LAND-USE CONFLICTS IN A SWISS PERI-URBAN LANDSCAPE: WHICH SOCIO-DEMOGRAPHIC AND ENVIRONMENTAL VARIABLES ARE ASSOCIATED WITH THEIR PRESENCE AND ABSENCE?

Andreas VON DER DUNK[1], Adrienne GRÊT-REGAMEY[2] & Anna M. HERSPERGER[1]

[1]*Swiss Federal Research Institute WSL, Landscape Dynamics, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland, andreas.vonderdunk@wsl.ch, anna.hersperger@wsl.ch;*
[2]*Swiss Federal Institute of Technology (ETH) Zürich, Institute for Spatial and Landscape Planning. Wolfgang-Pauli Strasse 15, 8093 Zürich, Switzerland, gret@ethz.ch*

Abstract: Land-use conflicts are multifaceted social phenomena especially prevalent in periurban landscapes where land is limited and the margin of separation between diverse urban and rural uses is small. Their complexity poses an ongoing challenge for research and management. We investigate which socio-demographic and environmental variables are associated with conflict occurrence. The study area is located in a peri-urban landscape of Switzerland where conflict data were collected through a content analysis of the local print media. Decision trees are calculated to relate the presence or absence of conflicts to possible explanatory variables. The results show that four main variables are associated with the occurrence of land-use conflicts: proportion of rented accommodation, steepness of the terrain, population growth, and the proportion of commuters. The tree model is useful for theory building and can stimulate discussions on where land use conflicts are most likely to occur. Furthermore, based on the study we would suggest accompanying land change processes in areas with a high proportion of rented accommodations with especially comprehensive public participation processes.

Keywords: decision tree; classification tree; print media; locational characteristics;

1. INTRODUCTION

Around the world more than three and a half billion people live in urban and periurban areas (United Nations, 2012). This number is expected to rise to more than six billion by the year 2050. Consequently urban areas will expand into their surrounds and bring urban land uses into areas with rural land uses. The resulting peri-urban landscapes are particularly suitable for the study of land-use conflicts. Land-use patterns in these landscapes are highly fragmented and experience dynamic changes as the various individuals and groups compete over the limited land available (Antrop, 2004). Peri-urban landscapes are therefore more susceptible to land-use conflicts than less dynamic and less heterogeneous landscapes (Cadieux, 2008; Darly & Torre, 2013; Hoggart, 2005). The existence of multiple perspectives and preferences in these areas can result in conflicts and can complicate local governance efforts (Hiner, 2014). Furthermore the available land is limited and the margin of separation between diverse urban and rural land uses is small (Platt 2004).

Land-use conflicts are defined as a situation in which involved parties or individuals have incompatible interests concerning the use of a certain piece of land (von der Dunk et al., 2011). Several factors make them unique from other disputes: complexity, scale, timing, and competing land-use goals pursued by various actors and interest groups (Sze & Sovacool, 2013). The sources of disputes about land are many and may include disagreement over fundamental issues, resource scarcity, social power imbalance, and a lack of institutional arrangements, including property rights, among others (Brown & Raymond, 2014). Land-use conflicts have the potential to affect every aspect of society, be it the human, financial, social, natural or physical capital. Frequently they center on who is to

maintain control over a particular areas of land, who possesses the right to participate in decision making about its management, and who experiences the social and environmental impacts of its development or use (Andrew, 2003). Not every clash of incompatible land-use interests erupts in a dispute, however.

Recent research on land use conflicts has revealed the complexity of land use conflicts and the challenges to coping with them (Henderson, 2005; Ianos et al., 2012; Sze & Sovacool, 2013). Much research focuses on in-depth analysis of individual conflict cases such as: the siting of natural extraction sites (Marinoni & Hoppe, 2006); the externalities of wind energy plants (Josimovic & Pucar, 2010); conflicting land-use associations (Tudor et al., 2013) or legal issues of land ownership (Campbell et al., 2000). Further research focuses on conflict resolution. A number of valuable handbooks on environmental conflict resolution have been developed in face of the relatively weak government regulation in the US (Crowfoot & Wondolleck, 1990; Susskind et al., 1999). Case studies have explored many specific issues of land-use conflict resolution, e.g. computer-based workshops for conflict resolution (Timmermans & Beroggi, 2000) and the contribution of sustainability and equity to successful resolution (Tudor et al., 2014).

Improved understanding of land-use conflicts can aid the management of existing disputes and the anticipation and subsequent prevention of future ones. Specifically, it is expected that knowledge about spatially explicit variables that are associated with the occurrence of land-use conflicts can lead to more informed planning decisions (Pelletier et al., 2011). Techniques for identifying and mapping potential land-use conflicts have thus received attention in planning research (Carr & Zwick, 2007; Ioja et al., 2014).

Each land-use conflict emerges from site-specific social, economic, and environmental interactions (Bryant et al., 1982). Therefore conflicts are not randomly distributed across space. Rather their occurrence is related to the local context. However, so far few researchers have focused on locational characteristics of conflicts. Notable exceptions are, for example, the following studies: Janelle and Millward investigated possible correlations between the occurrence of land-use conflicts and the general character of urban districts, and found that disputes related to preservation issues were dominant in districts with a large proportion of buildings judged to have historical, architectural or sentimental value (Janelle & Millward, 1976). Taylor found that house values influence resistance

to development in Victoria, Australia (Taylor, 2013). Ley and Mercer established that conflicts frequently appear in those districts of Vancouver City that are characterized by short-term residency (Ley & Mercer, 1980). The authors also found that districts with a high proportion of well-educated residents experience more conflicts. These results are backed up by Joerin and colleagues, who identified a correlation between level of education and the distribution of conflicts in Québec (Joerin et al., 2005). Both studies claim that the level of education may influence people's capacity to understand and use information to defend their point of view if they are confronted with unwanted nearby land use. So far, most studies relate individual explanatory variables to land-use conflicts one at a time. However, no factor alone constitutes the sole underlying cause of a conflict and analyzing explanatory variables in isolation misses the holistic character of conflicts.

Our explorative study contributes to closing this research gap as it aims to identify socio-demographic and environmental characteristics that correlate with the occurrence of land-use conflicts. In particular, we ask: Which explanatory variables best distinguish between sites with conflict and those without conflict? We address the question by investigating land-use conflicts that occurred in a peri-urban landscape in the Canton of Aargau, Switzerland. Decision trees are used to simultaneously assess the relative explanatory power of various variables. The study is based on a subset of conflict data which was used for the research on defining a typology of periurban land-use conflicts, published in von der Dunk et al. (2011). Our study focuses on conflicts that reach a certain level of public relevance since they are especially important for spatial planning. The numerous neighborly conflicts about private issues are not the topic of this study.

2. METHODS

The study area (Fig. 1) is located in the Swiss Central Plateau, a densely populated and intensively used, peri-urban landscape in the north of Switzerland (Hediger, 2006). Swiss peri-urban landscapes are multifunctional, economically active regions and have experienced intensive land-use changes over the past decades (Hersperger et al., 2012; Mueller et al., 2010). The study area covers approx. 600 km^2 and comprises ninety-six municipalities, with approx. 590,000 inhabitants.

The average population density of 513 inhabitants/km^2 is high for a non-urban area. All

municipalities are within the distribution area of the Aargauer Zeitung, a local newspaper which we selected as the data source. The topography is undulating, with some hills reaching slopes of more than 30°. Most human activities are concentrated in the relatively flat valley floors. Major transportation networks of national and international importance transect the area, making it popular with commuters to the nearby urban agglomerations Basel, Bern, and Zürich. Selected sites from within this area are used for the statistical analysis.
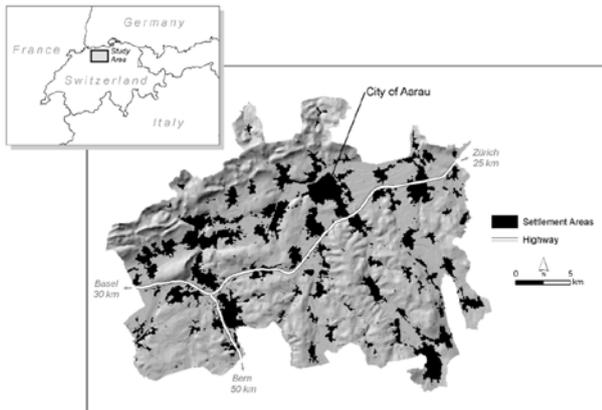

Figure 1. Study area.

2.1. Conflict sites

The response variable is the presence or absence of land-use conflicts at a site. Since there are no publicly available databases on conflicts in the study area we create our own conflict database based on media analysis. Conflicts involve emotions. Thus researchers who conduct interviews with conflicting parties are likely to already introduce a level of subjectivity to their notes (Glasl, 2004). In order to minimize our own subjective influence we turn to print media and conduct a media-content analysis. This approach has advantages and disadvantages. News selection processes and socio-political relations of power can bias the content in news media. Although journalists are also not immune to bias and subjectivity, we expect that in politically independent quality newspapers their profession obligates them to the principle of objectivity. Furthermore, daily newspapers deliver information for present and past conflicts, they can provide information on the development of conflicts, and they cover relatively large geographical areas. Further, conflicts covered in quality newspapers clearly have reached a certain level of public relevance. Ley and Mercer argue that any other source of land-use conflicts is at least as biased as newspaper reports – and most definitely less complete (Ley & Mercer, 1980). Newspapers

are therefore an accepted source for gathering data on land-use conflicts (Darly & Torre, 2013; Pelletier et al., 2011; Torre et al., 2014).

The Aargauer Zeitung, a newspaper with a politically independent local section, served as the data source. It is published six times a week, has the highest circulation (125,000 copies) of all newspapers in the region and also serves as the official publication for administrative matters. For the thirty-six months between October 2006 and September 2009 the newspaper was manually checked for reports on land-use conflicts. We favored the manual approach over the digital one because a pilot study revealed that media content analysis software like AtlasTM requires in our case a considerable amount of time to precisely retrieve articles on land-use conflicts from the digital news database. Specifically, a wide range of keywords and many combinations of these keywords would be necessary to calibrate the software in order to keep the number of erroneously selected articles low. All articles that report a disagreement concerning the use of a specific piece of land in either the title or the body of the article are analyzed. Incidents where stakeholders expressed incompatible interests concerning the use of a specific piece of land constitute a conflict for the purposes of this study and are integrated into the conflict database. The fact that a dispute is covered in a newspaper article is taken as indication that it is of public interest. Several conflicts are covered by more than one newspaper article, which is easy to determine upon reading the entire article. For every conflict, information on location and conflict issues is extracted.

Disagreements most often developed in context of new road and construction, urban development and the management of existing public facilities. Typical conflict examples include residents' complaints about the noise emitted from nearby sports grounds; residents complaining about proposed unaesthetic building structures within their sight; and environmentalists protesting about the destruction of animal habitats for the sake of urban development. The remaining conflicts are related to health hazards, preservation of the past, and changes to the neighborhood. For a complete list of the issues involved in land-use conflicts 2006-2009 in the study areas (see von der Dunk et al., (2011)).

The location of each conflict is geo-referenced as a point location, either by address-coding, or, in the absence of a unique address, by locating the centroid of the disputed polygon (e.g. farm field, industrial site) or line (e.g. road segment, transmission line segment). To represent a conflict regarding a line or polygon with a point introduces

some inaccuracy into the analysis which has to be considered when interpreting the results. Only conflicts on sites for which socioeconomic data is available (i.e. conflicts in inhabited areas) can be considered in the classification tree analysis.

The media content analysis yielded 81 land-use conflicts in inhabited sites. No two conflicts occurred within the same site. To prepare the dataset for the classification tree analysis, the 81 conflict sites are paired with a subsample of 81 randomly selected sites without conflicts (also called pseudo-absences (Barbet-Massin et al., 2012)). We assume that these selected sites differ in their environmental and socio-economic characteristic from the 81 conflict sites. To establish these differences is the goal of our research. The procedure of selecting pseudo-absences is common because the classification tree technique yields more informative results with a dataset with more or less equal numbers of observations with value 1 (here referring to presence of conflict) and value 0 (here referring to absence of conflicts) for the response variable (Barbet-Massin et al., 2012). In a dataset with much more observations with values 0 (for example 23'379 as in this study) than 1 (or vice versa), the classification tree techniques is less suited to discriminate between the conditions that are correlated with the 0 and 1 values respectively, because the model is overpowered by the information from the group with much observations. Our dataset with 81 sites with conflict and 81 sites without conflict is therefore optimal with respect to the response variable. The section on model robustness explores and explains how the choice of pseudo-absences can affect the analysis.

2.2. Explanatory variables

The selection of the explanatory variables was guided by their relevance for the study objectives and data availability. Potentially relevant variables such as house values (Taylor, 2013) or income levels (Ley & Mercer, 1980) are not included because these data is not available in the required spatial resolution. We selected ten variables (Table 1) in four categories: environmental suitability (slope, access), built environment (age of buildings and tenancy), demographics (population growth and population density) and socio-demographic characteristics (age, education, length of residency, and proportion of commuters). Pearson's correlation is used to assess potential collinearity between explanatory variables. The strongest correlation is found between population density and population growth (0.6) (Fig. 2).

Table 1 List of predictor variables

Variable	Unit	Data Source
Slope	Average degree/ha	DEM (digital elevation model) with 25 m resolution
Distance to nearest highway exit (straight line)	Meter	Swiss topographic map
Age of buildings	Average year of construction of residential buildings / ha	Swiss National Census 2000
Type of accommodation	Proportion of rented accommodation (%) / ha	Swiss National Census 2000
Population growth	Population growth rate (%) / ha	Swiss National Census 1990 and 2000
Population density	Total number of residents / ha	Swiss National Census 2000
Elderly population	Proportion of residents over the age of 65 (%) / ha	Swiss National Census 2000
Level of education	Proportion of residents with university degree (%) / ha	Swiss National Census 2000
Length of residency	Proportion of residents living within the same municipality for more than 5 years (%) / ha	Swiss National Census 2000
Proportion of commuters	Proportion of the workforce commuting outside the municipality (%) / ha	Swiss National Census 2000

All data for this study was scaled to the same unit of observation, cells of one hectare (hereafter referred to as 'sites'), because the source of the socio-economic data is the Swiss Land Use Statistic which is organized in a hectare-grid (Fig. 3).

This grid was created for monitoring purposes in the 1960s (Lendi & Elsasser, 1991) and covers the whole of Switzerland. Population in the study area averages 23 inhabitants per ha, with 575 in the most populated ha. A minimum of 3 inhabitants were

noted in all inhabited hectares since the Swiss Federal Statistical Office puts 3 in each hectare, even it in reality the number of inhabitants is less than 3. For the decision tree analysis we use the variables' values of the hectare in which the conflicts and the pseudo-absences are located.
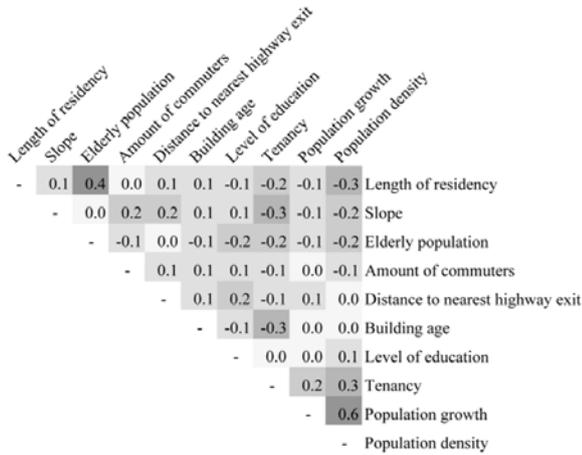

Figure 2. Pearon's correlation coefficients for the explanatory variables. The shade of the box indicates strength of correlation. Lightly shaded boxes refer to very low correlations; dark shaded boxes refer to the highest correlations.

Figure 3. All data are aggregated for 1 ha-sites.

2.3. Building the decision tree

Decision trees are a standard data-mining technique and have been frequently used in fields like health care (Rokach & Maimon, 2008) and ecological modeling (Elith et al., 2008) and can be used for interactive exploration and for description and prediction of patterns and processes (De'ath & Fabricius, 2000). The use of decision trees in conflict analysis, however, remains underexplored, although the method offers several advantages for studies like ours. First, decision trees are less bound by a priori assumptions than e.g. factor analysis or principal component analysis (Spielman & Thill, 2008). Second, decision trees use many different combinations of explanatory variables simultaneously to assess the probability of the presence or absence of a response variable (Breiman et al., 1984). Third, the decision trees classification process and its final results are easy to follow and interpret (Cherkauer & Shavlik, 1996). These factors make decision trees the preferred choice for our exploratory conflict analysis.

Two types of decision trees are distinguished: regression or classification trees (Yohannes & Webb, 1999). We use classification trees because of the binomial character of our response variable. Classification trees involve a machine-learning technique that examines a dataset consisting of response and explanatory variables and derives decision rules form it (Breiman et al., 1984). The rules contain information about which combinations of variables best predict the outcome of the response variable. A classification tree recursively partitions a dataset into increasingly homogenous subsets. The goal is to create a tree whose branches are composed of subsets which are as homogeneous as possible with respect to the outcome of the response variable. The decision about where to split the data into subsets is based on information statistics that measure how well each split further increases the homogeneity of the data in each subset. The final decision rules are displayed in a tree-like graph. The recursive nature of the classification tree algorithm tends to produce tree models that are statistically over-fitted to the data used to build the tree (McCune et al., 2002). To avoid over-fitting, the tree is pruned, i.e. the number of splits in the tree is reduced (Breiman et al., 1984). To find the optimal trade-off between tree size and predictive accuracy we conduct a ten-fold cross-validation for different tree sizes and choose the tree with the minimum cross-validated error rate as suggested by Therneau and Atkinson (Therneau et al., 2010). All statistical analyses are performed using the statistical package R, Version 2.12.0, including the rpart library (Therneau et al., 2010) for classification tree analysis.

3. RESULTS

The final classification tree model is displayed in figure 4. Based on 81 sites with conflict and 81 sites without conflict it identifies four variables that are associated with the occurrence of land-use conflict. Variables that appear near the top of the tree are more important for the explanation of the presence or absence of conflicts than variables in later splits (Miller & Franklin 2002).
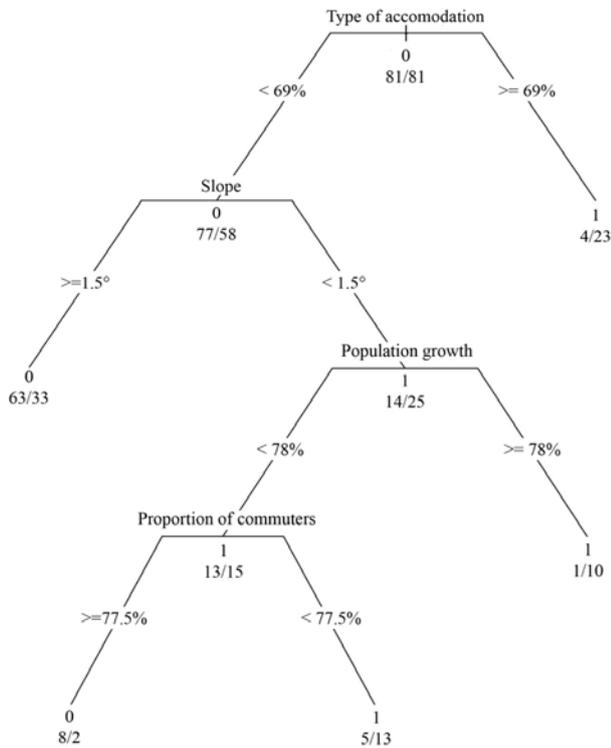
Figure 4. Pruned classification tree of the conflict data (81 sites with conflict, 81 sites without conflict) generated using rpart. Splitting criteria are specified on each branch. Values at the endpoint of a branch indicate whether a subset has been classified as conflict (1) or no-conflict (0). The pairs of numbers at the endpoint of each branch show the distribution of observations within that subset, following the format no-conflict/conflict

Consequently, type of accommodation is the most important variable, followed by slope, population growth and proportion of commuters. The tree model encodes a set of decision rules: For example, if 'Type of accommodation' at a site is <69%, and 'Slope' is < 1.5°, and 'Population growth' is ≥ 78%, then conflicts are very likely. Eleven sites are assigned to this subset. Of these sites, one site is without conflict and ten are with conflict. Starting from the top of the tree, land-use conflicts are most likely at sites with a high proportion of rented accommodation since 23 of 27 sites with a high proportion of rented accommodations are conflict sites. For sites with a lower proportion of rented accommodation (< 69%), the probability of conflict occurrence is higher in flat areas (slope value < 1.5°). In flat areas 25 of 39 sites are conflict sites where as in steep areas (slope value > 1.5°) only 33 of 96 sites are conflict sites. For sites where the proportion of rented accommodation is <69% and slope < 1.5°, the conflict risk is proportionally higher for those sites with a population growth of ≥ 78%. In these areas one site is without conflict and 10 are with conflict (see

example above). For sites where the proportion of rented accommodation is <69%, slope <1.5°, and population growth < 78%, the probability of conflict is higher if there is a low proportion of commuters (13 conflict sites of 18 sites) than in if there is a high proportion of commuters (2 conflict sites of 10 sites).

The tree model contains only four of the initial ten explanatory variables. 'Age of buildings', 'Elderly population', and 'Distance to nearest highway exit' were used by the algorithm to construct a first tree, but were excluded after the tree was pruned to avoid over-fitting (see method section). 'Level of education', 'Length of residency' and 'Population density' were not included in the original tree by the tree-building algorithm at all because these variables were determined by the algorithm not to be useful for explaining the occurrence of land use conflicts. The confusion matrix for the tree model rates the classification error as 0.3148. This means: were we to apply the tree model to predict the outcome of the response variable for sites not sampled in the study area, we would receive a conflict risk map with a predictive accuracy of approximately 69%.

The tree model is tested for robustness in two ways. First, the classification tree is built from a dataset containing ten times the number of negative sites (810 instead of 81), which were then proportionally weighted by a factor of 0.1. These 810 sites are also randomly selected from all sites without conflicts in the study areas. The aim is to test for any bias that may have been induced by a smaller sample size. The results, however, do not considerably change the classification error (0.3165 as compared to 0.3148 with the original tree model). Second, buffers of 1000 m are created around each conflict site and negative sample sites area selected only from within those buffers. The aim here is to test for a potential bias that may have been induced by our approach of sampling the negative sample sites from the whole study area, rather than from within the immediate neighborhood of the conflict sites. However, again the classification error does not change considerably (0.3085 as compared to 0.3148 of the original tree model). We thus infer that the tree model is relatively robust.

4. DISCUSSION

The tree model reveals that land-use conflicts are more likely at sites with a high proportion of rented accommodation, rather flat terrain, a high population growth and a low proportion of commuters. The proportion of rented accommodation is the variable which is most associated with the presence or absence of land-use conflicts, with more

conflict likely in areas with a higher proportion of rented accommodation. Switzerland has with 66% the highest rental rate in Western Europe (Bourassa & Hoesli, 2010). Though many people would like to own a house, they cannot afford it because of the high land prices in Switzerland and because of the conservative practice of banks to give loans. Land prices are high because there is relatively little developable land, both for topographical reasons and because of land use policies. Indeed, Swiss land use plans successfully act as urban-growth boundaries and effectively limit the land available for building (Gennaio et al., 2009). Rented accommodations are more common in urban areas. Furthermore, they are generally concentrated in and around the center of settlements, a fact which we cannot quantify for our study area because of the extremely fragmented periurban landscape without obvious centers. In these locations we typically find conflicts over the positioning of mobile-phone antennas, protests related to noise emissions from e.g. open-air restaurants, or dissent about the proper way of dealing with historic buildings. This might explain why the variable 'Type of accommodation' in our case accounts on its own for the most variance in the presence or absence of land-use conflicts. A high rate of rented accommodations has not been discussed as a potential variable explaining conflict occurrence in land-use conflict discourses in Switzerland so far. This study therefore is likely to stimulate new discussions about the consequences of the low rate of home ownership. More detailed studies are however needed to clarify significance of rented accommodation in land-use conflicts. Furthermore, we would suggest accompanying land change processes in areas with a high proportion of rented accommodations with especially comprehensive public participation processes.

Slope is the second most important variable with flat sites experiencing more conflicts. Such sites are mainly located in the relatively even valley floors, which are the areas most suitable for residential, industrial, agricultural, and transportation land use. In these areas the margins of separation between diverse uses is small and unwanted externalities like noise tend to be a problem. Slope can thus be regarded as a proxy for the intensity of competition over land within the study area. Additionally, hillside residential areas are frequently characterized as being more socially exclusive and offering up-scale living conditions (Hoggart, 2005). This is true for many of these slopes in the study areas due to the view they provide. Such areas have been found to be less prone to land-use conflicts (Mesch & Manor, 1998). However, Taylor found that opposition to land use

change was higher in areas where housing values are higher (Taylor, 2013). Further research is needed to better understand these contradicting findings.

Population growth is the third most important variable, with more conflicts found on sites with a high population growth. Population growth in the study area is largely caused by in-migration from adjacent urban agglomerations like Zürich and Basel (Bundesamt für Raumentwicklung, 2005). Population growth is naturally accompanied by an expansion of the infrastructure needed for housing and transportation. Established residents' anti-urban and pro-rural view has previously been identified as a key factor in explaining resistance to land-use change (Gilg, 2009), and has also been termed the "preservationist paradox" (Murdoch & Lowe, 2003): residents have chosen deliberately to move to the countryside and are thus determined to retain the rural character that their very in-migration threatens (Hiner, 2014). One could expect that high population growth would be more likely associated with shorter periods of residency. However, figure 3 indicates no correlation between the length of residency and population growth. This might be due to the fact that the number of in-migrants is rather low compared with the overall population.

A low proportion of commuters is also associated with conflict occurrence. In Switzerland, the average commuting time has remained constant at about forty minutes over the past few decades. At the same time, however, the average commuting distance has increased as the transportation network has become more efficient (Frick et al., 2004). An increase in commuting distance has been found to increase the feeling of living two separate lives: a work life and a private life (van der Klis & Karsten, 2009). This might reduce the motivation for getting involved in conflict activities. If that also holds true where commuting time stays the same, remains unclear.

Interestingly the tree model includes population growth but not population density. Current political and planning discussions in Switzerland focus strongly on the effects of population growth and population density because Switzerland experienced rapid population growth in the past decade. There's a broadly supported political agreement that population growth should be accommodated largely in existing settlements to prevent sprawl. Locally, the required densifications of settlements are often contested. Since population growth is associated with conflict occurrence it is crucial that the resulting changes in the built environment are accompanied by a planning process that addresses people's needs and fears. The variable "distance to nearest highway exit" is not

included in the pruned tree model, though its inclusion in the first tree model indicates some association with the occurrence of conflicts. It might not be more important in this study because highway density is extremely high in the study area.

The quality of the tree is rather good as the value of 69% for predictive accuracy indicates. Predictive accuracy, however, is only one aspect of classification tree performance (Hand & Henley, 1997), and in our case the classification tree was mainly applied because of its abilities to provide new insights into general relationships between attributes of social phenomena. In natural sciences, however, the predictive capabilities of classification tree are widely used, and predictive accuracies frequently reach > 80% (Gellrich et al., 2008; Murray et al., 2008). One drawback of using classification trees may be the way it handles correlated variables. The explanatory variable 'Population density' was not used for the construction of the tree model at all. However, this variable may not have been excluded because it is unimportant, but because of its relatively high correlation with the variable 'population growth'. Where two variables correlate the classification tree algorithm prefers the one that splits the dataset slightly better (Therneau et al., 2010).

The potential bias introduced through the selection and coverage of conflicts reported in the newspaper articles has been discussed in the method section. Alternatively, a conflict data base could be generated based on interviews and surveys with experts or the public. These approaches rise however the following questions in regard to potential bias: How should the experts be selected? How gets selected and who not? To what degree can the expert's answers be considered un-biased? Which survey can represent the public? Who did answer and who not? Documented appeals to local land use decisions also provide a source for conflict data. However, these appeals are often difficult to access and conflicts that have been resolved in the conflict resolution process cannot be caught with this source. We regard newspaper articles especially appropriate in a context where the public is strongly involved in planning and decision making about land use. This is certainly the case in Switzerland where the local population routinely decides on land-use issues through binding votes on zoning and facility-siting. Articles and letters to the editors in local newspapers play an important role for the discussions preceding the votes. Systematic comparisons of the performance of different methods in establishing a conflict data base would be very useful. Standardized data collections such as the Conflicts © data base (Torre et al., 2014) or the Observatoire des conflits urbains et

périurbains are especially promising since they combine several sources.

Data availability restricted the choice of potential explanatory variables in this analysis. To collect sensitive socio-demographic variables at a detailed spatial scale (e.g. for hectare grids) will always remain a challenge because of privacy right issues. An alternative approach would be to associate the data of a larger area (e.g., of the municipality) with conflict sites. However, the characteristics of the periurban land-use conflicts in the study area (e.g. noise and visual blight) suggest that close neighborhood is a crucial factor in the occurrence of peri-urban land use conflicts. Future studies therefore should address in detail which area around a localized land-use conflict is most useful for establishing associations between explanatory variables and conflict occurrence.

5. CONCLUSION

Our research question was whether the occurrence of land-use conflicts can be related to certain environmental and socio-demographic characteristics of a conflict site. We found four variables that are, to a varying degree, associated with the occurrence of land-use conflicts: 1) proportion of rented accommodation, 2) slope, 3) population growth and 4) proportion of commuters. A classification tree model revealed the configurations of these four variables that make the occurrence of land-use conflicts most likely. An increased conflict risk is found in areas with large proportion of rented accommodation, where topographical conditions are favorable for human use (valley floors), where the competition for land is high (high population growth), and the daytime population is large (few commuters). The tree model uses many different combinations of explanatory variables simultaneously to assess the probability of the presence of conflicts. It is especially useful for theory building and can stimulate discussions on where land use conflicts are most likely to occur. However, more research is needed before conflict potential can be adequately mapped based on socio-demographic and environmental variables for complex multifunctional periurban landscapes.

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