejich aplikace pro rozhodování a efektivní využití záchranných prostředků. Pro modelování šíření se využívají vlastnosti atmosféry a povrchových toků. Jako referenční oblast byl zvolen Liberecký kraj o rozloze 3163 km², který obsahuje 533 potenciálně nebezpečné objekty zařazené do kategorií podle směrnice č. 2003/105/ES. Modely reagují na každodenní změny hydrologické a meteorologické situace, přičemž systém dokáže automaticky aktualizovat data z databází provozovaných v Českém hydrometeorologickém institutu a komunikovat s databází látek publikovanou krajskými úřady. NASYP je vhodný především pro tzv. „N“ třídy operátorů definovaných ve směrnici, kde jsou z důvodu menšího množství uložených nebezpečných látek omezena bezpečnostní opatření a pravidelné kontroly.

Klíčová slova

Prostorová data, geoportal, krizový management, modelování.

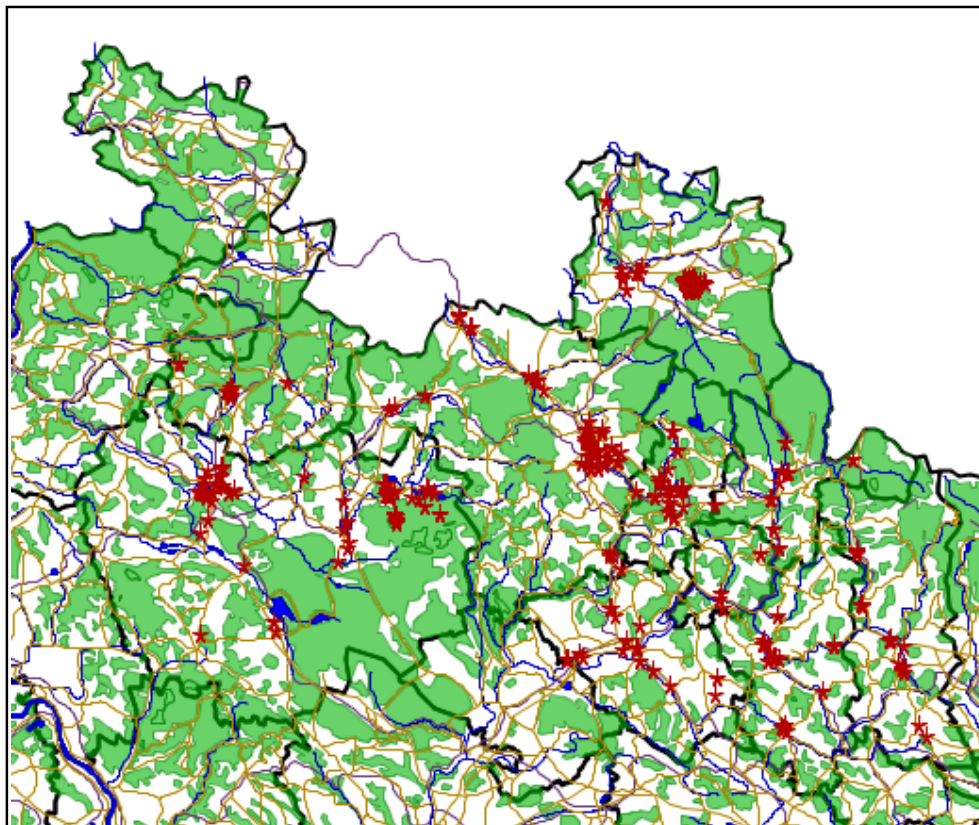


Figure 1: Places with dangerous substances in Liberec region.

Introduction

NASYP is a prototype of a prevention system of major accidents with respect to potential sources of the risks in harmony with the implementation of the directive of the European Parliament and the Council No.2003/105 in new states of EU. The final output of the project will be represented by the uniform geoportal component of evaluation of the risks, supplemented with an innovation module system for the formation of applications. This could be effectively used in the sphere of integrated control of risks which will enable a simple looking at the existing state, and thanks to this system it will even simplify a following actualization of information, classification, etc. The results should contribute to the Law No. 59/2006 of the Collection of Laws on prevention of major accidents in the Czech Republic (implementation of the directive of the European Parliament and Council No. 2003/105/ES from December 16th, 2003 in the Czech Republic) and the relating operating regulations. Within the frame of the project, the information has been collected and elaborated clearly in a simple form, familiar to the users (tables, data bases, maps). So, the results could be suitably used for a purpose of Regional authorities for the fulfillment of their duties according to the

law and for the elaboration of regional accident plans. The acquired data could also contribute for better evaluation of cases of synergy effects of individual objects registered according to the law which have not been uniformly evaluated yet. Data are subsequently used for a selection of suitable scenarios. A simple point system - till now missing in general practice - evaluating the receiver of the risk - will make part of the project, in the year 2010. The system of preventing major accidents will be, in the form of regional scenario, prepared for selected regions in Czech Republic and Poland. Within the frame of international cooperation, even a testing system across the borders (Czech Republic/Poland) is planned. The project NASYP is consisting of modeling and database applications. The issue of risk management in GIS is followed up also in the article of Alhawari.

Technical Solution

The technical solution of NASYP project is based on a web application (geoportal), which is connected to the four main components:

1. Database (created and managed in PostgreSQL) containing the spatial data. These data sets describe objects in Liberec region keeping the risk material (e.g. gas stations,

chemical plants or store of explosives) – Figure 1. The current version of the database contains except above mentioned items these tables – an overview of risk materials and their characteristic (codes, labels etc.) and codetables. In the database, buffers representing risk zones around spatial objects were created.

2. Database (web) client to database updating and exploiting, including interconnection to partners' tools (e.g. transfer of results of controls or date of a next control). The client is developing in cooperation with final users. They declared following requirements – possibilities of filtering according selected data attributes (a type of danger material), access rules for all types of users, including public, pre-prepared compositions for all types of users.
3. Geovisualization framework (Figure 2) – a part of geoportal which ensures the cartographic visualization of data. This component is very important in the terms of efficiency and conveniences. The database could be interconnected to many another visualization tools (e.g. Quantum GIS, Google Earth etc.). Users (the parts of crisis management in the Czech Republic) are not forced to work with a potentially unsafe web solution, but they can use the close desktop solution (database & desktop

geographic information system /GIS/) as well. Geovisualization tools are based on a technology developed called Geoportal4everybody. It is solution supporting visualization and sharing of spatial information, but also providing Web based analysis and on line vectorization. The components of the Geoportal4everybody could be also easy integrated with other systems. Risk mananagement and geoportal solutions are also dealed by authors Giuliani and Peduzzi.

4. Modeling tools (details in the chapter Modeling)

Modeling

Surface water

The project is capable of solving simple linear pollution transport scenarios for surface streams in the pilot region. For these model calculations the data are prepared using GIS software (Khan, Akhter, Ahmad, 2011). In the vicinity of the watercourses, there're selected areas with potential leaks polluting substances. Concerning leakages to surface water clusters with a radius of 1 km are used to identify possible pathways of the contaminants. The model calculates two basic variables. The first variable is the time for a contaminant to reach from point A to point B concerning the current flow. The second variable is the concentration of

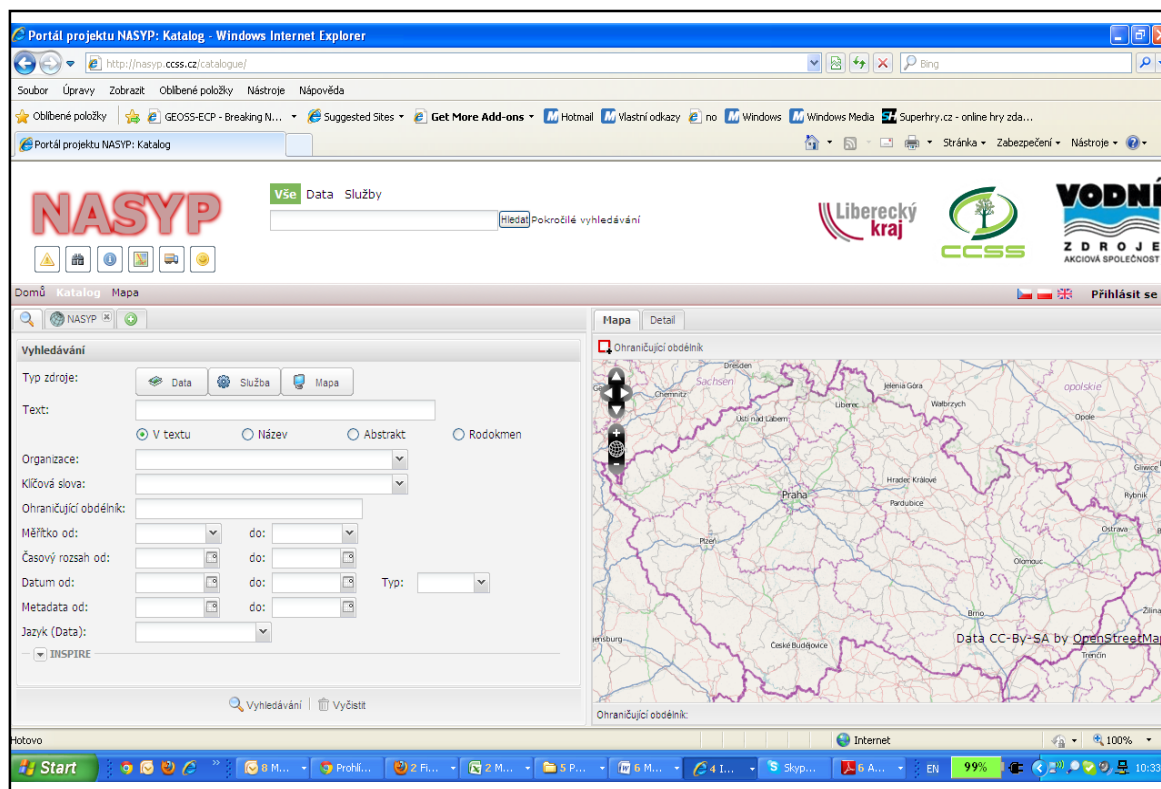


Figure 2: Nasyp Geoportal.

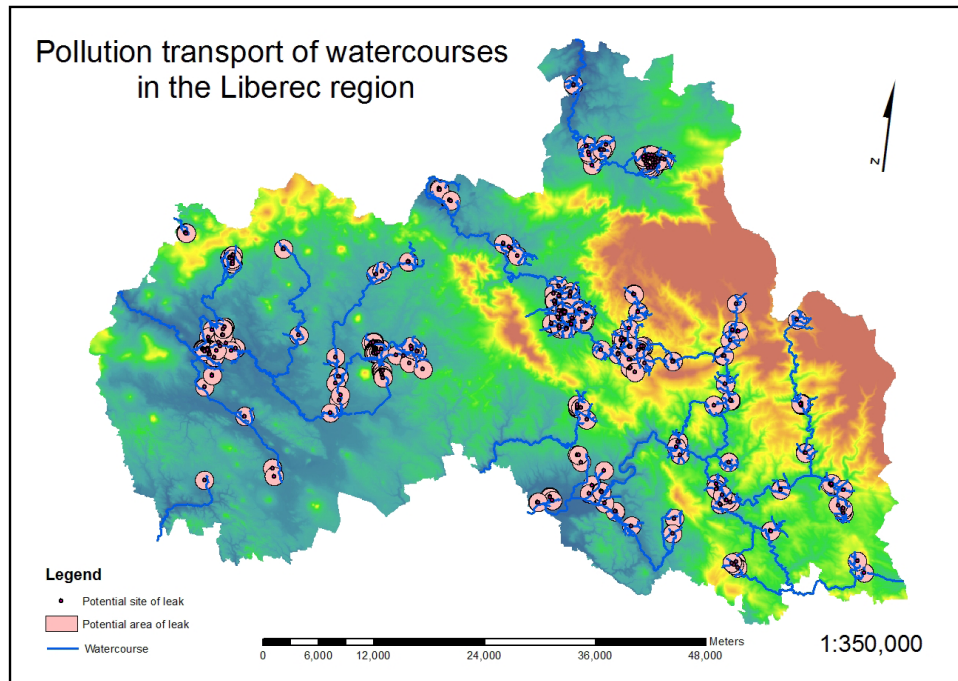


Figure 3: Streams and potential threats for surface water contamination – Liberec region, Czech Republic.

pollutant at a particular time. Among the required data for calculations (the hydrological model) we can identify the flow rates at specific sites, data on individual sections of the streams and data on the quantity of discharged pollutant. General possibility of solving are also given in article by Fewtrell.

For time measurements for contamination transport from point A to B, the method of sections is applied. With use of interpolation and data modification, we know the average flow rate of individual sections of the watercourse and their lengths. Time for a pollution arrival from the upper end of the section to the bottom end = length / speed. This calculation is performed for all sections related to the possibly contaminated site and monitored at the end point. The resulting times are summed to create the final time.

Concentration measurements of the pollutants are determined through flow rate interpolation in individual sections. Furthermore, we know the amount of spill and the time at which the contaminant escaped. First step is to find out the mass of water flowed during the contaminant discharge time ($V = Q \cdot S$). Secondly the volume is increased by volume of the contaminant itself. The sum of share volume and contaminant concentration occurs to us at that time. For the next sections we will consider, as if the contaminant flowed at the top of this section which consequently changes the water flow on underlying sections. The measured concentration value is used for each section separately.

The simplicity of this model allows a rapid use

in emergency situations. Due to the large scale of the model area just the principle of advective diffusion is applied. Available data do not allow more detailed modeling. Interesting case study is presented by Gurzau.

Air pollution

Flow field modeling

A calculation of the three-dimensional flow fields in the boundary layer of the atmosphere in the study area is performed by the computational fluid dynamics (CFD) code as a numerical solution of the system of Reynolds averaged Navier-Stokes (RANS) and continuity equations. The Reynolds stresses tensors are calculated following the Boussinesq hypothesis. The isotropic coefficient of turbulent viscosity μ_t is obtained from the turbulent kinetic energy and its dissipation rate using the standard $k - \epsilon$ model of turbulence closure (Jones and Lauder, 1972). Numerical steady state solution of the system of equations was performed by the standard method of control volumes in a three dimensional non-orthogonal boundary fitted grid using a collocated variable arrangement in hexahedral cells. The lower boundary of the computational domain is delimited by the detailed model of the surface in the study area in the altitude map. The domain of 11000 m by 11000 m in the horizontal and 1000 m in the vertical was gridded with a 220×220 regular grid in the horizontal plane and a 27 node grid in the vertical direction. A vertical step in the hexahedral grid was designed as a boundary layer i.e. was increasing

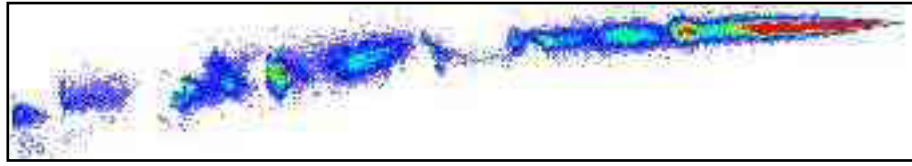


Figure 4: visualization of operated particle dispersion model.

in a direction towards the upper boundary of the computational domain by using a factor 1.2 for the distance increment. The first vertical grid node was adjusted 1 m above ground surface.

The calculation of the flow field in a neutrally stratified PBL was performed for eight basic wind directions set through the upstream boundary conditions as lateral inlet boundaries of the computational domain. The inlet wind profile was set through the logarithmic law.

At the inlet profiles for $k - \varepsilon$ turbulence modeling is set estimation approached by Richards and Hoxey (1993). At the lower ground surface boundary of the computational domain, both components of the turbulent energy were standard determined by the wall functions.

The second order upwind approach was used as the spatial discretization scheme. A temporal discretization was achieved by an implicit scheme. The continuity was resolved through a pressure correction of the SIMPLEC type (Van Doormal and Raithy 1984). To get a steady state solution, the iterative process was converged after about 230 iterations.

Particles dispersion modeling

The modeled three-dimensional vector flow field generated input data for the related Lagrangian simulation of transport and diffusion dispersion of passive, gravitationally non-falling (or neutrally buoyant) model particles assumedly emitted from a point source. Local transport motion of each particle is determined by the velocity flow vector active in the partway of this motion. This vector is obtained through linear interpolation of the input flow field. The motion of the particles simulating the dispersion through turbulent diffusion is based on solution of the Langevin equations. The components of the fluctuation vector are given by Equation:

$$u_i(t + \Delta t) = au_i(t) + b\sigma_{u_i}\xi + \delta_{i3}(1-a)T_{Lx_i}\frac{\partial}{\partial x_i}(\sigma_{u_i})$$

The new position of the passive, gravitationally non-falling particles is caused by the joint action of the two vectors.

The amplitude of the modeled turbulent fluctuations

including random parameter ξ varies in the range delimited by $b = (1 - a^2)^{1/2}$; $a = \exp(-\Delta t/TL)$; TL is the Lagrangian integral time, which, in agreement with the approach of Zannetti (1990), was set at 200 s in the horizontal plane and 20 s in the vertical plane. Variances of wind speed components σ_u were estimated from the modeled turbulent kinetic energy: $\sigma_u = 0.91k^{1/2}$, $\sigma_w = 0.52k^{1/2}$. The relevant constants are taken from the work of Panofsky et al. (1977) and correspond to neutral stratification. The time step for the motion of passive particles Δt was selected as 5 seconds. The emission flow of the source was set at 2000 fictive particles per Δt .

Conclusions

The development of web-based open solution for risk management represents a modern and very important part of geomatics and geoinformatics research. It is necessary to emphasize benefits of such a solution:

- Relations to international web standards enable the next development and/or modification of application as well as the interconnection to the similar solutions (e.g. external databases, other clients etc.).
- Web applications are accessible anywhere through the Internet connection. It is possible to use them not only in offices but in real emergent situation the mobile units can work with such application. This is important in conjunction with growing number of mobile hardware in crisis management.

Discussion

- The current version of NASYP application does not represent a final situation. Based on users' tests and consequent requirements, we plan these changes:
- Adaption of application to mobile hardware tools,
- New codelist of emergent materials,
- Interconnection to other similar applications (e.g. Flooding portal of Liberec region).

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Information and Communication Technologies for Regional Development in the Czech Republic – Broadband Connectivity in Rural Areas

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Abstract

The present paper introduces chosen results of an ICT development survey in the regions of the Czech Republic. The survey was primarily focused on broadband connectivity and its adoption by agricultural enterprises operating in rural areas. The survey was conducted in the context of both the EU strategy "Digital Agenda for Europe" and the national program document "National Policy in Electronic Communications - Digital Czech Republic". It stems from the enquiries that the situation is not – in spite of a certain improvement – satisfactory and the digital divide remains highly topical in rural areas of the Czech Republic. Broadband connectivity reaches practically 100% in urban areas and more than 85% in suburban areas whereas the rural areas show only about 75% availability. In many parts of the Czech Republic, a high quality Internet connection is quite questionable and sometimes even unavailable until present.

Keywords

ICT adoption, broadband, Digital Agenda for Europe, ADSL, FTTx, Wi-Fi.

Anotace

Príspevok prezentuje vybrané výsledky výzkumu rozvoje informačních a komunikačních technologií (ICT) v regionech ČR zaměřené především na problematiku vysokorychlostní konektivity a dále na její adopci zemědělskými podniky, tedy podnikatelskými subjekty, které zde působí. To vše v kontextu strategie EU „Digitální agenda pro Evropu“ a národního programového dokumentu „Státní politika v elektronických komunikacích - Digitální Česko“. Z rozsáhlých průzkumů a šetření vyplývá, že situace i přes určitá zlepšení není zdaleka uspokojivá a problematika digitální propasti je v podmínkách venkovských oblastí české republiky stále velmi aktuální. Zatímco vysokorychlostní konektivita městských oblastí je v ČR prakticky 100 %, příměstských potom více než 85 %, venkovské oblasti mají dostupnost pouze okolo 75 % a v řadě lokalit je kvalitní konektivita doposud poměrně velký problém, případně není dostupná vůbec.

Klíčová slova

Zavádění informačních a komunikačních technologií, vysokorychlostní Internet, Digitální Agenda pro Evropu, ADSL, FTTx, Wi-Fi.

Introduction

ICT development is driven by high dynamics that can even be surprising in many ways. New models of smartphones, new revolutionary gadgets (tablets, netbooks), e-book readers, GPS module devices etc. are recent phenomena that occur everywhere around us. Broadband connectivity, its availability and mobility are basic prerequisites of an effective use of today's modern technologies. The development of broadband networks has nowadays a revolutionary impact, similar to that of the electricity and transport infrastructure development one hundred years ago.

In August 2010 the European Commission launched within the framework of its "Europe 2020 Strategy" the "Digital Agenda for Europe" [1]. The Agenda strives to maximise the social and economic potential of ICT, especially the potential of the Internet, a key medium of economic and social activity in all domains (education, commerce, work, communication, culture etc.). The strategic objective is to bring basic broadband connection to all European citizens by 2013 and to ensure that by 2020 all Europeans have access to much faster Internet (above 30 Mbps) while at least 50% of European households should have access to Internet

connections of 100 Mbps or more.

A long-term strategic plan has been launched as well by the Czech government – **National Policy in Electronic Communications - Digital Czech Republic** [8]. It states among others the necessity of eliminating the digital divide between inhabitants of urban and rural areas. The digital divide stems usually from limited broadband availability and subsequent impossibility to use the respective Internet-based services. Two main objectives have been identified in this program document:

1. *To ensure that by 2013 all inhabited areas of the Czech Republic have access to broadband Internet with the minimum speed of 2 Mbps (download) and 10 Mbps in the cities.*
2. *To ensure that by 2015 the availability of broadband in rural areas reaches the speed of at least 50% of the average speed available in urban areas. 30% of households and enterprises in the cities should have access to the speed of at least 30 Mbps.*

Objectives and methods

In accordance with recent strategic documents of the EU and the Czech Republic and at the same time with the long-term research focus of the Department of Information Technologies FEM CULS, broadband connectivity and ICT development in regions has been examined. Two researches and some of their relevant findings are presented below in detail:

- a) Broadband – Current State and Development Opportunities in Rural Areas of the Czech Republic
- b) Exploration 2010 - ICT Use and Development in Agricultural Enterprises of the Czech Republic (ICT adoption by enterprises)

Broadband – Current State and Development Opportunities in Rural Areas of the Czech Republic

In the second quarter of 2010, a detailed survey focused on end-user connectivity in rural areas was carried out and assessed. It dealt not only with rural areas in general but accentuated small villages and attached settlements, i.e. areas with none or

insufficient coverage. A comparable survey has never been carried out. The Klatovy district has been chosen as an example (see Fig. 1). The survey was conducted in four villages, namely Poleň, Měčín, Chanovice and Strašín, each of them having several attached settlements in its territory.

The surveyed areas have been chosen with regard to different geographical location, natural conditions, terrain ruggedness, vicinity of bigger settlements etc., i.e. with regard to those factors that might influence both the Internet connection availability and quality. The research was carried out according to the Department of Information Technologies methodology in close cooperation with the Local Action Group Pošumaví (LAG Pošumaví). The LAG Pošumaví ensured a part of the general enquiry and especially detailed local enquiries.

The research was focused on basic technologies to be taken into account in rural areas, in other words on ADSL, mobile technologies (3G, EDGE, CDMA) and Wi-Fi.

ICT Use and Development in Agricultural Enterprises of the Czech Republic – Exploration 2010 (ICT adoption by enterprises)

The third stage, called Exploration 2010, of an extensive ICT development survey in agricultural enterprises of the Czech Republic was carried out in 2010. Exploration 2010 prosecutes the surveys conducted in previous years, in particular those of 2009 and 2008. The total of 902 questionnaires was collected, representing 20.5% of the enterprises addressed. Primarily, the survey addressed bigger agricultural enterprises; from the viewpoint of the Czech Republic, it means enterprises farming at least 100ha of agricultural land. This paper introduces and discusses only those results connected directly to its topic and focus.

In 2010 (in contrast to previous years) all available Internet connection technologies were taken into account even if some of them - cable internet (CATV) or satellite connection - are negligible in rural areas. Mobile internet connection has been newly analyzed from the point of view of the individual operators' role and presence.

Chosen results of the survey are subsequently compared with the findings of the Czech Statistical Office published in its "Information Society in Figures 2011" [3].

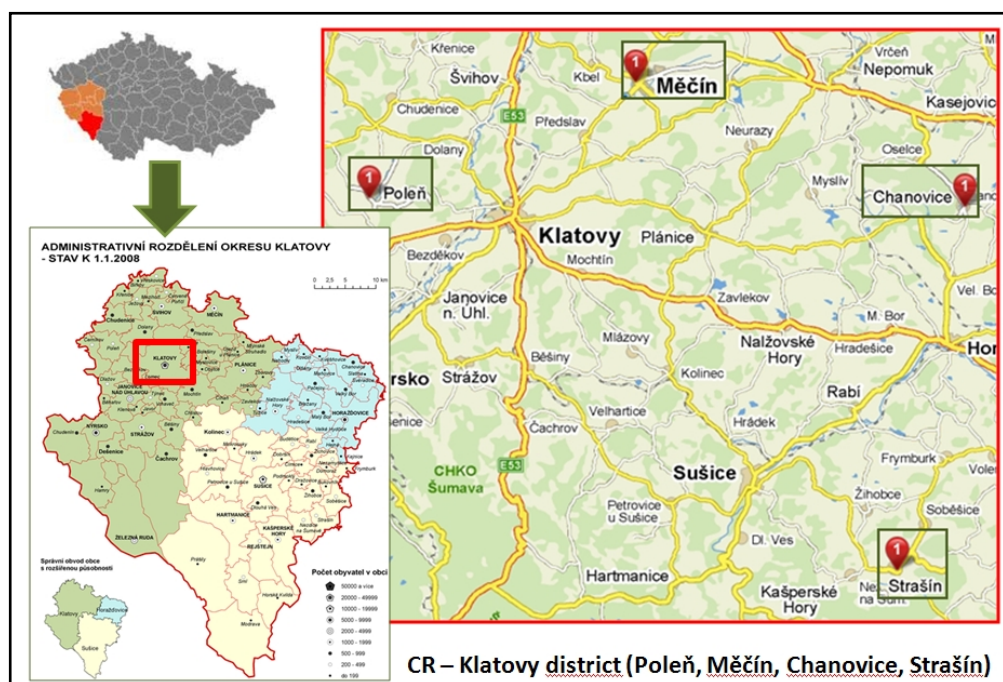


Figure 1: Broadband – Exploration 2010 - detailed analysis of selected areas (Klatovy district) .

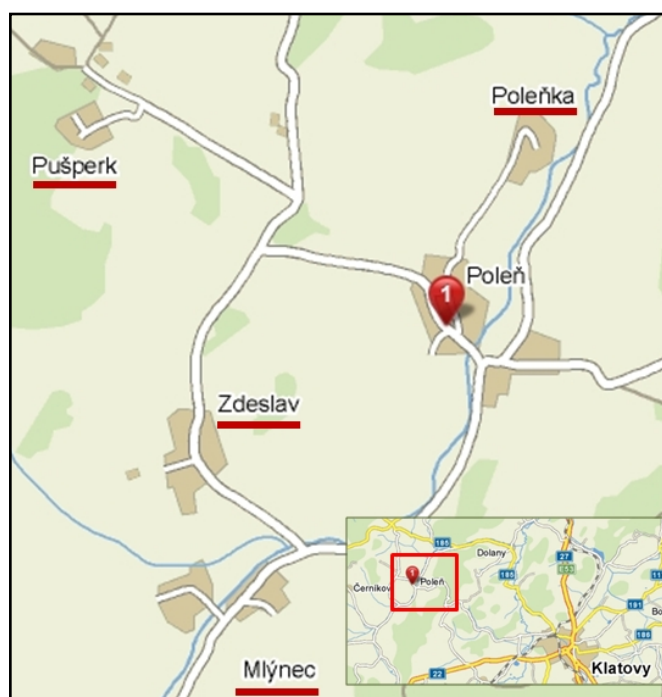


Figure 2: Broadband – Exploration 2010 - Klatovy district (the village of Poleň, attached settlements Pušperk, Poleňka, Zdeslav, Mlýnec).

Results and discussion

The survey "Broadband – Current State and Development Opportunities in Rural Areas of the Czech Republic" brought many up-to-date findings and enabled us to picture the real situation of Internet availability in the country. An extensive local enquiry revealed the true state of things that is in many cases very different from providers' declarations, marketing offers and public

awareness. The enquiry results are recently being processed and published.

In order to illustrate the findings, the village of Poleň with four attached settlements (Pušperk, Poleňka, Zdeslav, Mlýnec) has been chosen – see Fig. 2. It clearly shows that there exist many rural areas where the connectivity remains significantly limited and therefore the broadband is practically unavailable.

If we take into account the existing phone lines in the area and strive to investigate the ADSL-based connectivity, we will see that the attainable speed is very low or does not even allow the Internet connection. In many cases, it was not even possible to assess the quality of the considered connection (it can be assumed though that the connection will not be possible).

The village of Poleň unfortunately represents quite a common situation in many rural areas of the Czech Republic. The village itself has a partial

connectivity, however, on a relatively low level. If the ADSL technology is available, the download speed is 3.5 Mbps in one case and 1 – 2 Mbps in a few cases; the respective upload speed is 256 or 128 Kbps. ADSL is not available at all in the attached settlements (Pušperk, Poleňka, Zdeslav, Mlýnec).

As far as the Poleň area is concerned, the ADSL technology is offered only by one single provider – O2 company. It goes without saying that the O2 owns the cable infrastructure and local loops. ADSL availability is shown in Fig. 3 and 4.

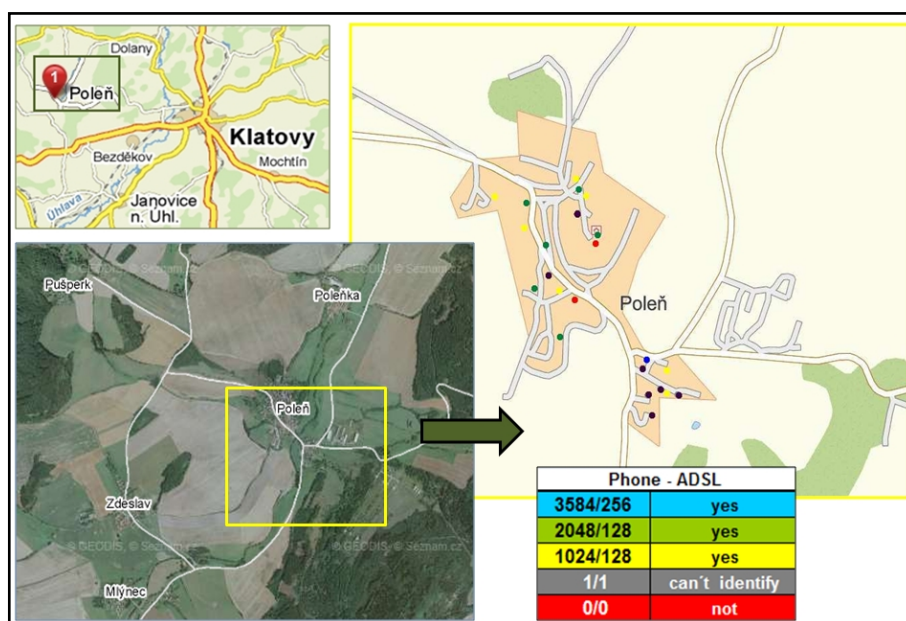


Figure 3: ADSL availability – detailed view (the village of Poleň).

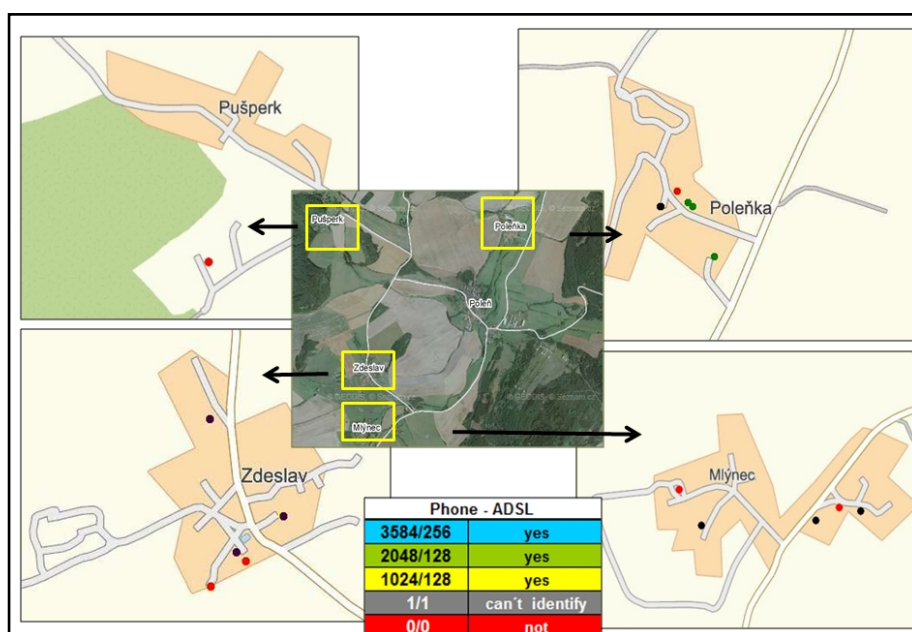


Figure 4: ADSL availability – detailed view (Pušperk, Poleňka, Zdeslav, Mlýnec).

Mobile internet connection is another means of connectivity to be considered. However, it is quite problematic. In the area concerned, 3G technologies are (and will probably be) unavailable. A relatively slow CDMA connectivity is partially available (maximum theoretical download speed is about 1 Mbps while the real average speed is around 300 Kbps). The CDMA is also significantly limited or unavailable even if it is offered by two providers (O2, U:fon). A much slower (real speed of about 150 Kbps) EDGE technology is available and even offered by three operators (T-Mobile, O2, Vodafone). Nevertheless, it is currently available without limitations only from O2 and Vodafone.

Recent coverage maps provided by the individual mobile operators were used. However, the coverage shown does not always correspond with the reality (based on the survey results and common experience), especially with regard to connection quality and availability.

Figures 5 – 7 show insufficient CDMA coverage in rural areas and in the Czech Republic as a whole. Furthermore, they illustrate insufficient coverage by standard mobile EDGE services within some operators and especially the lack of 3G networks (with an exception of big settlements). We have to mention here that 3G networks have been intensively built since mid-2010 by all Czech operators, starting again with urban areas. It is therefore the question when and how this

technology will be made available in rural regions. In general, we have to state that the 3G technology development in the Czech Republic falls behind the neighbouring countries (Austria, Germany etc.) and is significantly delayed.

In general, we can suppose that the mobile connectivity coverage and quality will go on increasing. However, the situation in the Czech Republic is far from being optimal especially in rural areas and the existing problems seem to be rather persistent.

Wi-Fi constitutes the last theoretical connection alternative, similarly to the whole area of the Czech Republic in the long-term perspective. In the area concerned (Poleň and attached settlements), Wi-Fi is offered by one single provider – reportedly without limitations. However, this provider refused to report the number of users and other detailed pieces of information. As a result, this kind of connectivity cannot be assessed properly, or it can rather be considered inapplicable. The present situation is not rare; on the contrary, it is quite typical of many rural regions. There are areas where no Wi-Fi providers at all operate or there exists one single provider in the area with a questionable service quality. This fact, together with general Wi-Fi technology limitations prevents it from further spreading and use even if it would otherwise constitute the only theoretical available higher speed connection.

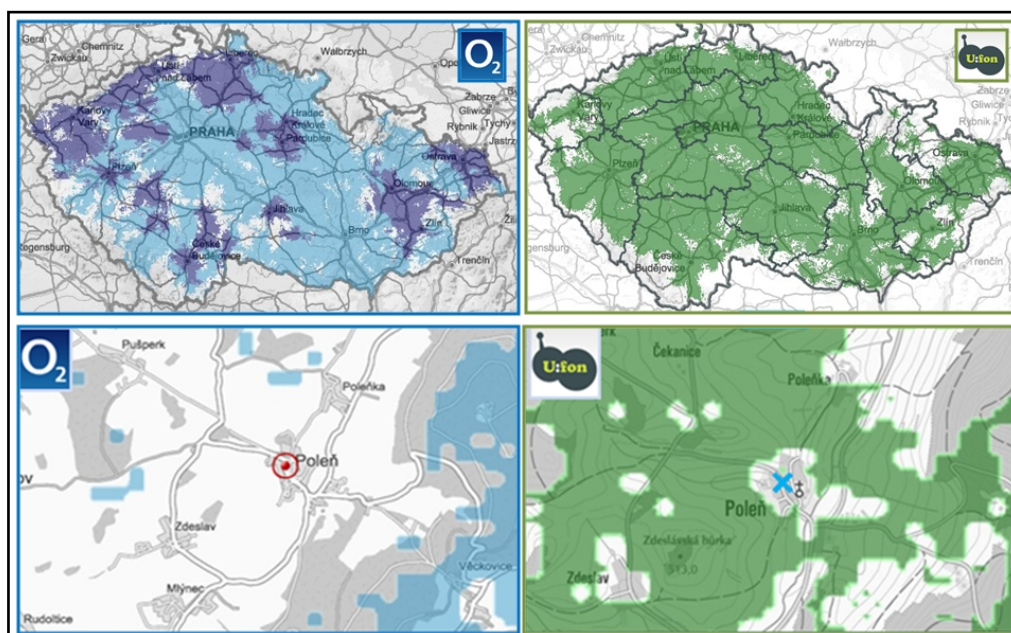


Figure 5: CDMA availability (O2, U:fon) - Czech Republic and the Poleň area.

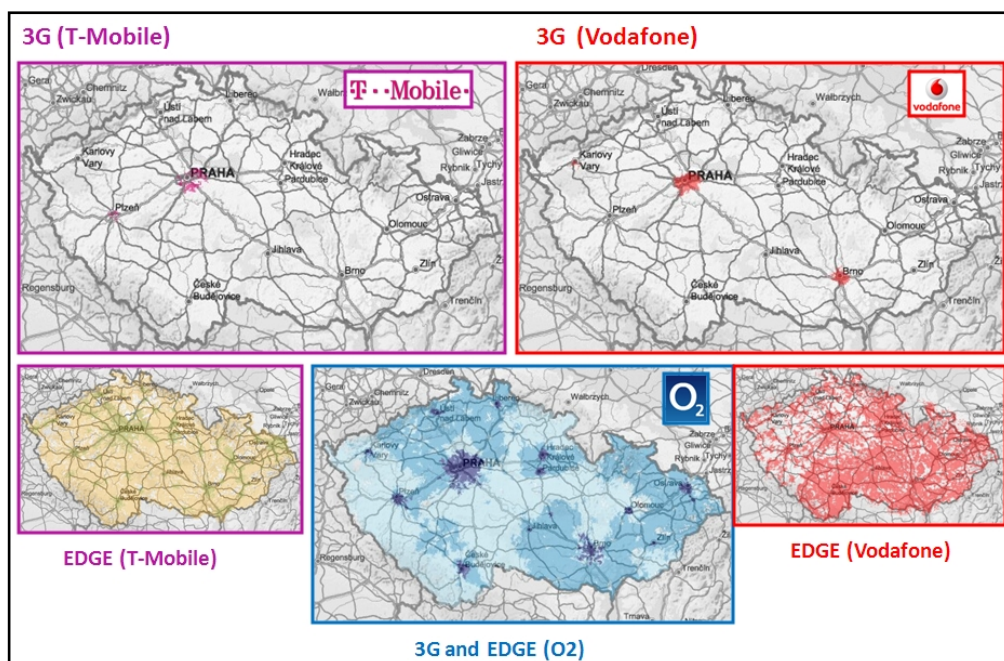


Figure 6: 3G, EDGE availability – Czech Republic.

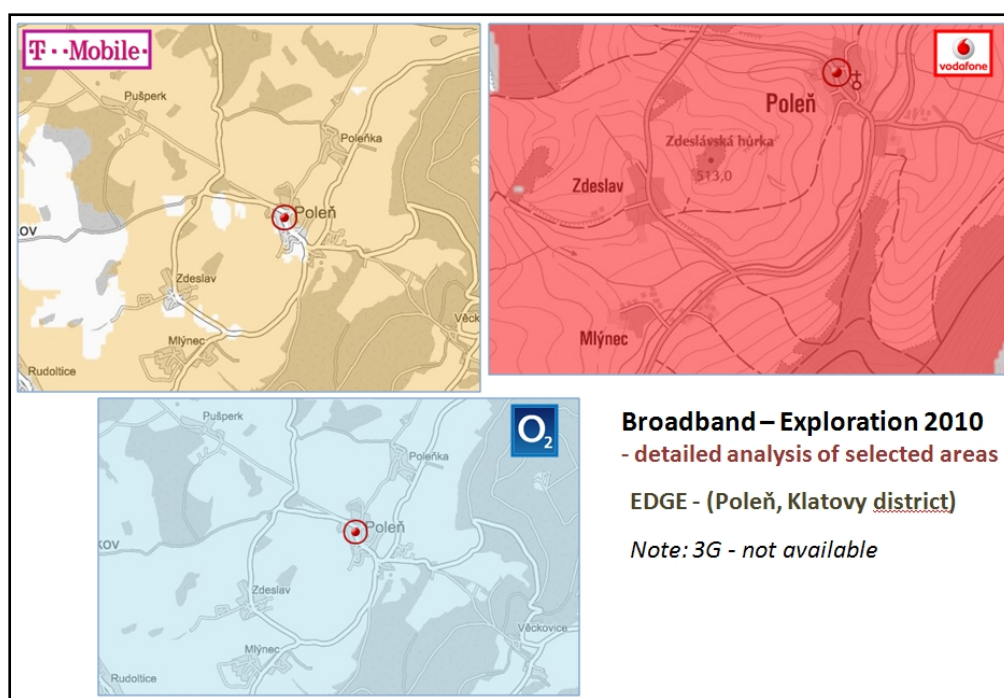


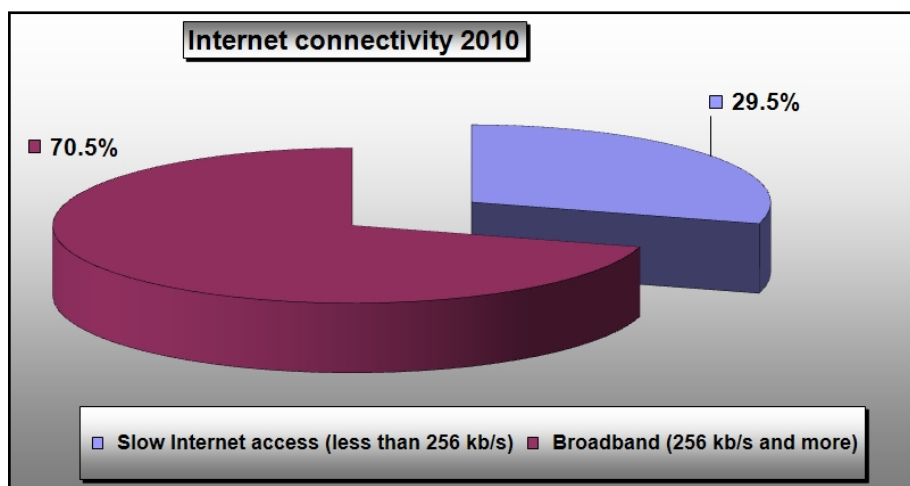
Figure7: 3G, EDGE availability – area surveyed (Poleň, Klatovy district).

Based on the survey "ICT Use and Development in Agricultural Enterprises of the Czech Republic – Exploration 2010 (ICT adoption by enterprises)", we can state that corporate internet connectivity (i.e. the number of enterprises with internet connection) has further increased to almost 95% and other enterprises are planning to establish it too.

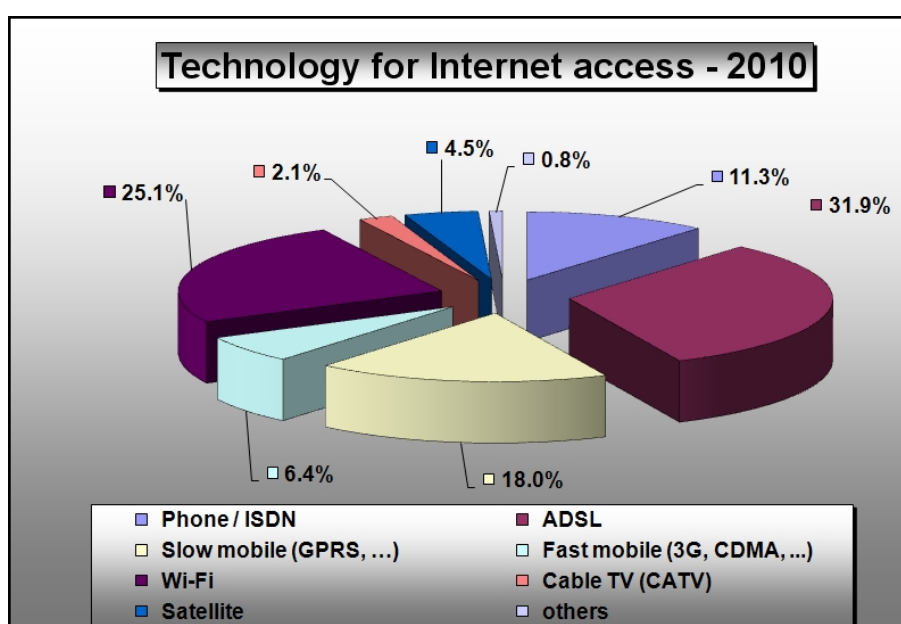
Mobile connectivity was also surveyed in an elaborate manner, including the share of the

individual operators. The dominant position of O2 has been confirmed in the survey. At the time of the survey, O2 was offering adequate technologies in the regions and had relatively the best coverage. Details are provided below in pie charts 1 – 4. This issue is introduced in detail with all respective commentaries e.g. in [9].

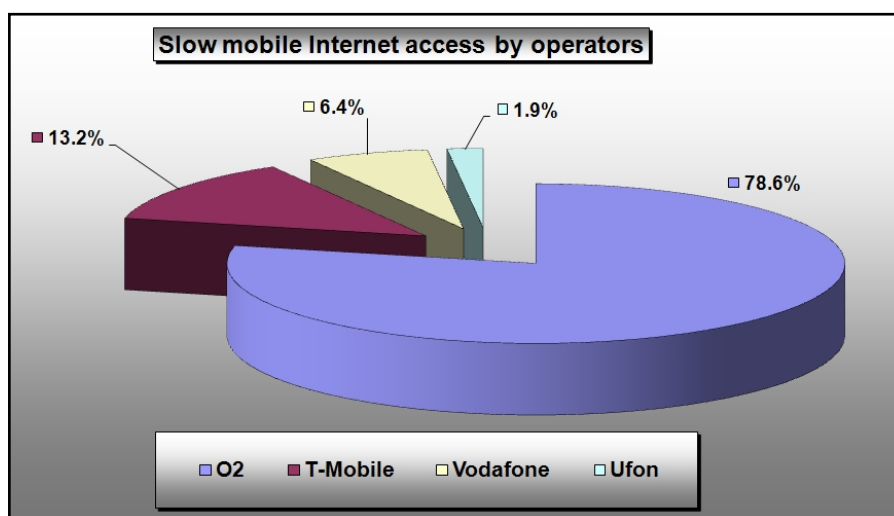
It is quite interesting to compare the survey results and findings with the brochure of the Czech



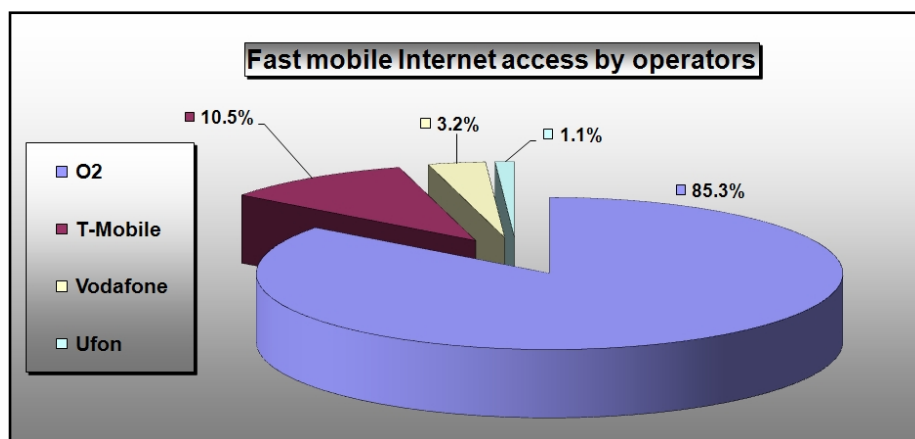
Graph 1: Connectivity structure (broadband x slow access).



Graph 2: Internet connectivity – individual connection technologies.



Graph 3: Connectivity structure (slow mobile access by operators).



Graph 4: Connectivity structure (broadband by operators).

Statistical Office "The Information Society in Figures 2011" [3] that was released on 17th April 2011. The document comprises statistical data on ICT development in the Czech Republic and ICT use in the entrepreneurial sector in 2010. The Czech Statistical Office survey follows the Regulation (EC) No 808/2004 and therefore enables a comparison to be made between and among the individual EU member states. The CSO methodology states: "In 2010 this survey was conducted in the first quarter, with the response rate of approximately 6,500 enterprises with ten or more employees in all fields of economic activity, except for agriculture, educational services, health care, cultural, entertainment and recreational activities." It means that the survey was not directly conducted in the agrarian sector and, taking into account the existing methodology, the agrarian sector will not be included in near future. The CSO deals with three categories of enterprises according to their size, i.e. the number of employees (10-49, 50-249, 250 and more). From the viewpoint of the agrarian sector, this categorization is generally not suitable as the number of employees is not always determinant. Moreover, the scope itself of the survey is quite narrow as far as the ICT domain is concerned. Nevertheless, some of the results can be compared.

According to the CSO, more than 85% of Czech enterprises disposed of broadband connectivity at the beginning of 2010. As far as the agricultural enterprises are concerned, the survey recorded broadband connectivity of 70.5% (within connected enterprises). The rate is then significantly lower than the general estimate of the CSO while the total connectivity is almost 95%. This is influenced by the fact that a vast majority of agricultural enterprises operates in rural areas where the connectivity (its quality in particular) are still quite limited (key factor of the digital divide).

According to the report, almost two thirds of the enterprises (65%) had an internal computer network. Agricultural enterprises recorded a substantially lower number of networks in our survey – a little less than 29%. We can assume that smaller enterprises do not have a network built at all or do not even use more PCs even if the survey dealt solely with digger enterprises that farm more than 100ha.

As for the Internet use, e-banking services are the most frequently taken advantage of with the average rate of 87% enterprises (85% small enterprises, 94% large enterprises). The results of both surveys are quite similar at this point. Our survey showed that 90% of the connected agricultural enterprises use e-banking. If we take into account all agricultural enterprises from the survey sample, the use of e-banking would record similar figures, i.e. 85%. High intensity of use can be easily explained - it was just the e-banking that was and still is the main driving force of ICT development in the agrarian factor. From this point of view, 2003 was a real milestone when companies adopted Internet mainly for e-banking sake (of course using contemporary technologies – Dial-up, ISDN, fixed line). This 2001-2003 phenomenon was examined, described and discussed e.g. in [9], general trends and specificities of the Czech Republic then in [8].

The CSO report stated that 74% of Czech enterprises have their own websites and 14% run corporate e-shop on the website. As indicated above, just a small share of agricultural enterprises has their own websites and only 3% run their e-shop. However, almost 6% reported that they had already made plans to open one too. The agrarian sector has some particularities and shows a certain level of conservatism. WWW presentation is not considered to be that important and e-selling is substantially limited in most cases (it is not needed). It does not

mean that agricultural enterprises do not use the Internet trading - just it is not used as a promotional and selling tool. On the other hand, Internet purchases account for more than 68%, e-submitting is used in 54% cases and e-auctions represent 11%.

"ICT Use and Development in Agricultural Enterprises of the Czech Republic – Exploration 2010" survey brought many interesting findings and, together with previous researches, enabled us to pursue and record a range of development trends in this domain. The same survey has been carried out in 2011; its results are currently being processed and will be published as soon as possible.

Conclusion

Based on the extensive enquiries and surveys, it can be stated that the development of broadband communication infrastructure in rural regions is – in spite of a certain improvement – far from being satisfactory and the digital divide remains highly topical. While broadband connectivity in urban settlements is always available, its accessibility in rural areas constitutes a real problem and it is sometimes even not available at all.

Mentioned issue is dealing with many authors around the world, for example Zouganeli at all [10], Mosenthal at all [5] or Kim at all [4].

Research activities concerned with the current state, quality and Internet connectivity development in the regions (with a special focus on broadband) confirmed a range of persistent problems and the ranking of the Czech Republic in both world and

European statistics as well as in EU and OECD materials. For example, the Europe's Digital Competitiveness Report ICT Country Profiles [2] says: *"The Czech Republic still lags behind other EU countries in Information Society development and deployment, including high-speed internet connections..."* or *"In general, the Czech Republic scores relatively low on broadband internet indicators despite the high rural coverage of DSL."*

How the above-mentioned situation can be influenced by the recently launched "National Policy in Electronic Communications - Digital Czech Republic", that is a question. The policy arose as a quite delayed modification of the formerly prepared strategy "Digital Czech Republic" at the Ministry of Industry and Trade.

If we are to evaluate in brief this document, we have to mention its significant vagueness, focus on several isolated domains and rather unimportant activities (such as e.g. establishing a special portal).

It goes without saying that the present issues will be researched in the upcoming period as they concern remarkably the regions and the respective information support.

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