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ANALYSES OF HISTORICAL DEVELOPMENT, SOIL MOISTURE REGIME AND SCATTERED VEGETATION IN THE LANDSCAPE AREA OF UAE ŽABČICE

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Abstract

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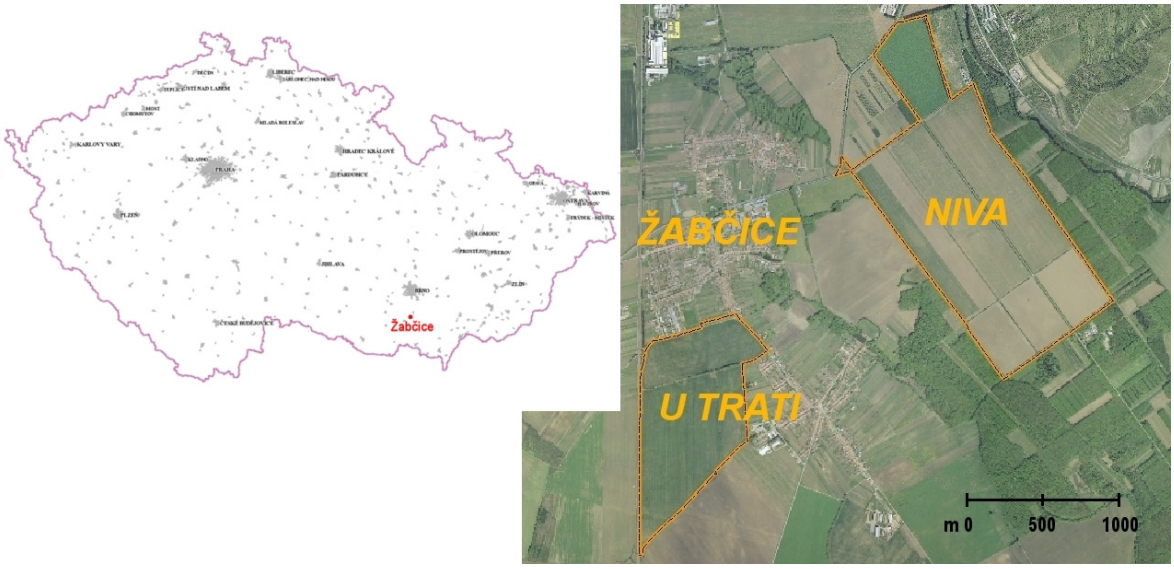
The aim of the project was to evaluate developmental changes in land use (using the method of retrospective time profiles) and their effects on the function and stability of rural landscape in the model area of the University Agriculture Enterprise in Žabčice. The former states of landscape have been evaluated according to archival aerial photographs and maps of selected area. The present situation was examined on orthophotomaps and by field survey. Another aim was taking of the soil samples from the model area and their physical analysis for determination of soil moisture. Soil drying out disposition on particular parts of model area has been found out by analysis of soil samples and climatic characteristics. The third aim was to evaluate the "green structure" of the model area and to propose its regeneration. The results of the two previous aims have been used as a basis for the proposal, together with evaluation of the present condition. The bad condition of the scattered vegetation has been found out by the field survey, especially by the lack of maintenance and spreading of invasive plants.

landscape, developmental changes, scattered vegetation, soil moisture regime

Lately the interest for evaluation changes in landscape is rising. Results of such evaluation can be used in many branches of both science and practice, e.g. in landscape planning. This article combines a few methods of landscape evaluation – first evaluation of developmental changes in land use, then measuring of soil moisture with respect to agricultural use and in the end evaluation of present condition of scattered vegetation in landscape and their relation.

As the model area had been chosen University Agriculture Enterprise (UAE) in Žabčice (Fig. 1), on whose land Medel University of Agriculture and Forestry in Brno has the right to farm. Two groups of pieces of land had been chosen, on which different crop is produced and where quite a lot of scattered vegetation elements can be found, mostly in poor condition. One is called Niva, which means flood–plain, the second one U Trati, which means the location near railway. Chosen land plots are marked out by communications, western part of Niva by water course. Model area lies in cadastral areas of Žabčice and Nosislav and its area is 275 ha. It concerns open landscape without any built-up areas.

History of UAE is described in work of Žižlavská (2001) and on school web pages. Žabčice´s objects became an university grange on 1st July 1925 when Yard Žabičce with Poplužní Yard Oulehla were allotted to management of the University of Agriculture which pertained to the Habsburks in the Austro-Hungarian period. The original land area was 600 ha of farmland. After the realization of the land reform in 1927 only 394 ha remained. On 1 January 1964 the farmers´ cooperation Unkovice with a land area of 307 ha and the farmers´ cooperation Přísnotice in 1979 were assigned to the grange´s management. The land area of Agriculture Enterprise reached 1881 ha. About 280 ha of land were returned to original owners from 1991 so the state of farmland was



1: *Model area – part of UAE Žabčice*

1602 ha in 1999. In 2001 UAE Žabčice and UAE Lednice were joined up.

According to Culek (1995) model area belongs to north–pannonic biogeographical subprovince. The height above sea level defers from 178 m to 180 m in Niva and from 180 m to 185 m in the area U Trati. From the topography's point of view model area is the flat land. Quitt classifies the area as the warm area T4, which is the hottest in Czech Republic. Annual average temperature is 9.2 °C. The vegetation period has the average temperature 15.7 °C. The precipitation amount per year is 480 mm. The drought period begins in half of July and lasts to beginning of October, in some years the spring is typically dry.

The eastern part of model area lies in river flood–plain, where originally both rivers created meanders and many branches. Western part of the model area is made by graves sand terrace, covered by a thin (or medium thick) layer of loess. The soils in UAE Žabčice are neutral to slightly acid and with lack of humus. Different soil classes appear here – from sandy soils (mostly) to clay soils. In the whole model area we can find gley alluvial soils.

Potential vegetation (determination based on BPEJ and STG) would U Trati meet oak woods with privet and in Niva lime oak woods and hornbeam elm ash woods.

Open landscape without vegetation is threatened by drought winds, which cause wind erosion and connected damage of agriculture crop, increased amount of dust and worse microclimate.

MATERIAL AND METHODS

Evaluation of developmental changes in landscape

Several basic time profiles were needed to be chosen for evaluation of developmental changes in landscape from the ecological impact and sustainability of agriculture point of view. The first time profile chosen was the agriculture socialization period 1950–1960 when uniform agricultural cooperatives originated but their member land base was not stable yet and therefore often varied (Fig. 2). The second time profile is the period of the years 1970–1980 (Fig. 3). This period features formation of land blocks and forced merging of cooperatives by aggregation of several thousands hectares of land area. The aim was a maximum utilization of land fund for agricultural production. To a significant extent in this period a land image which exists at the present form was being created. The third profile is the period of the years 1990–2000 when in terms of restitution of agrarian land, the land was being returned into the hands of private farmers. The last time profile is the present state of landscape.

For the sequential comparison of land use changes it is possible to use the following underlays: archival aerial photographs, orthophotomaps, basic maps, cadastral maps, old maps, photographs and postcards. For evaluation of the historical state of agriculture landscape structure digitized aerial photographs (1953, 1976, 1990) of model area rendered by Military Geographical and Meteorological Office in Dobruška were used. In contrast to maps the aerial photograph is a wholly objective, unmistakable and exact document of the landscape state in a specific moment, inexact can be only our interpretation of its content. Further, historical maps, especially cadastral and data from Land registers were used. For analysis of the present state of landscape mapping of a select area (c. a. Žabčice) is needed in addition to up-to-date orthophotomaps (2003). The resulting data were obtained by the interpretation of ortophotomap which was verified and supplemented by mapping of present state of landscape.

2: *Aerial photograph of the year 1953*

3: *Aerial photograph of the year 1976*

The comparison of landscape development was elaborated by computer software ArcGIS 9.1. In this program land use categories in the particular years were compared by methods of comparative measuration of areas. For examination of the present land use production blocks of Land Parcel Identification System (processer – Ekotoxa Opava) were used. The area of particular land use categories in landscape with regard to land area of whole model area in hectares and further their percentage representation were found out. In the next part coefficient of ecological stability for a particular time period was calculated. The most suitable is calculation according to methodics of Agroprojekt of the year 1987, because as only one takes into account different interior quality of areas, their individual size, connectivity and mutual context and it can be used for comparison of the ecological stability in a time line in regard of differential quality and structure of areas in several historical time periods. It is possible to evaluate autoregulation ability of this landscape on the basis of determined K_{ES}.

K_{ES} ACCORDING TO METHODICS OF AGROPROJEKT (1987)

$$K_{ES} = \frac{1.5A + B + 0.5C}{0.2D + 0.8E}$$

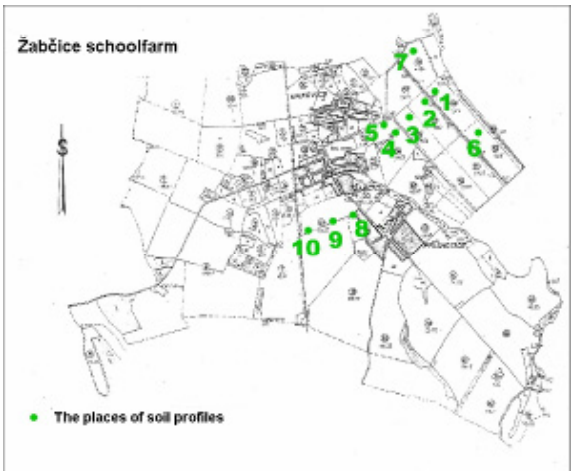
A = percentage of area with 5th quality grade (the best)
B = percentage of area with 4th quality grade
C = percentage of area with 3rd quality grade
D = percentage of area with 2nd quality grade
E = percentage of area with 1st quality grade (the worst, the least stable)

Landscape classification depending on values of a stated K_{ES}:

$K_{ES} < 0.1$	devastated landscape
$0.1 < K_{ES} < 1.0$	disturbed landscape with ability of autoregulation
$K_{ES} = 1.0$	balanced landscape
$1.0 < K_{ES} < 10.0$	landscape with prevalent natural element
$K_{ES} = 10.0$	landscape natural or to nature close

Soil moisture regime

The soil moisture regime in selected area of Žabičce schoolfarm in ten soil profiles was observed. Number of soil profiles was chosen (Fig. 4) according to the size of soil type area. The area of the soil type was determined according to the map of soil assessment.



4: *The grant model area with marked places of soil profiles*

The methodology was consulted with experts from Department of Agrochemistry, Soil Science, Microbiology and Plant Nutrition. The way of taking soil samples and working with them is based on methodics published by Jandák (2003) and Rejšek (1999).

The soil profiles sections was described in periodical intervals and the soil samples was taken from each

soil section for following physical analyses. The volume and specific weight and soil moisture were determined within physical characteristics. All physical characteristics were determined by analyzing soil sample which is taken by means of Kopecky cylinder (100 cm^3) from 10, 20 and 30 cm depth (Fig. 5). Soil moisture has been defined by gravimetric analysis (Fig. 6).

5: *Taking of soil samples*

6: *Saturation of soil samples*

From the results graphs and evaluation have been created.

The results of soil analyses were also compared with the data obtained from selected area in previous time. The data provided the Department of Agrosystems and Bioclimatology.

Classification of scattered vegetation in landscape

A short excursion in terminology in the field of vegetation in landscape is intermediated by Kolařík et al. (2003). Scattered vegetation "rozptýlená zeleň" is a term used in spatial planning and literature considering landscape formation and preservation, environment and so on. This term means individual woody species or their formations growing in the open landscape dispersed or scattered, both on arable or non–arable land, and which are not signed up as a forest or agriculture crop in real estate register and have different origin, spatial form, pattern, layout, species composition and so on. The term basically has the same content as the term nowadays used in legislation (Act No. 114/1992 Sb.) non–forest wood species "dřeviny rostoucí mimo les".

Before the proper classification started the discussion on the topic "what the function of the scattered vegetation and character of its particular element should be" went on with the director of University agriculture enterprise in Žabčice. Second step had been evaluation of the present condition of the scattered vegetation in model area by the field survey. According to the spatial structure and function the vegetation has been divided into particular elements, which has been classified. Characteristics that had been evaluated see in Tab. I:

I: *Characteristics evaluated for the landscape dispersed vegetation elements*

Shape of element	line
	point
	area
Character	trees with undergrowth
	grasses and herbs
Functional type	windbreaker
	attending path
	attending water stream
	attending architecture
	protection
	line of trees
	fallow
Cover density	tree layer
	shrub layer
	herb layer

Species	
Soil cover	
Silvicultural and health condition	1 – convenient
	2 – decreased
	3 – inconvenient
Age stage	young
	adult
	old
	different age stages
Suitability of species composition	1 – convenient
	2 – partly convenient
	3 – inconvenient
Spatial structure	1 – convenient
	2 – partly convenient
	3 – inconvenient

Functional type corresponds with the function, which the element should fulfill in the agrarian landscape. One element can fulfill more than one function.

Cover density is given in tens of %, the total is not 100%, the layers overlap each other. S – tree layer, K – shrub layer, B – herb layer.

Species composition is described with the shortcut of the specie's name and proportion in tens of %.

Soil cover is due to site character and species composition divided into five categories – Ruderal; Grasses and weeds – ley; Moisture like community; Mesophilic meadow; Xerophilic meadow.

Silvicultural and health condition 1 – convenient – guarantees long lasting appearance of the functional type on the site; 2 – decreased – means lack of care, in a part of an element some intervention is necessary; 3 – inconvenient – needs fast and big intervention like reclamation.

Suitability of species composition 1 – convenient for the functional type character and site condition; 2 – partly convenient, doesn't endanger the stability of the element, but needs a modification; 3 – inconvenient – endangers element's stability, skeletal species are missing.

Spatial structure 1 – convenient for the functional type; 2 – partly convenient, it is necessary to modify stratification or individual allocation; 3 – inconvenient – spatial structure needs to be newly formed.

According to the results of field survey, needs of University agricultural enterprise, nature condition and landscape character has been for particular elements developed principles of regeneration. The actions made has been divided into three stages

I – most urgent – stability or character of the whole element are endangered without any action, or the safety of people can be threatened

II – less urgent, connected with other actions – building houses or implementation of Spatial System of Ecological Stability

III – the least urgent, in marginal parts of University enterprise, where usually nobody comes, so the elements don't endanger anybody, but from the point of landscape character view they should be made.

RESULTS

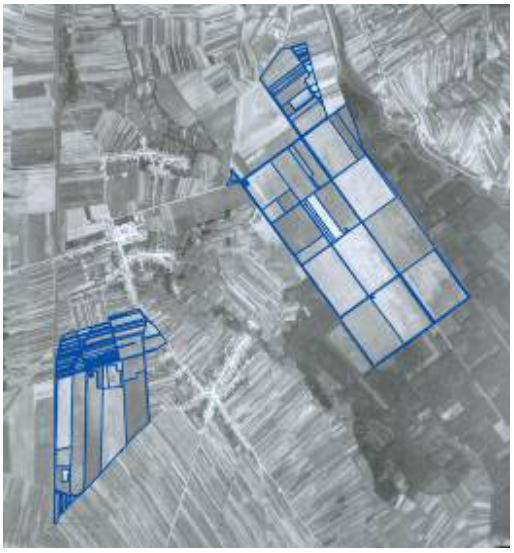
Evaluation of developmental changes in landscape

II: *Development of land use in select part of UAE Žabčice in years of 1953–2003*

categories	Land area in ha			
	1953	1976	1990	2003
pro tem devastated area	x	1.43	x	x
landscape vegetation	2.81	7.99	8.23	12.99
wetland ley	x	x	x	0.37
arable land	244.79	254.60	260.06	258.96
pastures	13.89	x	x	x
field orchards	1.11	1.50	x	x
rural roads	4.83	3.61	3.06	1.9
grasslands	7.13	4.81	2.84	x
water flows	1.21	1.83	1.58	1.55

III: *Development of land use in select part of UAE Žabčice in years of 1953–2003*

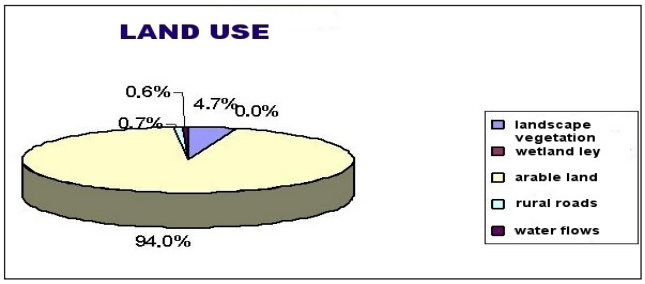
categories	Representation in %			
	1953	1976	1990	2003
pro tem devastated area	x	0.52	x	x
landscape vegetation	1.02	2.90	2.98	4.71
wetland ley	x	x	x	0.00
arable land	88.77	92.32	94.31	93.90
pastures	5.04	x	x	x
field orchards	1.75	1.31	1.11	0.69
rural roads	0.40	0.54	x	x
grasslands	2.58	1.75	1.03	x
water flows	0.44	0.66	0.57	0.56



7 and 8: *Measuration of areas of land use categories land use in the year 1953 and in the year 2003 – evident change in subdivision of land*

IV: *Development of ecological stability coefficient values in model area (according to Agroprojekt, 1987)*

	1953	1976	1990	2003
Kes	0.07	0.06	0.05	0.03



9: *Percentual representation of land use categories (2003)*

From the results presented in Tab. II and III and Fig. 10 and 11 it stands to reason that it is being evaluated the part of landscape whose structure of land use has not practically changed during last fifty years. The only expressive change was outplanting of monocultural windbreaks and completion of fruit trees alleys and decreasing a number of subdivisions of land (Fig. 7 and 8). This is caused by an intensive agricultural use of this area already since 19th century.

Because it is concerned an area where at the present the arable land forms almost 95% of all land (Fig. 9) it is not possible to expect a higher ecological stability there. In such an intensively used landscape the calculation of ecological stability can appear debatable. There has actually never been an ecologically stable, polyfunctionally used landscape in this solely agriculturally used area and its heterogenity was rather determinated by the continuous small – area agricultural management in the past.

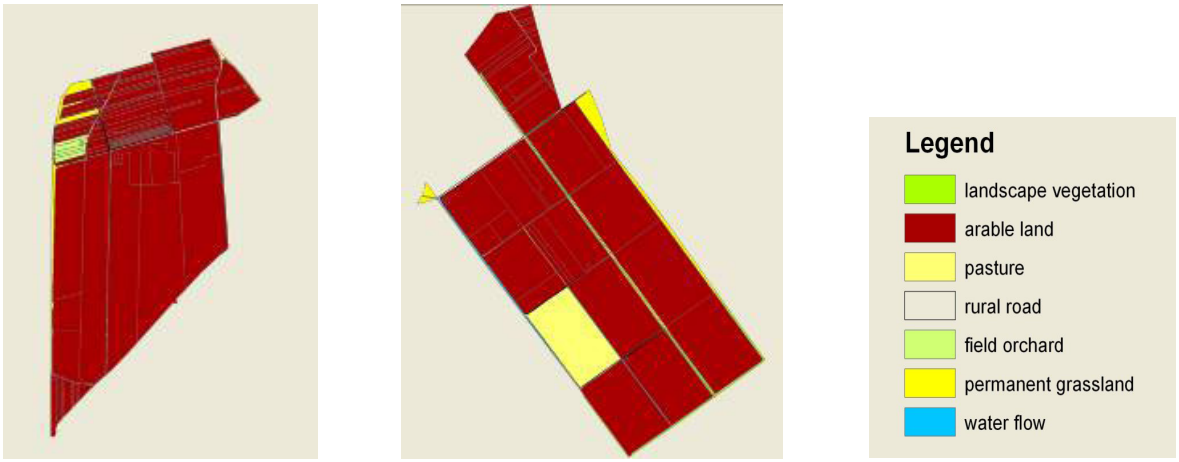
In spite of the fact the coefficient of ecological stability was calculated (Tab. 4) and even if these values showed to be lower than 0.1 in all years and therefore according to the Agroprojekt´s table it may be concerned a devastated landscape it is not possible to deduce a conclusion so unambiguously. On the orthophotomap showing the present landscape it is namely possible to see that particular areas covered by forests occur round about this labile and highly agriculturally used part of landscape and have a favourable effect on the mentioned labile parts and so increase the ecological stability of the whole landscape.

However in the table III it is possible to see that the coefficient of ecological stability declines from 0.07 to 0.03 that is why the ecological stabilization in this area such as restoration and outplanting landscape vegetation is needful. Therefore the hazard of wind erosion which in this area can be considered as significant might decline in this way.

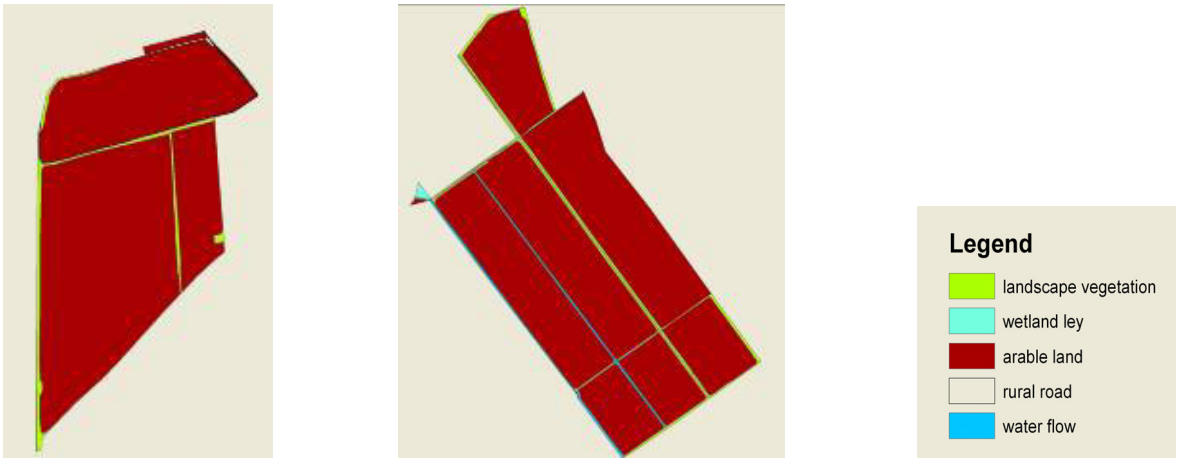
However it is not possible to expect any cataclysmally increasing values of the coefficient of ecological stability or a stability in this area not even after restoration and creation of new vegetation, because

the present trends of UAE Žabčice do not suppose that a decrease of arable land in this fertile area will occur. An improvement of the total physique of the model area by the proposal of vegetation restoration might be a compromise.

It is necessary to mention that during the work, inaccuracies in interpretation of archival aerial photograph´s contents may come into being, because like already it was brought up before the interpretation requires some experience. An important role is also played by a bad quality of digitized aerial photographs which can even be an inflictor of contingent numerical inaccuracies during the measuration.



10: *Land use of select area in the year 1953*



11: *Land use of select area in the year 2003*

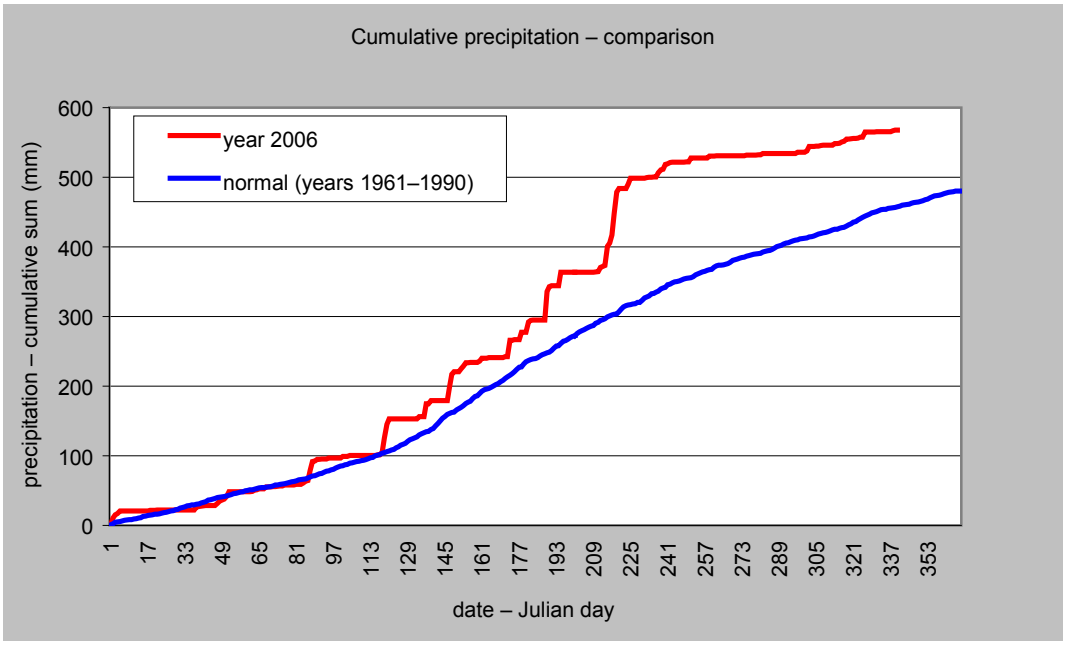
Soil moisture regime

The most of the soils in the model area is situated in zone of gley alluvial soils on floodplain deposits, middle-hard soils, without stone or lightly stony. The rest of soils in selected area is situated in zone of modal and carbon alluvial soils which are created on loess (30–70 cm depth), middle-heavy-textured soils, middle-arid, depending on precipitation in vegetation season.

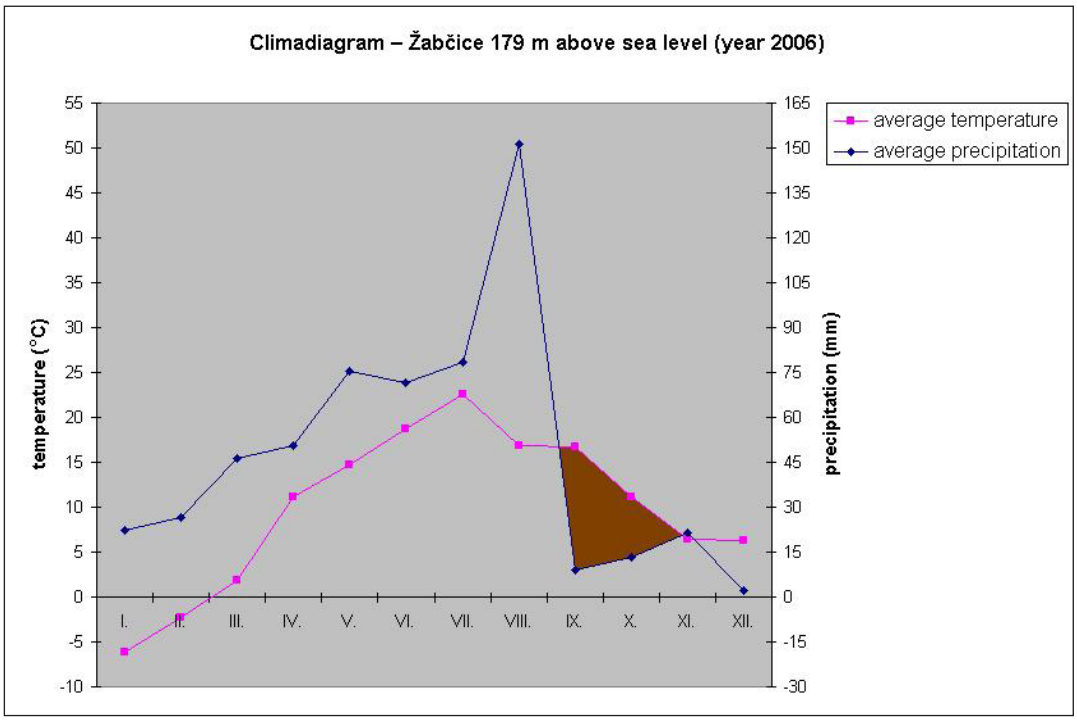
The first graph represents comparison between cumulative precipitation in year 2006 and normal (years 1961–1990). In Fig. 12 it is stated that precipitation in year 2006 is above normal.

The climadiagram of Žabčice was created from the data of precipitation and temperature in year 2006 (Fig. 13). The graph shows the drought period occurred in year 2006 even a lot of precipitation happened in first eight months period of that year. This drought period came after our research, so there are no results from that period. The drought period in Žabčice area at average comes up early in July and it takes till end of September.

Fig. 14, 15 and 16 show results of soil moisture and soil-moisture constants in 10 cm depth in May, July and September. Setting of the soil pits for the best mapping of different conditions of soil moisture impact was chosen.



12: *Comparison between cumulative precipitation in year 2006 and normal (years 1961–1990)*



13: *Year 2006 climadiagram, brown area is drought period*

Places of the soil pits:

The soil profile number 1 – cornfield nearby bushes

The soil profile number 2 – sunflower vegetation which was destroyed by flood

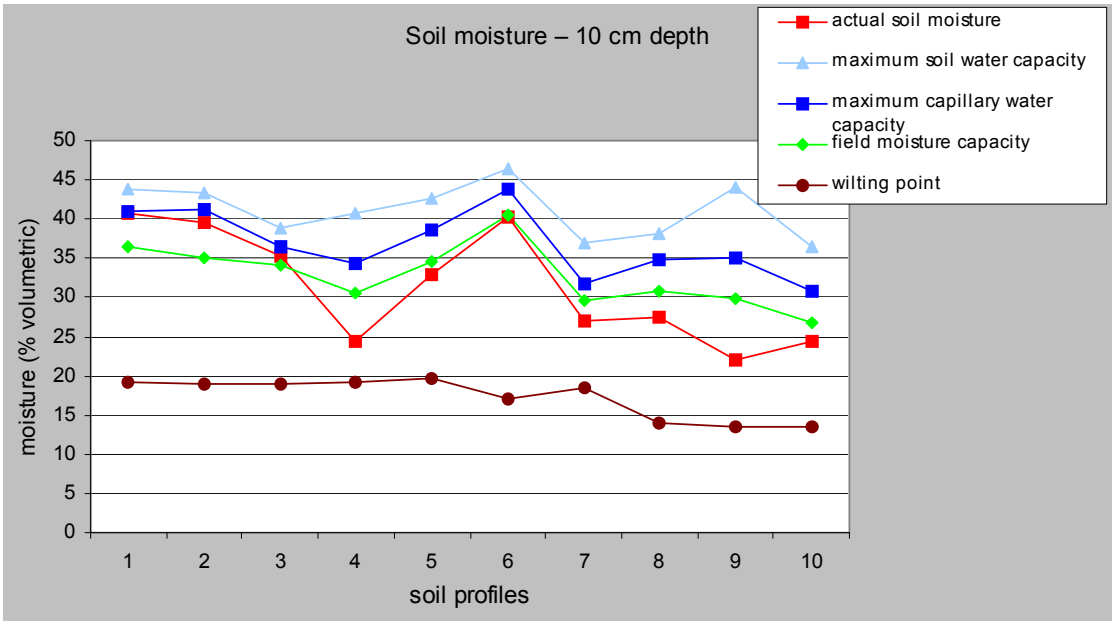
The soil profile number 3 – field of barley near fieldpath

The soil profile number 4 – grass plot near continuous outplanting of poplars and the river Šatava

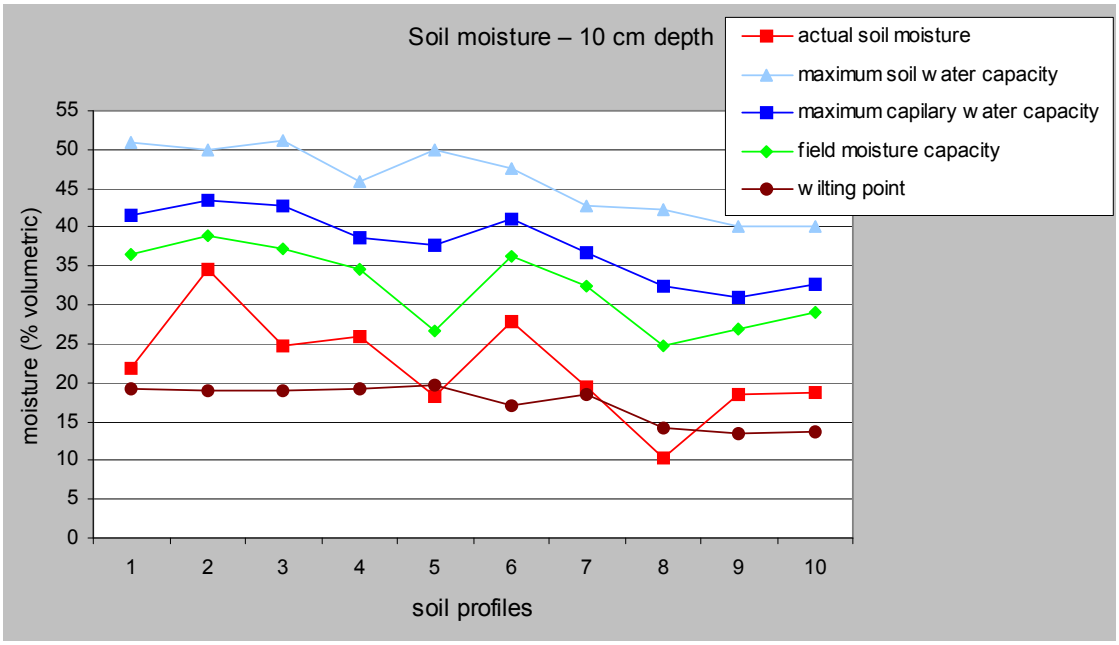
The soil profile number 5 – ley

The soil profile number 6 – cornfield by flood mound

The soil profile number 7 – field of Lucerne by the road



14: *Soil-moisture constants in 10 cm depth in May*

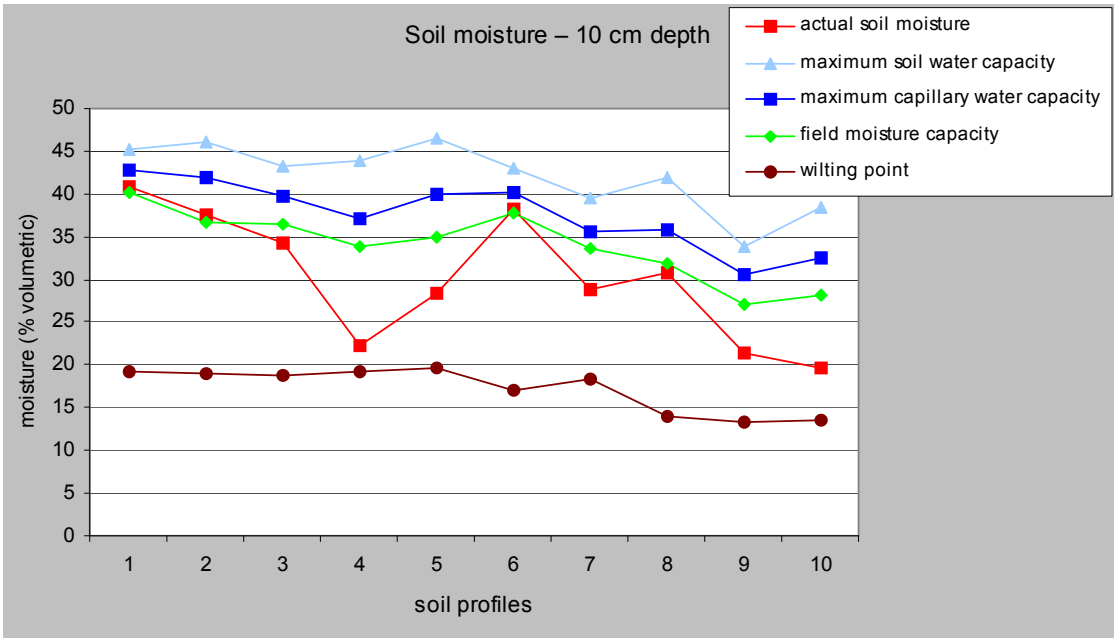


15: *Soil-moisture constants in 10 cm depth in July*

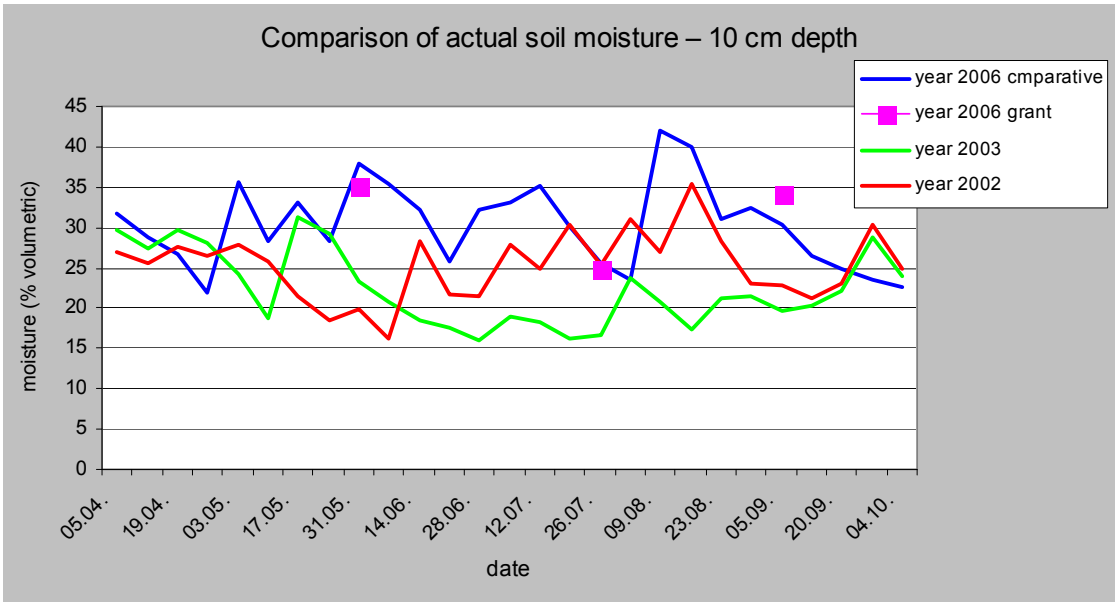
The soil profile number 8 – cornfield by the field-path
The soil profile number 9 – field of barley nearby alley
The soil profile number 10 – cornfield by the train route

The graph from May data shows that the soil moisture is in most cases in normal. The highest moisture was measured in soil pit number 6 and 2. Both places were by sight more wet, but the graph shows that the soil moisture in soil pit 6 is in normal too. The soil moisture does not exceed the soil field capacity. Only the soil pit number 2 has exceeding of the soil field capacity. This fact could be caused by the spring flood, which completely destroyed the vegetation. Lower soil moisture was found out in soil pit number 4 and 5. The soil pit number 4 had the soil moisture in 10 cm depth lower than more deeply. This fact could be caused by shallow-rooting grass plot and its taking of moisture.

Next graph shows the soil moisture found out in July. However there was a lot of precipitation in year 2006 and in that summer didn't come drought period, some soil profiles had soil moisture under the wilting point. Wrong holding capability of soil



16: *Soil-moisture constants in 10 cm depth in September*



17: *Comparison of results from soil pit number 3 (10 cm depth) with the results obtained in previous time (barley)*

brought on low moisture in soil pit number 5. Maize is highly water demanding and that caused poor soil moisture of soil pits 1 and 8. In most of soil pits was measured very low soil moisture in July. This moisture was actual soil moisture, which can waver during day period. Hence this fact is not alarming.

Third graph of measured results shows soil moisture in September. Taking of samples was done in the beginning of the month. Soil moisture was in norm for most of soil pits, because of a lot of precipitation in August. Only soil pits number 2, 4 and 6 had abnormal results. The soil pits number 2 and 6 had during whole research higher moisture due to alluded flood and also due to high level of groundwater. Only soil pit number 4 had very low moisture in all three depths. This abnormality could be caused by close continuous outplanting of poplars and their higher requests for moisture.

For results comparison have been decided to compare results in last ten years and particularly year 2002 (the wettest in last ten years) and 2003 (the driest in last ten years) have been chosen. The results obtained from that years comes just from one locality in area of interested. Because of this year 2006 was chosen for next comparison. The data for compari-

son have been provided by the Department of Agrosystems and Bioclimatology.

Fig. 17 shows comparison of results from soil pit number 3 with the results obtained in previous time. The grant measurement is almost similar to comparative measurement. The graph illustrates the year 2006 as dampest.

Development of the scattered vegetation in Žabčice surrounding

The area around Žabčice is according to Culek (1995) included to the old-settlement area, nowadays are in the usage dominant fields, grass and herb lay is rare, small forest are almost only acacia, in flood plains willow and poplar. Characteristic feature is large fields, orchards and partly vineyards. The original character of floodplains (woods, wet meadows and wetlands) has been changed by water utilization regulation.

The appearance of the model area changed from wet meadows and floodplain forests during baroque time through regulation of the rive Šatava and regular use and dividing of the forest to its change to arable land with regular structure in 19th century. In that time tree alleys along the paths played a great role.

Fruit tree alleys have a long tradition in University agriculture enterprise. When the university got the farm they were the only fruit trees survived the cutting in the time of sugar beet boom, as says Chmelař (1931). There have been alleys in the area of Niva (called Knížecí les that time). University agriculture enterprise focused on development of horticulture in the beginning, to give the example, how to decrease the sales crisis. For us the most important information is that the alleys have been plum and sustained like that (even in poor condition) until now (Fig. 18). To this problem Chmelař in 1935 says, that fruit trees along the paths had been planted circa 50 years ago and so were very old, not giving enough fruit. In autumn 1935 they had been supplemented with 186 plum trees and 155 trees more had been prepared to be planted. Numbers of trees had been 640 plum trees, 49 apple trees, 16 pear trees.

From the nowadays landscape character point of view another distinct characteristic (besides fruit tree alleys) of the intensively used agriculture landscape are lines of poplar windbreakers and lines attending water streams. Poplars have their treetops overgrown to each other and their big scale fits to the big consolidated fields. From the functional, operative and cost point of view this is going to be a characteristic unable to be kept. Anyway at least high tree vegetation shouldn't disappear. In the flat landscape around Žabčice, where the structure is not given by topography, trees visually break up landscape to visually enclosed areas. Especially Niva is visually enclosed – landscape of wide horizons and high sky opens up to south of Žabčice.

18: *Almost monumental character have the fruit tree alleys even today – straight, continual and hard line rising up from cultivated flatland*

Present condition of the scattered vegetation

There have been evaluated 38 elements of scattered vegetation in the model area, 33 of them lines, 4 areas and 1 point. The elements had both woody and herb species character, the criteria has been continuing fixation of the functional type on the spot and different use than arable land.

If we summarize evaluation done for all vegetation elements, majority of them are in decreased silvicultural and health condition and partly convenient suitability of species composition and spatial structure, as the balance tables (Tab. V, VI and VII) show:

V: *Balance of silvicultural and health condition of the vegetation elements*

	SILVICULTURAL AND HEALTH CONDITION			Total sum
	1	2	3	
Total	9	16	13	38

VI: *Balance of suitability of species composition of the vegetation elements*

	SUITABILITY OF SPECIES COMPOSITION			Total sum
	1	2	3	
Total	5	24	9	38

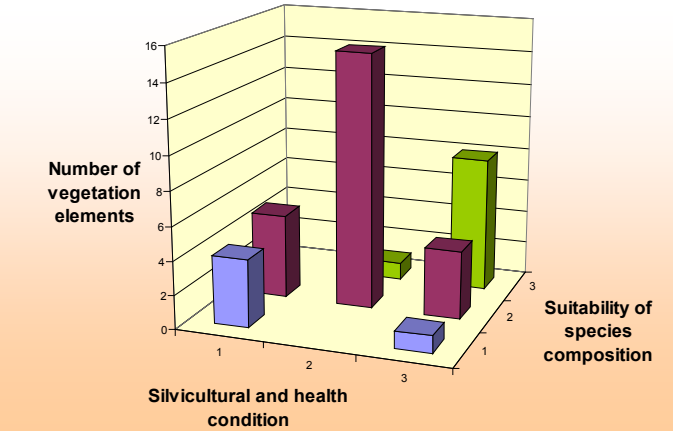
VII: *Balance of spatial structure of the vegetation elements*

	SPATIAL STRUCTURE			Total sum
	1	2	3	
Total	7	30	1	38

There are many of self-seeding woody species in the vegetation elements (*Robinia pseudoacacia, Acer negundo, Prunus cerasifera*). Fruit trees generally show decreased silvicultural and health condition and especially along the paths spread myrobalans, which are able to overgrow and extinguish everything. If suitability of species composition and silvicultural and health condition of vegetation elements are compared, the correlation between partly convenient species composition and decreased silvicultural and health condition can be seen (Tab. VIII, Fig. 19). It indicates mainly not maintained element, where unnatural species composition is not able to prevail against competition of self-seeding woody species or fruit trees survive without men's care.

VIII: *Balance of suitability of species composition and silvicultural and health condition of the vegetation elements*

Silvicultural and healt condition	SUITABILITY OF SPECIES COMPOSITION			Total sum
	1	2	3	
1	4	5	0	9
2	0	15	1	16
3	1	4	8	13
Total sum	5	24	9	38



19: *Balance of suitability of species composition and silvicultural and health condition of the vegetation elements*

Comparison silvicultural and health condition to a functional type of the vegetation element showed, that in the worse condition are vegetation elements attending paths and in the best condition are those attending water streams (Tab. IX). The fact is that they are both the most often being found in the model area.

IX: *Comparison of functional type and silvicultural and health condition of vegetation element*

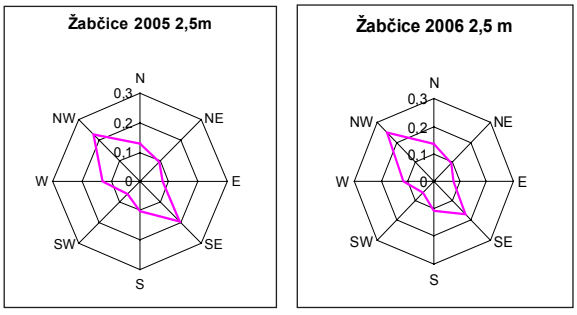
Functional type	SILVICULTURAL AND HEALTH CONDITION			Total sum
	1	2	3	
Attending path	0	4	7	11
Attending water stream	4	6	4	14

The reason probably is the relation to the species composition, as mentioned above. It is more natural in vegetation elements attending water streams so it can better stand lack of maintainance and shows better silvicultural and health condition. Health condition of vegetation elements attending paths is made worse by dead or dying fruit trees, which are overgrown by myrobalans and can't prosper without care (myrobalans make inconvenient spatial structure and are not desirable species structure).

This qualitative analysis of present condition had been the basis for developing principles of regeneration of existing vegetation elements or setting new ones. In the frame of functional point of view the principles take into account the possibility of having positive impact on moisture regime of soils, especially by decreasing wind flow. From the landscaping point of view the scattered vegetation should positively appear in character of the whole area and should respect local landscape character.

Principles for regeneration of vegetation elements

From the wind roses on Fig. 20 and 21, made on Academy of sciences from data got on agrometeorological stand in Žabčice belonging to MUAF 2,5 m above the ground, can be seen, that the curve of the sum of wind directions is similar in both years 2005 and 2006. Only in 2006 majority of wind had northwest direction against southeast, during 2005 the proportion was more ballanced.



20 and 21: *Dominant wind directions in Žabčice 2,5 m above the ground in years 2005 a 2006. Academy of sciences.*

From these two most often distributed wind direction result, that the most effectual barrier against wind would be the northeast – southwest direction. This is even the direction of shorter "transverse" paths in Niva and approximately poplar tree row near the railroad. Keeping vegetation on these lines, eventually establishing new ones seems to be very desirable.

Within solving the project have been worked for developing principles of regeneration with pruning away particular individuals in vegetation elements, making treatment on individuals left, planting new individuals or complete replacement of the whole element.

From the Tab. X can be seen that in the model area is one vegetation element, where cutting some individuals and treatment others is proposed. It is a part of a dike around Niva, where spontaneous growing of alder and ash can be presumed. For 8 elements cutting some individuals and planting new ones is proposed. The individuals to be cut are dead ones, those unfitting to composition or invasive species, the element is to be completed stepwise. For 7 elements is together with cutting and planting proposed treatment of some individuals. For one element is proposed only treatment – it goes about two trees standing together with the crosslet by the field path. Only planting is proposed for 4 elements – those are elements without woody vegetation by now and have potential for its replenishing.

Complete replacement is proposed for 7 elements. It means removing of the whole stand and planting a new one on the place of the old one. Those are the lines of plum trees and apple trees in Niva. One of the reasons is requirement of the School farm – get rid of myrobalans, which are growing out from the rootstocks.

No action is proposed for 10 elements. Either there is no space for taking a piece of land (it is used for agriculture) or they are in condition convenient for their function and they can be left to the care of nature.

In the first regeneration stage the replacement of vegetation elements attending paths, which are overgrown by myrobalans, and partly elements attending water stream, where died all the ash trees (most of the trees) – together 11 vegetation elements. In the second stage the regeneration will affect 15 elements, which are supposed to be still functional for some time. Regeneration of 2 elements is proposed in the third stage, vegetation attending water stream and dike, which are in so marginal and inapproachable parts of School farm, that there is no need to hurry with regeneration. On the other hand, they are visually connected with Niva and are part of landscape picture, so it will be loss to leave it without regeneration at all.

From the historical point of view would be desirable to renovate plum tree alleys, but to fulfill

the functional and economical needs (maintenance demanding as little as possible and small shade on agricultural land) the School farm requires low non-fruit tree species or shrubs. Low non-fruit tree species could be the acceptable compromise, anyway for formatting this landscape rentability has been always important and if today fruit trees are not profitable, there is no value in keeping them artificially in the production area.

X: *Principles of regeneration of particular vegetation elements*

Element	Functional type	Stage	Principles of regeneration of vegetation elements			
			Cutting off some individuals	Treatment	Planting	Complete replacement
A1	attending path	II	X	X	X	
A2	protection	II			X	
A3	protection	II	XXX			
A4	attending water stream					
A5	attending architecture	II		X		
A6	attending railroad, protection	II	X	X		
A7	line of trees, windbreaker	II	X	X	X	
A8	protection					
A9	attending path, protection					
A10	fallow	II			X	
A11	fallow	II			X	
A12	attending path	II			X	
B1	mowed fallow					
B2	attending water stream, windbraker	II	X	X		
B3	attending water	I	X	X		
B4	attending water	I	X	X		
B5	attending water and dike	II				X
B6	attending water					
B7	attending path, windbreaker	I				X
B8	attending water					
B9	attending water and dike	II				X
B10	attending path	I	X	X	X	
B11	attending water stream and path	I	X	X	X	
B12	attending path					
B13	attending path	I	X	X	X	
B14	attending path and ditch	I				X
B15	attending path	I				X
B16	attending path and ditch	I				X
B17	attending path	I				X
B18	attending water and dike					
B19	attending water and dike	II	X	X		
B20	attending water and dike	II	X	X	X	

Element	Functional type	Stage	Principles of regeneration of vegetation elements			
			Cutting off some individuals	Treatment	Planting	Complete replacement
B21	attending dike	II	X		X	
B22	fallow					
B23	windbreaker	I	X		X	
B24	fallow					
B25	attending water	II	X		X	
B26	attending water, fallow	II	X		X	

DISCUSSION

To the importance of scattered vegetation in landscape brings Bieber (1998) forward three values – first role for preserving biodiversity both for plants and animals, second economic value and third landscaping value. In the relation with environment moisture characteristics is as a positive effect of vegetation given decreasing evapotranspiration – both evaporation and transpiration are rising with the air temperature and its movement, with lowing the wind speed by the vegetation elements they are decreasing. Concerning moisture of soil in the spring can the soil nearby the vegetation elements get partly dry, because of their intensive growth.

As well Trnka (2000) assigns lossmaking production on the windward side of the windbreaker, even to the 1.5 multiple of it's height by the reason of competition of woody species on moisture and nutrients and the unfavourable effect of shade. Anyway the loss is compensated by increased production on leeward side up to 12 multiple of its height.

Soil analyses done in the project tried to discover as well this fact. From the soil samples numbers 1, 4 and 9 were taken from the very close of tree vegetation elements. 1 – near the path through Niva with the line of myrobalan; 4 – near the line of poplars along Šatava; 9 – near the line of poplars along the path near railroad. Theoretically these samples should have the lowest actual soil moisture (in %), because water is more taken by trees.

When looking at comparing tables can be seen, that it is not true for sample No. 1; samples No. 4 and 9 show in all three take-offs lower rate of soil moisture. It can be done by taking the samples immediately next to well grown poplars, which are extremely demanding on water need. From the agriculture production point of view using poplars in the close contact with arable land is not suitable.

XI, XII, XIII: *Comparing tables of actual soil moisture (%) for May, July and September*

May	actual soil moisture		
sample No.	10 cm	20 cm	30 cm
1	40.69	38.45	35.42
2	39.60	42.42	36.90
3	35.23	33.67	33.33
4	24.46	26.79	28.35
5	32.93	33.94	24.19
6	40.30	38.45	36.23
7	26.99	26.89	27.09
8	27.42	27.14	26.35
9	22.00	28.64	24.57
10	24.30	24.73	25.54

July	actual soil moisture		
sample No.	10 cm	20 cm	30 cm
1	21.76	20.33	22.01
2	34.52	35.01	32.94
3	24.85	23.41	19.23
4	25.87	24.46	25.46
5	18.26	17.34	15.31
6	27.80	24.64	24.47
7	19.50	18.40	19.55
8	10.35	11.04	11.88
9	18.50	19.04	16.19
10	18.72	17.56	17.05

September	actual soil moisture		
sample No.	10 cm	20 cm	30 cm
1	40.72	37.20	36.43
2	37.59	40.33	36.26
3	34.34	38.24	34.66
4	22.16	21.10	20.09
5	28.45	29.12	28.68
6	38.19	38.96	39.23
7	28.84	29.13	28.41
8	30.74	35.64	30.40
9	21.43	22.01	23.07
10	19.73	20.87	21.24

Of course poplars have been traditionally used for planting windbreakers. Problem of present condition of windbreakers and possibilities of their regeneration on south Moravia have been solved in VÚMOP or AGROPROJEKT for example. According to Macků (2005) nowadays dying of poplars (building the core of the windbreaker) can be observed. So in species composition it is necessary to prefer other longer living species, eg. oak, lime and maple. To have the windbreaker function even in winter can be

considered pine-tree. So that the windbreaker functions well, it should be composed from 6–8 rows of trees and 4 rows of shrubs.

Such a big dimension is not usable in model area, despite here the single row plantings should be replaced (vegetation attending path, water stream and dike). When keeping talking about narrow, single row plantings, as the most effective against the wind erosion Bieber (1998) considers semipermeable line, where the effect of decreasing the wind speed and strength can be 10–20 multiple of the line height.

The problem in effectiveness of the windbreaker is also the same age and usually the only specie survived in the planting and so the loss of function comes in the whole windbreaker in the same time. So it is important if possible to use different kinds of species with different dynamic of growth, or to recover the line in steps, thin it a little bit and plant new individuals. This method is also proposed in model area.

CONCLUSION

The aim of the before described project was an evaluation of developmental changes in land use and their effects on the function and stability of rural landscape in model area of the University Agriculture Enterprise in Žabčice belonging to Mendel University of Agriculture and Forestry in Brno. Taking of soil samples from selected area for detection of soil moisture, physical analyses, graphics processing and evaluation was another aim. Soil moisture is crucial for plants growth and the height of production. In model area it is decreased mainly due to soil drying wind. Based on the results of soil and land-use changes analyses, analyses of the present condition and detailed field survey of vegetation elements have been evaluated the structure of scattered vegetation in landscape on the land of University Agriculture Enterprise and its function from the landscape-ecological point of view.

These methods have been used for the problem solution

For the comparison of developmental changes in land use of the landscape map underlays in a digital form which were worked with in program ArcGIS 9.1 were used. In this program land use categories in selected years were compared by methods of comparative measuration of areas. Coefficients of ecological stability according to methodics of Agroprojekt, 1987 were calculated in particular years to evaluate of the stability and autoregulation ability of this landscape.

The way of taking soil samples and working with them is based on methodics published by Jandák (2003) and Rejšek (1999). The soil profiles sections was described in periodical intervals and the soil samples was taken from each soil section for following physical analyses. The volume and specific weight and soil moisture was determined within physical characteristics. Soil moisture was defined by gravimetric analysis.

Based on the field survey classification of particular elements of scattered vegetation have been done (with accent on functional type, species composition, silvicultural and health condition, suitability of species composition and spatial structure). Combining results from classification, needs of University Agriculture Enterprise, nature condition and landscape character have been for each vegetation element proposed principles of regeneration – ways of treatment have been specified and divided into three stages, according the urgency.

The results got during solving the project can by shortly summarized

In the select area there especially occur areas of long term and permanently used as arable land. It deals with the area of a stable agricultural use (mainly as arable land) and consequently with existence of a high anthropic press throughout all the historical period.

The expressively low intensity of changes in this area is caused by the unimpeded functioning of the local agriculture enterprise and agrarian support of MUAF Brno.

Understanding of the dynamic historical development of cultural landscape and the particular structural parts of landscape is essential for its present ecological stability. “The memory of landscape” which respects the old age and length of duration of individual landscape structures should not be missed out during the mapping of landscape and proposing of the territorial system of ecological stability.

The results of measurement and climadiagram demonstrate that the year 2006 was the richest in precipitation. The soil moisture in all ten soil profiles wasn’t alarming neither from results of measurement nor visually. Taking of soil samples was delayed by spring flood. Impact of flood was also evident on the results from soil pits number 2 and 6. However there was a lot of precipitation in vegetation period 2006, almost all soil profiles showed decrease of soil moisture during tropical days in July. But this decrease wasn’t critical. The drought period in Žabčice area at average comes up early in July and it take till end of September. In year 2006 the drought period was moved to the end of September and took almost two months. The drought period didn’t influence results of research.

In the model area have been classified 38 scattered vegetation elements, most of them lines attending paths and water streams. 29 elements are in decreased or inconvenient silvicultural and health condition, 33 elements have partly convenient or inconvenient species composition and 31 elements have partly convenient or inconvenient spatial structure. The condition is in relation with species composition in the way that elements with inconvenient species composition are also in inconvenient silvicultural and health condition. According to the func-

tion in the worse silvicultural and health condition are elements attending paths, where is none in convenient condition. Regeneration of these elements is proposed in first, most urgent stage of regeneration. There are 11 elements, for which doing no action endanger stability or character of the element.

Decreasing condition or disappearing scattered vegetation elements can affect not only ecological stability of the whole area, but also rate of soil moisture, because the vegetation lines attending paths positively effect decreasing wind speed and by this enable soil draining. Keeping and regeneration of the vegetation elements is therefore desirable.

This article could be written thanks to support from Internal Grant Agency MUAF to a project IGA no. 3/2006 Landscape Area Optimizing Analysis at the University Agriculture Enterprise in Žabčice. Project have been focused on landscape-ecological research of changes in rural landscape structure and it's ecological stability, which is one of the basic in the Department of Applied and Landscape Ecology, and worked up topics of thesis of all three executers.

SOUHRN

Analýza historického vývoje, vlhkostního režimu půdy a rozptýlené zeleně v krajinném prostoru ŠZP Žabčice

Cílem popisovaného projektu bylo na modelovém území Školního zemědělského podniku v Žabčicích zhodnotit změny ve využití krajiny a jejich důsledky pro funkčnost a stabilitu zemědělské krajiny (land-use) v retrospektivních časových řezech. Dalším cílem bylo odebrat z modelového území půdní vzorky ke zjištění vlhkostních charakteristik půdy, jejich fyzikální rozbor, grafické zpracování a vyhodnocení. Získané výsledky dále porovnat s výsledky měření půdní vlhkosti v minulých letech. Na podkladě získaných výsledků, rozboru současného stavu a důkladné inventarizaci stávajících vegetačních prvků byla vyhodnocena struktura rozptýlené zeleně v krajině na pozemcích ŠZP a její funkčnost z krajinně-ekologického hlediska.

Výrazně nízká intenzita změn v řešeném území ŠZP Žabčice je zapříčiněna nepřerušeným fungováním místního zemědělského statku (dříve družstva) ve venkovské krajině, která není vystavena tlakům na nezemědělské využívání, ale naopak je podporována Mendelovou zemědělskou univerzitou.

Výsledky měření i samotný klimadiagram ukazují, že rok 2006 byl za posledních deset let a také oproti normálu (roky 1961–1990) srážkově nejbohatší. Samotné odběry půdních vzorků byly zdrženy díky jarní povodni, jejíž vliv byl patrný i na výsledcích sond číslo 2 a 6. I přes srážkově bohaté vegetační období se v měsíci červenci v době trvání tropických dní téměř u všech sond projevilo snížení půdní vlhkosti, které ovšem nebylo nijak kritické.

V řešeném území bylo hodnoceno 38 prvků rozptýlené zeleně, v nichž převládaly liniové doprovody cest a vodních toků. U 29 prvků byl vyhodnocen zhoršený nebo nevyhovující pěstební a zdravotní stav, u 33 prvků ne zcela vyhovující nebo nevyhovující druhové složení a u 31 prvků ne zcela vyhovující nebo nevyhovující prostorová struktura. Zhoršení stavu či zánik prvků rozptýlené zeleně ovlivňuje nejen ekologickou stabilitu řešeného území, ale také hodnoty půdní vlhkosti, neboť liniová zeleň podél cest působí pozitivně na snižování rychlosti větru a tím zabraňuje vysoušení půdy.

krajina, vývojové změny, rozptýlená vegetace, vlhkostní režim půd

REFERENCES

BIBER, J. P., 1988: *Hedges*. Planning and Management Series, No. 1. Strasbourg: Council of Europe. 64 s. ISBN 92-871-1511-7.

CULEK, M., 1995: *Biogeografické členění české republiky*. Praha: ENIGMA. 347 s. ISBN 80-85368-80-3.

Historie ŠZP Žabčice. [cit. 2006-24-06] <http://old.mendelu.cz/~szp/historie.html>

CHMELAŘ, F., 1931: *Zpráva o činnosti Žabčického školního závodu zemědělského v letech 1925–1929*. Zprávy Žabčického školního závodu zemědělského Vysoké školy zemědělské v Brně. Číslo 1. Brno. Archiv MZLU v Brně.

CHMELAŘ, F. 1935: *Zpráva o činnosti Žabčického školního závodu zemědělského v roce 1934*. Zprávy Žabčického školního závodu zemědělského Vysoké školy zemědělské v Brně. Číslo 6. Brno. Archiv MZLU v Brně.

JANDÁK, J. a kol., 2003: *Cvičení z půdoznalství*. Brno: MZLU. 92 s. ISBN: 80-7157-733-2.

KOLAŘÍK, J. a kol., 2003: *Péče o dřeviny rostoucí mimo les, I. díl*. Metodika ČSOP č. 5. Vlašim: ČSOP. 261 s. ISBN 80-86327-36-1.

KOLEKTIV, 1969: *Školní statek Žabčice*. Informační zpráva o školní statku Žabčice, vydaná u příležitosti 50. výročí založení Vysoké školy zemědělské. Brno: VŠZ. Archiv MZLU v Brně.

LIPSKÝ, Z., 2000: *Sledování změn v kulturní krajině*. Ústav aplikované ekologie ČZU, Kostelec nad Černými lesy. 71 s. ISBN: 80-213-0643-2.

LIPSKÝ, Z., 1999: *Krajinná ekologie pro studenty geografických oborů*. Karolinum, Nakladatelství Univerzity Karlovy, 129 s. ISBN: 80-7184-545-0.

MACKŮ, J., 2005: Větrolamy versus biokoridory. In: *ÚSES – zelená páteř krajiny, sborník k semináři*. Brno: AOPK. s. 55–65. ISBN 80-86064-85-9.

MÍCHAL, I., 1994: *Ekologická stabilita*. Veronica a MŽP ČR, 275 s. ISBN: 80-85368-22-6.

PODHRÁZSKÁ, J., 2006: *Projektování pozemkových úprav*. MZLU v Brně, 215 s. ISBN 80-7375-011-2.

REJŠEK, K., 1999: *Lesnická pedologie – cvičení*. Brno. MZLU. 152 s. ISBN: 80-7157-352-3.

ROŽNOVSKÝ, J., SVOBODA, T., 1995: *Agroklimatická charakteristika oblasti Žabčic*. Folia, řada A. Brno: MZLU. 49 s.

TRNKA, P., 2000: Ekologický a estetický význam liniové zeleně – větrolamy a živé ploty. In *Obnova liniové zeleně v krajině, Sborník přednášek ze semináře*. Brno: MZLU. s. 80–87. ISBN 80-7157-438-4.

ŽIŽLAVSKÁ, S., 2001: *Školní zemědělský podnik Žabčice v letech 1925–2000*. MZLU v Brně, 28 s.

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