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Effect of Water Features Proximity on Farmland Prices in a Landlocked Country: the Consequences for Planning

*Pavel SEKÁČ, Miroslav ŠÁLEK, Alena WRANOVÁ, Peter KUMBLE and Petr SKLENIČKA**

Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Prague, Czech Republic

**Corresponding author: sklenicka@fzp.czu.cz*

Abstract

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Conversion of farmland to non-farm uses significantly influences the spatial variability of farmland prices. We tested 12 factors of land prices that experienced real estate brokers indicated to be the most important determinants for the conversion of farmland to non-agricultural use. Five factors can be described as landscape, four as geographic, and three as climatic explanatory variables influencing farmland prices. Our results indicate that the two most powerful factors in explaining the sales price per square metre were proximity to a river and proximity to a lake. In both cases, the price of land diminished significantly with the increasing distance from the edge of water bodies, so the prices in their immediate vicinity are 3.5 to 3.7 times higher than the prices of similar lands more than 5 km from the edge of a water body. The other significant factors were population size of the nearest municipality and percentage representation of forest. The fact that the two most powerful factors indicate the distance to a river, brook, lake or pond shows how important are these freshwater features as determinants of farmland prices in a landlocked country such as the Czech Republic, where this study was performed. The consequences of this finding for water resources planning and management are discussed.

Keywords: agricultural land value; land market; land development; water resources planning; real estate

Prices of farmland are determined by a number of not only agronomically important factors, such as soil quality, water availability, distance from a farm, land tenancy, etc., but also increasingly by prospects for future land development (Plantinga & Miller 2001; Sklenicka *et al.* 2015). A number of non-agricultural attributes associated with farmland support the speculative character of transactions wherein the buyer intends to develop the land, most frequently for commercial, residential or recreational purposes, and is willing to pay a premium to obtain the farmland. Barnard (2000) determined that non-agricultural factors account for approximately one-quarter of the average market value of the U.S. farm real estate.

The most frequently mentioned characteristics of farmland real estate affecting conversion to non-agricultural uses are proximity to a settlement (Guiling *et al.* 2009), distance to a metropolitan area (Naydenov 2009; Sklenicka *et al.* 2013), soil quality and parcel size (Sklenicka *et al*. 2009; Zeithaml *et al*. 2009), quality of the infrastructure and accessibility (Stewart & Libby 1998), and size of the adjacent settlement or local population (Guiling *et al*. 2009). These factors generally support all of land uses for future non-agricultural purposes whether they are residential construction, recreational purposes, or commercial construction.

In addition, there are a number of additional characteristics that describe amenities sought by those interested in land for recreational purposes and which support traditional or less traditional recreational activities. In this sense, factors affecting the quality of the environment can also be of great importance. Attributes characterizing the levels of water and air

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pollution are mentioned the most, while soil less frequently. Feenberg and Mills (1980) pointed out that environmental pollution control has both primary and secondary benefits, if evidence suggests serious diseases to be linked with the quality of environment.

The attractiveness of an area for recreation or residential development is also determined by climatic characteristics. Their influence cannot be generalized, as this differs for summer vs winter recreation, but it will differ also according to geographic position and other factors (e.g. Horna 1995). Mieczkowski (1985) was among the first to apply general climatic findings about human comfort to the specific activities related to recreation and tourism. Perry (2000) confirmed that changes of temperatures and precipitation due to overall climate change were of a great importance for tourism in the Mediterranean region. Mieczkowski (1985) proposed an equation for calculating a tourism climatic index for outdoor recreational activities, which includes such variables as temperature, amount of sunshine, amount of precipitation, and wind characteristics. Amelung and Viner (2006) subsequently confirmed the influence of this index in both negative and positive respects.

Land prices are also determined by factors emphasizing landscape characteristics. Such characteristics include e.g. the presence of water features like a river, stream, lake or pond (Acharya & Bennett 2001; Jennings 2007), distance to forest or its proportion in a the vicinity of a parcel (Pukkala *et al.* 1995), value of wildlife habitats or natural resources (Mittenzwei *et al.* 2010), scenic value of the surrounding landscape, or attractive views of the landscape (Mooney & Eisgruber 2001). Practical valuation of a scenic view is mentioned by Goetgeluk *et al.* (2005) in a case wherein the seller of a large property divided it into several smaller ones so that all would have a lake view preserved. In maritime countries, the distance from the seaside or important shore sites as harbours and beaches cannot be overlooked (Rush & Bruggink 2000).

The goal of this study was, in cooperation with experienced real estate brokers, to identify the factors relevant to farmland conversion for recreational purposes and to test their influence on the spatial variability of land prices at the parcel scale in a landlocked country with a rugged topography, in this case the Czech Republic. The secondary goal of this study was to interpret how the findings might impact courses of action made by local and state decision makers within the context of water resources and landscape planning policies.

MATERIAL AND METHODS

Data collection. To collect data, we cooperated with 17 real estate agencies operating in all of the fourteen regional administrative units of the Czech Republic. The dataset used in this study included all transactions carried out by these 17 agencies during 2012 in which just one parcel or a group of adjoining parcels was sold. In the non-included transactions, the price reflected various characteristics of the parcels sold, and it would therefore have been impossible to determine the influence of individual factors. All transactions included in the sample took place between a willing buyer and a willing seller. There were no distress sales or transactions between co-owners, as all these circumstances could influence the price in manners which would be difficult or impossible to assess.

The dependent variable in our study was Farmland Price (CZK/m^2). The selling prices were determined from 296 transactions executed during 2012 throughout the Czech Republic. The collected data was evenly distributed across the country (not locally concentrated) in order to represent the entire range of its natural and socio-geographic heterogeneity.

Twelve price predictors for these parcels were chosen for further analysis, of which five can be described as landscape-amenity, four as geographic, and three as climatic explanatory variables in relation to farmland prices. Seventeen experienced real estate brokers contributed to their a priori selection, such that only those amenities which according to their professional opinion most affect the recreational attractiveness of an area were selected. These factors, their data type, data sources, means, and ranges are presented in Table 1.

By overlaying the cadastral map with current orthophotomaps and working within the GIS environment (Arc GIS 9.2), the variable Lake Proximity (LAKE) was determined as the shortest direct distance between the edge of a given parcel and the nearest lake (minimum area of 1 ha) or pond. The variable River Proximity (RIVER) was measured in an identical way, as the shortest distance between the edge of a parcel and a river or stream embankment (all parcels in the flood zone of a river where construction is prohibited were excluded). We also calculated the variable Forest Percentage (FORPERC)

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Table 1. Description of explanatory variables used in the study

Variable	Abbreviation	Data characteristics	Data source	Data mean (range min–max)
Landscape variables				
Lake proximity	LAKE	shortest distance from edge of parcel to bank of nearest lake or pond (km)	orthophotographs, maps of the Office for Surveying, Mapping and Cadastre	4.1 (0.1–13.5)
River proximity	RIVER	shortest distance from edge of parcel to bank of nearest river or stream (km)	orthophotographs, maps of the Office for Surveying, Mapping and Cadastre	3.7 (0.1–13.0)
Forest percentage	FORPERC	percentage of forest in a 10 km range from the parcel (%)	orthophotographs, maps of the Office for Surveying, Mapping and Cadastre	28.0 (2.0–68.0)
Landscape protection	PROTECT	legal protection for nature or landscape at parcel location (yes/no)	database of the Ministry of the Environment	yes = 67 no = 219
Scenic value of landscape	SCENIC	classification of landscape scenic value (increased/average/decreased)	typology of scenic value of landscapes of the Czech Republic according to Mu-ransky and Nauman (1980)	increased = 79 average = 170 decreased = 37
Geographic variables				
Municipality population	INHAB	population size of nearest municipality (*n*)	database of the Czech Statistical Office	2998 (1–67 543)
Travel time to capital city	CAPIT	travel time by car from location of parcel to capital city (min)	GIS of the Czech Ministry of Transport, maps of the Office for Surveying, Mapping and Cadastre	139.8 (35–289)
Travel time to regional capital	REGIO	travel time by car from location of parcel to regional capital (min)	GIS of the Czech Ministry of Transport, maps of the Office for Surveying, Mapping and Cadastre	47.7 (5–113)
Travel time to a district town	DISTR	travel time by car from location of parcel to a district town (min)	GIS of the Czech Ministry of Transport, maps of the Office for Surveying, Mapping and Cadastre	24.7 (3–56)
Climatic variables				
Number of days with snow cover	SNOW	number of days with snow cover exceeding 1 cm (*n*)	database of the Czech Hydrometeorological Institute	56.6 (31.1–145.5)
Number of summer days	SUMMER	number of days with maximum temperature exceeding 25°C (*n*)	database of the Czech Hydrometeorological Institute	41.6 (6.1–66.4)
Mean annual precipitation	PRECIP	mean annual precipitation 1961–1990 (mm)	database of the Czech Hydrometeorological Institute	400.0 (281–704)

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as the proportional representation of forest within a 10 km range from each parcel. Using map databases of the Ministry of the Environment for the Czech Republic, we determined whether each parcel was or was not located in the protected area of a National Park or a Protected Landscape Area (PROTECT). The scenic value of the landscape (SCENIC) was determined by using a methodology referred to as landscape typology prepared for the entire territory of the Czech Republic by Muransky and Nauman (1980). This typology distinguishes three specific types of landscape (natural, cultural, man-modified) and three specific levels of scenic value (increased, average, or decreased). This allows one to classify as many as nine landscape typological units that evaluate both the physical as well as the visual attributes of a specific landscape. Municipality Population (INHAB) was determined from a database of the Czech Statistical Office as the number of inhabitants of the nearest village or town, as the settlement in the Czech Republic is almost entirely nucleated. The values of the predictors Travel Time to Capital City (CAPIT), Travel Time to Regional Capital (REGIO), and Travel Time to a District Town (DISTRICT) were calculated as the travel time by car to the centres of these cities. These calculations were based on vector data from the Czech Ministry of Transport covering roads of all categories with speed limits.

To take into account relevant climatic characteristics with a view of the attractiveness of an area for summer and winter recreation and human comfort for recreational activities, the following three variables were determined from the databases of the Czech Hydrometeorological Institute: number of days with snow cover exceeding 1 cm (SNOW), number of summer days with mean temperature of 25°C and higher (SUMMER), and mean sum of precipitation from May to September (PRECIP).

Data analysis. Linear modelling was applied to reveal the driving factors influencing farmland prices across the Czech Republic. As we had no such detailed data justifying the use of hedonic models with precisely specified and reliable variables, we used the most general form – linear modelling – to analyze the possible predictors of farmland prices rather than a specific hedonic approach that would require solutions of complicated partial differential equations in order to fully characterize market conditions and equilibrium. Knowledge as to the general effects of the selected predictors provides opportunity for further detailed economic evaluation of the selected factors using hedonic models and an opportunity to decompose the price of the items into separate components that determine the price.

First, we checked the normality of all continuous variables to be included in the model. While REGIO and DISTR were normally distributed (Kolmogorov-Smirnov test, both $d < 0.08$, $P > 0.1$), logarithmic transformation was applied to Farmland Price, RIVER, LAKE, and INHAB to normalize the data (Kolmogorov-Smirnov test, all $d < 0.07$, $P > 0.1$). A correlation matrix presenting relationships among all continuous variables revealed a strong dependence of the three climatic attributes ($r = 0.68$ for SNOW and SUMMER, $r = 0.58$ for SNOW and PRECIP) whereas all remaining relationships were characterized by $r < 0.5$. Therefore, SNOW was included into the analysis to represent also SUMMER and PRECIP.

The effects of the 10 fixed predictors and their first-order interactions were included into the null model and, afterwards, nonsignificant variables ($P > 0.05$) were eliminated step by step, using backward selection procedure to achieve a minimum adequate model. Chi-squared tests were applied to assess the contributions of particular terms to the model deviances and to calculate statistical significances (α being set to 0.05). Software R 2.12.0 (R Development Core Team 2010) was used for computations of a generalized linear mixed-effect model (GLMM, 'lmer'in R package 'lme4') with normal error distribution to test the effects of the included variables on Farmland Price. The GLMM framework was applied to account for the proximity of localities within regional administrative units by including the regional administrative units as a random effect.

RESULTS

All transactions included in this study were denominated in Czech crowns (CZK). The exchange rate (both in 2012 and currently) is 1 EUR ≈ 26 CZK. The average sale price was 39.59 CZK/m^2, and prices ranged from 4.00 to 202.00 CZK/m^2.

Four of the 10 fixed variables proved to be highly significant predictors of farmland prices ($P < 0.0001$). Three of them were landscape variables (RIVER, LAKE, FORPERC) and one was a geographic variable (INHAB). The effects of the remaining fixed predictors and all interactions were not statistically significant. Table 2 lists statistical significances of all tested variables and interactions on Farmland Price included in the model.

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RIVER is the most powerful predictor of farmland prices variability (Figure 1a). The variable for proximity to a river shows declining prices with increasing distance to a river. The mean price of a parcel up to 1 km from the river (44.8 CZK/m^2) is 2.1 times higher than the mean price of parcels situated more than 5 km from a river (21.6 CZK/m^2). An even greater difference in mean price was determined for the second strongest predictor, LAKE (Figure 1b). Again in this case, proximity to a lake shows decline in prices with increasing distance to a river. The mean price of a parcel up to 1 km from a lake or pond (71.9 CZK/m^2) is 3.3 times higher than that of a parcel situated more than 5 km (22.0 CZK/m^2) from a lake or pond. The population size of the adjacent municipality (INHAB) is also a strong predictor of farmland prices. The results show a strong trend toward mounting farmland prices along with increasing population of the adjacent municipality (Figure 1c). In municipalities with more than 1000 inhabitants, the average land price is approximately 1.9 times higher (INHAB > 1000; mean = 55.9 CZK/m^2) than in municipalities with fewer than 1000 inhabitants (INHAB < 1000; mean = 28.9 CZK/m^2). Another significant predictor was FORPERC, although the effect of this predictor on farmland prices is ambiguous (Figure 1d). The remaining variables and their first-order interactions as shown in Table 2 were not significant at $P < 0.05$.

Table 2. Results of the model presenting the predictors and their interactions which contributed significantly ($P < 0.05$) and non-significantly to the variance in farmland prices

Predictor	df	χ^2	P
LAKE	1.6	53.000	< 0.0001
RIVER	1.6	44.590	< 0.0001
INHAB	1.6	35.081	< 0.0001
FORPERC	1.6	15.742	< 0.0001
CAPIT	1.7	3.1797	0.075
PROTECT	1.8	2.2059	0.138
REGIO	1.9	1.0114	0.315
SNOW	1.10	0.3510	0.554
DISTR	1.11	0.8064	0.369
SCENIC	2.12	1.4225	0.491
SCENIC : SNOW	2.14	1.4839	0.476
SCENIC : INHAB	2.16	2.2617	0.323
SCENIC : DISTR	2.18	2.1239	0.346
PROTECT : SNOW	1.20	0.8745	0.350
SCENIC : LAKE	2.21	0.8972	0.639
PROTECT : REGIO	1.23	0.1985	0.656
PROTECT : INHAB	1.24	0.1642	0.6851
SCENIC : CAPIT	2.25	1.3574	0.507
SCENIC : RIVER	2.27	1.0633	0.588
PROTECT : RIVER	1.29	0.0020	0.965
PROTECT : LAKE	1.30	0.1180	0.731
SCENIC : REGIO	2.31	0.1696	0.919
PROTECT : FORPERC	1.33	0.5197	0.471
PROTECT : CAPIT	1.34	0.2806	0.596
SCENIC : FORPERC	2.35	0.0254	0.987
PROTECT : DISTR	1.37	0.0375	0.847

df – degree of freedom; for abbreviations see Table 1

DISCUSSION

Proximity to water features and other factors. Only four of the ten tested predictors of the spatial variation of farmland prices were found to be statistically significant, while three of them comprise landscape factors and one is a geographic factor. None of the defined interactions of these predictors proved to be significant.

The most significant factor affecting the variability in farmland prices is proximity to a river, where we determined a clear gradient of decreasing land price with increasing distance from the river embankment. While in the vicinity of the river (within 500 m from the bank, but outside a flood zone), farmland was sold for an average of 74.7 CZK/m^2, at a distance exceeding 5 km from the river it was only 21.6 CZK/m^2. These differences can be due mainly to a willingness to pay for a location in the vicinity of the river, and particularly in cases where there is active speculation as to the conversion of farmland into non-agricultural use. Especially conversions for construction and use for residential or recreational purposes generally motivate buyers to pay for a river view or to be in the vicinity of a river enabling such recreational activities as fishing, canoeing or swimming (Henderson 2010).

The willingness to pay prices for land in the vicinity of rivers up to several multiples of those for other lands nearby cannot be ascribed to agricultural use characteristics and higher fertility, as the relatively steep gradient in land price does not correspond to the gradient of soil fertility. This interpretation is also supported by the fact that residential and recreational

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houses also are more strongly in demand in the vicinity of rivers and command higher prices than do more distant properties (Kulshreshtha & Gillies 1993). The natural character of the river and its surroundings also plays an important role, as shown by the study of Mooney and Eisgruber (2001). Conversions to industrial or other construction land in the vicinity of a river cannot be substantiated as explanations, inasmuch as the law and its impact on land use planning ensure that obtaining permissions for industrial, commercial or warehousing structures in the vicinity of rivers is complicated and has low probability of being approved, especially due to rather strict limitations within the protective zones along rivers.

Speculative purchases of farmland for future development can also explain the high variance in prices associated with the next factor: proximity to a lake or pond. Similarly to the proximity to a river, here the price gradient rapidly decreases from the mean price of 82.5 CZK/m^2 at a distance of less than 500 m from the water feature to a mean value of 22.0 CZK/m^2 at a distance of more than 5 km from a lake or pond. The explanation for the price gradient will be similar here as in the previous case. While the price levels for other lands nearby but more distant from the water body are almost identical in both these cases, in the case of still-water features there can be observed a willingness to pay by approximately 10% more in the vicinity of a standing water feature than in the case of parcels near rivers. This higher price can be theoretically explained by the higher recreational potential of lakes and ponds for swimming during the

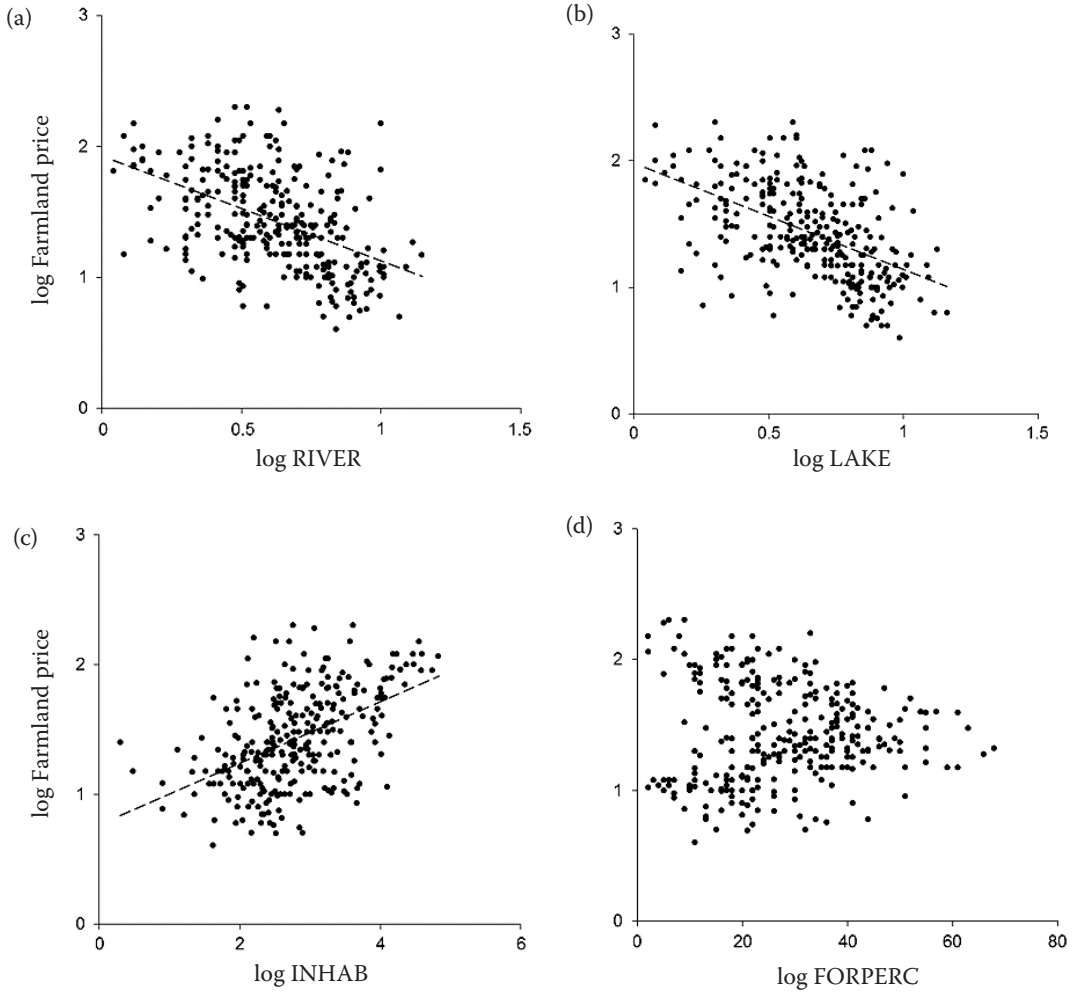

Figure 1. Effects of four predictors (all $P < 0.0001$) on farmland prices: (a) proximity to a river shows declining prices with increasing distance to a river; (b) proximity to a lake shows declining prices with increasing distance to a lake; (c) municipality population indicates increasing price with increasing number of inhabitants; (d) forest percentage is statistically significant but ambiguous as to its explanation

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summer, as they provide a safer and higher-quality resource and allow a wider range of recreational uses (diving, sailing etc.) in comparison to rivers (Jennings 2007).

The importance of the two factors relating to water features for the variance in the market prices of farmland indicates how crucial are these water features for buyers in the Czech Republic. They are willing to pay on average nearly four times more for farmland in the vicinity of rivers, lakes or ponds. This emphasis on water features is understandable in a landlocked state, as shown by works of other authors (e.g. Acharya & Bennett 2001). According to numerous authors, proximity to the sea is an important cause for heightened market prices for land and houses, recreational houses, rentals and housing expenditures (e.g. Rush & Bruggink 2000; Naydenov 2009). In maritime states, the presence of the sea usually increases the value of real estate more than does the presence of a lake or river. Judging from the steepness of the land price gradient and the results of the previously mentioned foreign studies, the absence of sea in the case of the Czech Republic, as a landlocked country, is apparently much more markedly compensated by the larger role of such freshwater features as rivers, streams, lakes, and ponds. This is reflected by the substantially higher prices commanded for farmland in the vicinity of water features in comparison to values for otherwise similar lands in the vicinity.

Even though a number of studies present the view that the presence of a water feature constitutes the reason for a willingness to pay more for real estate in its vicinity (Bender *et al.* 1997), it is an interesting fact that in our study the factor representing the scenic value of the surrounding landscape was not statistically significant. A study by Svobodova *et al.* (2012) may provide an explanation for this apparent contradiction. The authors found that the presence of a water feature in an evaluated landscape is the main reason for the public's higher visual preferences. In other words, a landscape without water features that was evaluated by experts (Muransky & Nauman 1980) as a landscape with increased scenic value can be thus evaluated at the general level. In the case of selecting real estate intended for recreational or residential purposes, the presence of a water feature can play an important role in the preference of the buyer.

It is a legitimate question whether the importance of the vicinity of a water feature is founded on its potential role as a water source for the irrigation of farm crops, and therefore whether it reflects a purely agricultural function. This interpretation (in contrast to the study by e.g. Faux and Perry 1999) is not confirmed due to the fact that the interaction with the variable Total Rain Precipitation between May and September was insignificant. This means there was no difference in the influence of the proximity of water features on the price of farmland in more arid vs humid areas. The reason is probably that in the Czech Republic the problem of drought in agriculture is not as limiting as in some other countries, which also is demonstrated by the low rate of using irrigation for agricultural production. According to the Ministry of Agriculture of the Czech Republic, irrigation occurs on less than 1% of the country's farmland. Currently irrigation is rarely used in the Czech Republic, and generally only on the most fertile lands and predominantly for special crops.

The third most important factor behind the spatial variability of farmland prices proved to be Municipality Population. Our results confirmed a positive influence of population size on farmland prices increase. This result can also be interpreted with regard to the speculation on the conversion of farmland mainly to land for construction, as the higher prices of farmland adjoining larger municipalities imitate the higher prices of land for development and for family houses (Livanis *et al.* 2006). In this case, however, the variability in farmland prices can also be explained by a stronger competition between potential local buyers in larger municipalities and the upward pressure this competition has on prices (Guiling *et al.* 2009). The possible explanation that the presence of a larger city increases the attractiveness of an area for recreation due to possibilities for cultural activities, shopping and the like also merits consideration.

The last significant variable is the proportion of forest in an area within 10 km from the sold parcel. This least powerful of the statistically significant predictors has an ambiguous effect. Despite our effort to find an interaction that would explain the behaviour of this predictor, we did not succeed. We suggest it to be the result of an interaction between the FORPERC variable and some undetected factor. Perhaps in some regions (such as in largely deforested areas where forests are rare and thus attractive) the trend is positive and prices are increasing while elsewhere it is the opposite, which is to day where open sites might be attractive (e.g., in mountainous

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areas). Likewise possible is that the influence differs for various types and forms of forest. For example, Cho *et al.* (2008) determined that deciduous and mixed forests, larger forest blocks, and smoothly trimmed and man-made forest patch boundaries are more highly valued. Therefore, in contrast to a study by Bender (1997), the assumption of increasing land price with decreasing distance to forest was not confirmed in our study. Future research might examine the preference for, and the impact of mixed forest species composition upon real estate transaction prices of adjacent land parcels.

Unexpectedly, the three climatic variables did not significantly influence land prices and also their interactions with other variables were not significant in any of the models. The expected influence of selected climatic factors that characterize the attractiveness of a location from the perspective of weather for recreation, and mainly during the periods of summer and winter vacations, was not confirmed despite the results of other studies which maintain that climatic factors comprise the prime motivation for mass leisure travelling (e.g. Horna 1995).

Nor was any influence confirmed in the cases of three geographic variables that characterize travel time to the national capital, regional capital, or district town. Although the results have shown that the variability of land prices is significantly influenced by the size of the nearby municipality, in contrast to the research findings of McDonald and McMillen (1998), we did not confirm the importance of timely accessibility to larger cities. It appears that those interested in buying land thus probably prefer immediate vicinity of larger cities with adequately high-quality services over commutes to large cities with higher-quality services but requiring longer commutes.

The statistically significant factors reflect attributes in common for buyers who want to convert farmland to some of the following uses: residential construction, individual recreational buildings, mass recreational sites (e.g. guest houses, hotels, camps, sporting and ski areas). Continuation in agricultural production with added functions, such as agro-tourism in particular, can also be considered. The data used in our study cannot discriminate between the purposes for which the properties were to be used by the interested parties, whether for housing or recreation. Nevertheless, whether the purchases were for individual or mass recreation as for residential purposes, the two most powerful factors express the proximity to a water feature. These are not important, however, for conventional agriculture or other commercial activities for which the buyer would have no motivation to pay multiples of average prices for the sake of proximity to a river, stream, lake or pond. Those who especially appreciate a view of water and the possibility for sporting or other recreational use of the water feature pay more.

Importance for water resources planning. Markedly higher values for farmland in close vicinity to water features create pressure for its conversion to non-farm uses. The pressure on freshwater features in landlocked countries is generally greater in comparison to coastal states, where such important shore sites as harbours and beaches attract much greater attention from developers (Rush & Brugginк 2000) than do freshwater features.

Water features protection and planning within land-use plans currently focus primarily on the water features themselves and their shore zones. However, lands within close proximity to water features have certain specific functions. Some of these are generally not projected into increased market prices for land (e.g. infiltration zones for runoff from fields, floodplain zones, ecotones). It is the recreational and residential functions that are decisive for increased land prices. These two functions are not only conditioned upon the proximity of water features but largely also upon visual connection to them (Acharya & Bennett 2001; Jennings 2007). This means that intensive construction or other unsuitable use of lands within close proximity or adjacent to water features can negatively impact the price of other land that is farther from the water. In this light, it is necessary at the local scale to analyze areas within the viewshed of the water features so that they are well visible from as large an area as possible in their broadest surroundings.

The use of water features should be decided not solely by their owners or users, but also by the stakeholders in relation to the lands in the wider area or even by the local community as a whole. Such a broadly defined area should be considered in plans as a single landscape zone, and its design and use should be planned comprehensively while considering its connection to the surrounding areas. Similarly, in planning new water features within a landscape, it is appropriate to select the locations with a view to the existing and future development plans of the surrounding area. A new water feature in a landscape can entirely change the presumptions for further use

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of an area. In particular, it can markedly increase the recreation potential of the area and, similarly, the residential attractiveness of the location. For that reason, it is only right that the owners and users of land in the wider area surrounding the future water feature participate in planning such new features. As in the case of a favourable design and implementation the value of their lands could increase. In keeping with their involvement in the public-participatory process, local landowners may also take an interest in financing the construction of the new feature and other related works (e.g. construction of amenities and landscaping in the vicinity of the feature).

When considering the higher value for parcels of land that in the future will have visual connection with the new water feature or access to water, upon agreement with the landowners it is possible to reallocate parcels within a wider area (Goetgeluk *et al*. 2005) so that the increase in value is reflected in the lands the owners of which financially supported the construction of the new water features, or in the lands the municipality is interested in. Similarly, it is appropriate to interest the stakeholders of lands in the wider vicinity of the water feature in revitalization, in augmenting the capacity of the water feature, and in modifications motivated by enhanced aesthetic quality of the water feature, as this not only increases the value of the water feature itself but also that of the surrounding lands (Mooney & Eisgruber 2001).

From the perspective of farmland conversion, when planning the future use of lands in proximity to water features, it is necessary to take into account the overall decrease and rate of decrease in farmland within the municipality, region, and state. In this sense, this issue should be addressed in the planning instruments at all levels. Even though changes of farmland to industrial, commercial or warehousing uses are typically more frequently cited as reasons for conversion, it is also important to protect farmland from excessive loss due to residential and recreational development. Water features and their associated lands have specific positions and functions in the landscape, and therefore it is necessary to protect these even more than farmland in other parts of the landscape.

Due to highly desirable location of land that perspective buyers are willing to pay for farmland near water features, farmers are frequently unable to compete with such prices. Protection of such farmland by means of statutory or planning instruments is frequently the only possibility of defence against development at these locations which are at one and the same time attractive but also environmentally valuable and sensitive. Effective application of these principles in farmland conservation and planning practices is frequently constrained by a lack of consistent, regularly updated land-use data at national, regional, and local levels (White *et al*. 2009).

CONCLUSION

In cooperation with 17 experienced real estate brokers and based on a literature search we identified a priori recreational amenities that affect the conversion of farmland for recreational purposes and thus determine market prices of farmland. On the basis of 296 transactions that were executed in the course of one year in the Czech Republic, we analyzed twelve factors, five of which can be described as landscape, four as geographical, and three as climatic explanatory variables of farmland prices.

Statistical analysis of these predictors (including their first-order interactions) resulted in significant results in the cases of just four single variables. Our results indicate that the two most powerful factors in explaining the selling prices were proximity to a river and proximity to a lake. In both cases, the price of land diminished significantly with increasing distance from the edge of a water body, so the prices in their immediate vicinity are 3.5 to 3.7 times higher than are the prices of a similar land situated more than 5 km from the edge of a water body. The steepness of this land price gradient on the one hand and the results of the cited foreign studies relating to the proximity to seaside on the other indicate that the absence of sea in the case of a landlocked country is apparently more substantially compensated by the larger role played by these freshwater features. This is reflected in the substantially higher prices commanded for farmland in the vicinity of water features in comparison to averages or to values for similar land more distant from water.

The other significant factors were population size of the nearest municipality and the percentage of forest. The results show a strong trend toward farmland prices increasing along with increasing population of the adjacent municipality. In municipalities with more than 1000 inhabitants, the average land price is approximately 1.9 times higher than in municipalities with less than 1000 inhabitants. Although the percentage of forest was determined to be a statistically significant factor, its effect on the variability

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of land prices was not unambiguous and we did not manage to interpret it.

When planning at the local level, it is also appropriate to delineate zones of heightened attractiveness for development on farmland. Increased farmland value due to the vicinity of a water feature should have an important role in this definition. Such analyses are mostly not incorporated into the relevant planning instruments, however, and therefore the function of the area in the vicinity of water features is insufficiently valued and consequently taken into account in the design for future land use (Sklenicka *et al*. 2014).

Unfortunately, the delineation of such zones cannot be generalized, as their spatial variability depends on a great many factors. Within the analytical parts of land-use plans, therefore, we recommend to evaluate the attractiveness of farmland in the broader vicinity of water features on an *ad hoc* basis from the perspective of their conversion to non-agricultural uses. The results of this analysis should be projected into the final designs for future use of the area, and especially at the local level in all forms of planning. We believe that a specific attention should be dedicated to areas with such attractive lands.

Land-use plans, master plans, and other forms of landscape planning should be closely linked with water resource plans. The current practice, however, quite frequently allows the plans for individual activity areas to present narrow interests that are not integrated with other issues into a unified and functional whole.

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