PASTURE FOR HORSES: AN UNDERESTIMATED LAND USE CLASS IN AN URBANIZED AND MULTIFUNCTIONAL AREA

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ABSTRACT
This paper investigates the spatial importance of horses in a multifunctional and urbanized area. The growing spatial importance of horses in the open space was already mentioned by different authors, but never quantified before. In many countries, including Belgium, statistics on horses are only partly covered by agricultural data. As a consequence, the amount of space in use for horses, especially hobby horses, is largely unknown but may encompass a significant area of the open space. Especially within the context of an increasing urbanization and growing demands on the remaining rural area, this evolution must not be neglected. A reliable quantification of the space used by horses is therefore essential and is given in this research for the case study Flanders. According to the results of fieldwork, about one-third of the pasture land in Flanders is used to keep horses. A qualitative analysis showed a higher horse density within the more urbanized areas with a fragmented agricultural area and a quantitative analysis showed negative associations between the presence of horses and (i) the distance to gardens, (ii) the parcel area and (iii) the distance to forest. Moreover, an internet survey assessed evolutions and motivations of horse owners to keep horses. The survey resulted in clear data on the fact that the number of horses is increasing. This is mainly motivated by recreational purposes. The majority of horsekeepers do not consider themselves to be part of the agricultural sector. These results, showing an intensified competition for land between stakeholders in the open space of urbanized regions put new challenges for sustainable land use planning. The major challenges are (i) to avoid increasing functional and spatial fragmentation of rural landscapes, (ii) to assure enough space for societal necessity urgencies such as food or energy self-efficiency, (iii) to increase positive interactions of horse keeping with other sectors such as agriculture, nature conservation and others and (iv) to develop a proper visual and cultural landscape strategy, helping in setting up guidelines for fencing and other infrastructural elements that do not deteriorate the landscape character.
Keywords: internet survey, Land use, land use change, multifunctionality, pasture for horses, urban areas.

1 INTRODUCTION

More and more, former agricultural land is used for horses covering a range of functions (sport, recreation, breeding …). Up till now, very little information is available on the spatial importance of horses. In many countries, including Belgium, statistics on horses are only partly covered by agricultural data. As a result, the amount of space in use for e.g. hobby-horses and its evolution could never be quantified properly. However, this land use can take up a significant amount of space and can have consequences for the functioning of the land and the rural economy [1]. Moreover, possible associations between the presence of horses and environmental characteristics like urbanization [2] were never quantified before. Therefore, this paper tries to investigate the spatial importance of horses for the case study Flanders. More specifically, we try to answer the following questions:

- What is the amount of space used for horses in Flanders?
- Which associations can be found between the presence of horses and environmental characteristics?
- To what extent can we talk about 'horsification' and what is the underlying motivation for this evolution?

To answer these questions, the paper starts with a short literature review to situate the subject in a Flemish as well as an international context. Next, the spatial importance of horses

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is estimated using fieldwork in six municipalities in Flanders. Using logistic regression, the spatial distribution is related to environmental characteristics, including among other things like urbanization, distance to gardens and forests and fragmentation. The evolution in number of horses and related land use changes are then examined based on an internet survey filled in by 1001 horse holders. In the survey, evolution in numbers of horses, use of space and motivations of horse holders are questioned. Finally, the evolution of horsification is discussed within the context of sustainable development and planning in a multifunctional and urbanized environment.

2 LITERATURE REVIEW

2.1 Economic context

In the past, horses were used worldwide as draught horse not only in agriculture, mines, forestry, and ports, but also in the army, and for private and public transport. After WWII horse power was substituted for motorization. For example, according to the agricultural statistics of Sweden, the number of draught horses diminished from 9,457 horses in 1901 to 0 horses in 1976 [3]. In Belgium, there were up to 200,000 draught horses in 1950. In 1960, the number declined to 157,350 (compared to 43,000 tractors) and to 16,258 in 1983 (compared to 120,000 tractors). Now (in 2009) there are around 15,000 draught horses left, mainly used for recreational purposes (www.trekpaard.be). While in the past the economic importance of horses was strongly linked to those draught horses, it has now shifted towards production, trade and use of riding and breeding horses. According to Viaene [4] and Policy Research Cooperation [5], the horse sector has a significant economic importance in Flanders. The sector generates an annual added value of 215 million and employment for 3,500 full time equivalents.

2.2 Social context

More and more people keep one or more horses for recreational purpose. Already in 1986, Daniels discussed the growing number of hobby-farms within the urban–rural environment of Oregon. In Finland, horse riding is an increasing recreational activity [6]. Viaene et al. [4] point to the growing interest in Belgium for recreational horse riding and driving. The same can be said about Sweden, where Myhr and Johansson [2] notice the link with the proximity of urban areas. In the case study of Busck et al. [7], the number of hobby-related animal units increased from 0.02 to 0.1 per ha between 1984 and 2004 in Denmark. In Flanders, according to VLM [8] around 200,000 people (3% of the entire population) are horse riders.

2.3 Spatial context

There is not much existing information on the spatial importance of horses. According to Van der Windt et al. [9], the Netherlands count around 400,000 horses. For Belgium, Viaene et al. [4] estimated the number of horses, donkeys and ponies at 160,000, taking up an area of around 69,500 ha. But now, experts estimate the number for Belgium to be around 200,000 (150,000 in Flanders). However, these are rough estimations and Verburg et al. [1] notice that in many countries hobby-horses are not considered by agricultural statistics. Therefore, the number of and the area for horses are largely unknown.

2.4 Horsification

Recently, some rather strange sounding terms like 'horsification' or 'horsiculture' popped up, especially in the Netherlands [9], referring to the growing number of horses. But also in Flanders the attention for the horse-sector grew, as in 2008 the Flemish government organized a series of stakeholder workshops to shed more light upon this sector. Veijre [10] mentioned 'horsification' to be a striking evolution in Denmark also, and Verburg et al. [1] talk about the growing area of pasture for horses in Western Europe.

Some of the causes of this horsification can be found in the economical strength of the sector. In some places, maneges replace agricultural enterprises, and production of crops or animals is no longer the objective. Another explanation could be found in the diversification of farms, where farmers develop alternative activities on their farm [7], e.g. renting land for horses.

Although horsification is a quite unknown evolution and there are no clear quantitative data existing, people express already positive as well as negative perceptions on this evolution. According to van der Windt [9] horseholdings could give a new stimulus to rural development and recreation. The opening up of an area for walkers and bikers could go hand in hand with the establishment of pathways for horse riders. He also notices that the small-scale parcel structure, related to horse-holdings, offers opportunities for the environment when special attention is given to small landscape elements on these parcels. However, different people talk about negative aspects, linked to horses and horse riding. For example Törn et al. [6] stress the negative impacts of the recreational pressure of horse riding on the environment, like condensation of the soil, damage of vegetation and a changing plant-composition due to the introduction of foreign seeds. Verburg et al. [1] on the other hand talk about the 'lumber' appearing into the landscape, referring to different artificial elements like buildings and fences. Finally, horsification is considered as a threat for the agricultural sector. For example, Daniels [11] states that hobby-farmers cause an increase in the land prices, because they are willing to pay more for a small parcel of land and they also contribute to further fragmentation of the open space leaving fewer opportunities left for the professional farmers.

3 METHODS

3.1 Study area

Flanders, the northern part of Belgium (Fig. 1), is known as an example of a strongly urbanized region, characterized by urban sprawl.

Figure 1: Location of the study area Flanders.

With a population density of 447 inhabitants per km^2 in 2007, it is one of the most densely populated regions in Europe. Only 10% of Flanders is defined as rural according to the OECD criterion of 150 inhabitants per km^2 measured at basis district level (municipalities). Data from Eurostat indicate that the average road density in Flanders is 4.7 km/km^2, much higher than the average for Europe (1.2 km/km^2). However, looking through the eyes of a Flemish inhabitant, rural open space is not solely present in those rural 10% of the area. Agricultural land encompasses more or less 45% of Flanders' surface, but it is for a large part spatially fragmented and interwoven with or in close proximity to other functions like housing, infrastructure and industry. This makes the Flemish open space not only a production space for agriculture and forestry but also an ecological space for nature. The ubiquity of urbanization adds a growing consumption function to the rural open space, like recreation for both dwellers and visitors or an attractive setting for (new) residential dwellings. Moreover, the open space is a buffering medium that prevents or mitigates environmental problems such as biodiversity loss, erosion, flooding, different forms of pollution and visual and acoustic impacts of development. This intertwining of different functions is both cause and effect of fragmentation and multifunctionality in the Flemish open space.

Since 2008, owners of one or more horses (including donkeys and ponies) have to register their horse(s) at the Belgian Confederation for Horses (BelCoHorse). These data are available at the level of a municipality. Because this registration has started recently, it can be assumed that this data source is not complete and that many people still have to register their horse(s). In February 2009, the number of horses registered counted almost 106,000. The spatial distribution of the horses in Flanders according to these data is presented in Fig. 2. The lower the number in the right figure, the more the existing pasture is used for other animals/activities than horses.

3.2 Case studies

Because the census data are incomplete, extra field work is carried out in six Flemish municipalities (i) to give a reliable estimation on the spatial importance of horses in Flanders and (ii) to quantify associations with environmental characteristics.

3.2.1 Cluster analysis

It is important to consider different parts of Flanders with different environmental characteristics to prevent a distorted result due to biased sampling. To define the case studies, a cluster analysis was carried out in SPSS 15.0, based on the following environmental characteristics:

- Urban characteristics: inhabitants per municipality and % built area.
- Agricultural characteristics: area% of different production activities (horticulture in open air, greenhouses, fruit orchards, arable farming (excluding fodder crops), cattle breeding, pasture and fodder crops).
- Fragmentation of agricultural parcels: *Perimeter/Area*.
- Forest characteristics: *Forest index*.

The cluster analysis used, is a K-means clustering. This is a non-hierarchical way of clustering in which k refers to the number of clusters. After standardization, the data are divided into k initial clusters. For each observation, the distance to the cluster centre is measured and observations are, if necessary, replaced to another – nearer – cluster, after which the cluster centers are calculated once again. These steps are repeated until no more re-allocation of data takes place [12]. This cluster analysis results in groups of municipalities with similar environmental characteristics. By taking

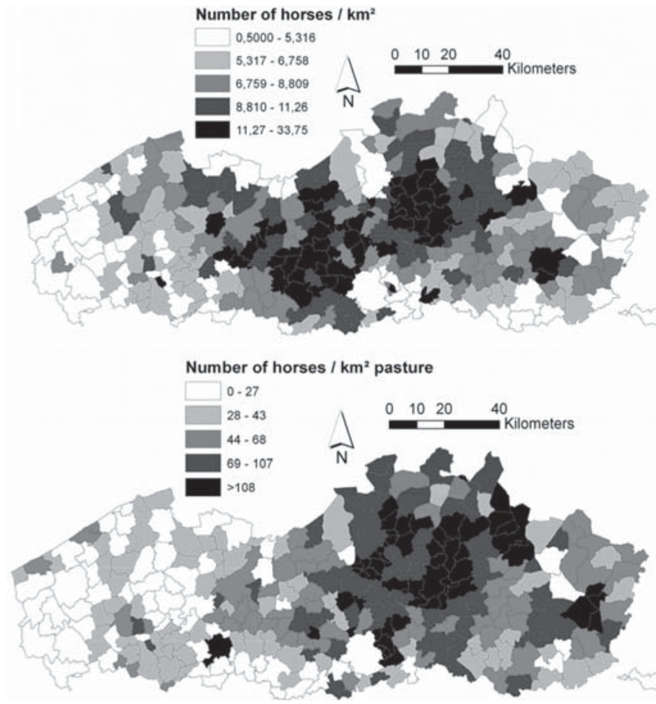

Figure 2: Number of horses per municipality, expressed per km^2 (above) and per km^2 of pasture land (below).

these clusters into account in the selection of the case studies, a variation in urban, agricultural, fragmentation and forest characteristics in Flanders is taken into account from the beginning. For each cluster, at least one municipality was demarcated as case study area. The result of the cluster analysis including the selected municipalities is presented in Fig. 3.

The horse density, calculated with the census data, is averaged per cluster to give a qualitative analysis on the association between horse density and environmental characteristics.

3.2.2 Sampling per case study

Because a total inventory of pastures for horses within the six municipalities was practically impossible due to time limits, a sample of segments was selected. The ***form*** of the segments can be determined by natural bounders, parcel bounders, roads or uniform segments [13]. To keep a good comparability between the segments of the different study areas, we chose to use square segments. Another advantage is that this is a fast and cheap way to define a sample of segments [14]. The segments were ***randomly*** distributed throughout each case study. Because the cluster analysis can be considered as a form of stratification, there is no further division within one case study.

Theoretically, the ideal ***size*** of a segment is the one that gives the highest certainty and the lowest costs [15]. Practically, this is difficult to decide, because the optimal size is related to different factors like goals of the research, costs, variability between segments, accessibility, availability of data, etc. [16]. The scale of the landscape under investigation determines for a big part the size of the segments. In general, small segments correspond to small parcels, an intensive agriculture and urban landscape, big segments with a more extensive landscape [13]. For complex landscape, the

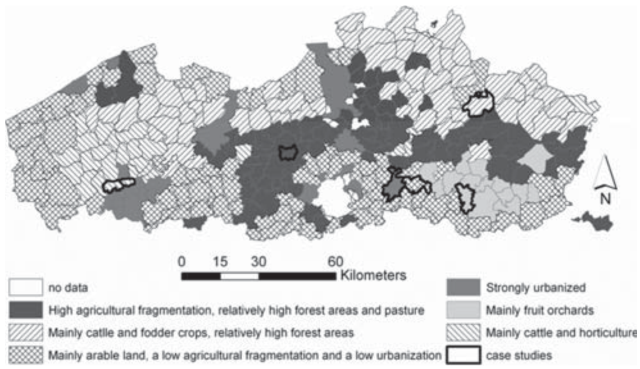

Figure 3: Selection of the case studies within the clusters (from left to right): Lendelede-Ledegem, Lebbeke, Leuven, Lubbeek, Zoutleeuw and Balen.

size of 25 ha is used [17, 18] and this size is generally smaller than the segments used in different landscape-ecological and land use studies (MARS (25–200 ha) in Gallego [19]; Countryside survey (1 km^2) in Bunce et al. [20]; Bunce et al. [17] (1 km^2); Sepp [21] (450–1200 ha), Rondeux et al. [22] (1 km^2). But compared to most of the previous studies, Flanders is smaller in scale, more complex and intensive by nature. However, according to a rule of thumb, given by O'Neill [23], 25 ha is too small, as this rule states that a segments needs to be two to five times the investigated patch (in this case pasture parcels). Because the maximum patch area within the investigated municipalities was 21 ha, a segment size of 49 ha was chosen (700 × 700 m). The ***number of segments*** was in each case study determined by a minimal area-cover of 10% of the total area. The location of the final segments is illustrated in Fig. 4 for the case study of Balen.

3.2.3 Land use mapping

Within each segment, the land use is mapped in detail on the field, based on aerial photographs from 2003, at scale 1:10,000. Pasture for horses is within the framework of this research the most important land use category to take into account. A pasture is considered to be used for horses if:

- Horses are present at the moment of mapping
- Typical horse-attributes are present, like ribbon fences
- Local inhabitants confirm that the pasture is used for horses

3.2.4 Analysis of the fieldwork-data

Spatial distribution and estimation of the area taken up by horses are analyzed using descriptive statistics to quantify the space used by horses in the different case studies. The results are translated to the scale of Flanders. *Associations with environmental characteristics are investigated with logistic regression, adopted to 346 observations.* Logistic regression is used for the prediction of the probability of the occurrence of an event (is there a horse present (1) or not (0)?). It makes use of several predictor variables (Table 1) that may be either numerical or categorical. Logistic regression is based on the odds, being the chance of 1 divided to the chance of 0. The odds can vary from 0 to +∞. The neperian logarithm of the odds or logit is taken to obtain values from −∞ to +∞:

$$\ln(p_1/p_0) = b_0 + b_1X_1 + b_2X_2 + \ldots + b_jX_j$$

with $\ln(p_1/p_0)$ the logit; b_j the value of the jth coefficient, j = 0, …, p; X_j the value of the jth independent variable; b_0 the intercept.

Figure 4: Example of a sample of square segments within the case study of Balen.

Table 1. Predictor variables used in the logistic regression.

Independent variable	Indicator
Proximity of gardens	Euclidean distance to gardens (based on the topographic land use map, NGI 2004)
Proximity of forest	Euclidean distance to gardens (based on the forest mapping by ANB, 2001)
Parcel area of pasture	Parcel area (based on the fieldwork)
Fragmentation of the agricultural area	Perimeter/area of connected agricultural parcels per km^2 (based on the VLM registration, 2006)

Logit coefficients correspond to b coefficients in the logistic regression equation, the standardized logit coefficients correspond to beta weights. Goodness-of-fit tests such as Hosmer–Lemeshow and pseudo-R^2 statistics are included as well as a validation of the model and indicators of model appropriateness, like the Wald statistic to test the significance of individual independent variables.

In logistic regression, multicollinearity should be avoided, because standard errors of the b coefficients will be high and interpretations of the relative importance of the independent variables will be unreliable. To check for multicollinearity, the VIF statistic is used. When there is high multicollinearity, VIF will be high. When VIF is high, the b and beta weights are unreliable and subject to misinterpretation. In general, multicollinearity is considered not to be a problem if VIF $\leq$ 2 [12].

3.3 Internet survey

The goal of the internet survey was to get a better insight into (i) the motivation of people to keep one or more horses, (ii) the evolution of land use, due to horsification and (iii) identified problems to get the land people need for their horse(s).

3.3.1 Context

The census data and fieldwork, described above, bring in useful information to investigate the spatial distribution of horses and associations with environmental characteristics. However, these data do not tell us anything about the motivation of people to keep a horse. Also, the census data do not satisfy when evolutions have to be examined. Therefore, an internet survey for horse holders was set up.

An important advantage of an internet survey is the low cost and the speed in which the survey can be distributed in different regions. Also the fact that answers are automatically saved in a database is an important plus, because this allows a faster automatic data processing [24, 25]. Moreover anonymity can be guaranteed and participation is totally voluntary. This makes the chances bigger to have more response [26]. Of course, internet surveys also have disadvantages. Examples are the limited availability of the internet for certain households, technical problems and the possibility of self-selection [27, 24]. Self-selection can be prevented by contacting people through more than one way. Another problem of internet surveys is the risk that people do not answer all the questions and related to this, the risk of a high 'drop out' (the phenomenon where people stop the survey without finishing it). Therefore, questions may not be too difficult or too long to read and the loading time may not be too long. A high drop out can also be prevented by holding out the prospect of a prize to the respondents [28, 26]. A simple design, rather short questions, the use of 'jump blocks' and the prospect of a prize were used within this research to prevent a high drop out. Using jump blocks means that the respondent only has to fill in the questions that are relevant for him/her, depending on previous answers.

3.3.2 Structure of the survey

The survey was developed with the program *Question Mark Perception 4* (QMP4). This program makes it possible to develop tests and surveys (anonym or not), using different types of questions: *Multiple Choice*, *Multiple Response*, *Knowledge Matrix*, *Numeric*, *Fill in Blanks*, *Text Match* and *Essay*. The survey consists of five main parts (the flowchart is given in Fig. 5). The first part deals with the present situation, the second part handles evolutions (in number of horses and land use) and the third part covers motivations as well as identified problems. The fourth part questions some socio-economic variables (like age and income) and finally, respondents are able to fill in further remarks in the fifth part. The server of the survey was connected to the domain registration: www.paardenenquete.be.

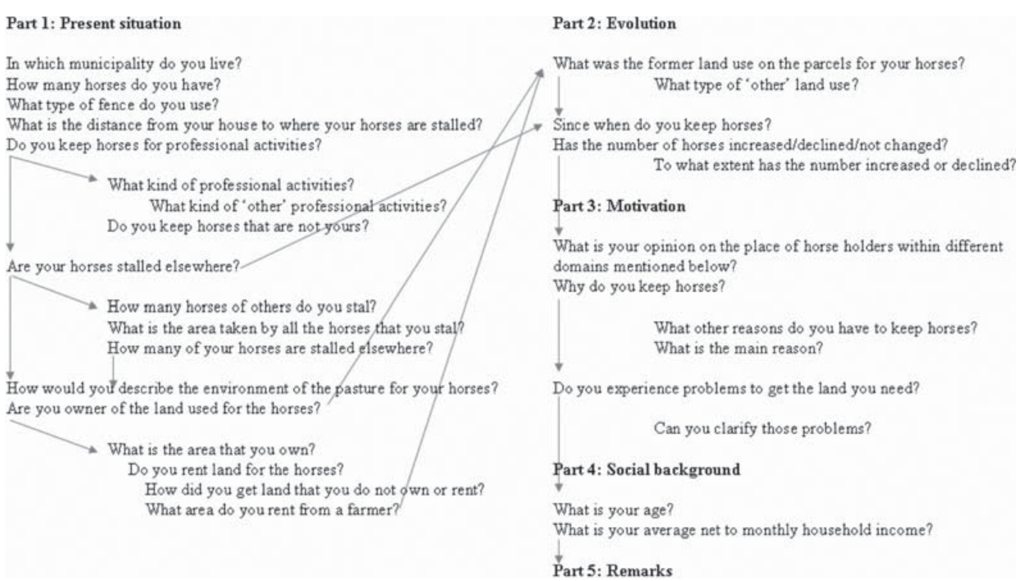

Figure 5: Flowchart of the internet survey.

3.3.3 A test version and distribution of the survey

The survey was initially tested by 20 persons to optimize the design, content and understandability of the questions and to prevent technical problems when the survey is largely distributed. The useful remarks were included into a new version of the survey to improve its quality.

To ensure a wide distribution of the survey, horse holders were contacted through different ways:

- A total of 10 different authorities within the domains of horse riding, horse holding, horse breeding … were contacted and asked to make know the link to the survey on their website or in their newsletter.
- The link to the survey was emailed to a list of maneges and horse holders.
- The link was sent to different contact persons to create a 'snowball-effect'.

3.3.4 Analysis of the internet survey

The official survey started on the 3rd of April 2009 and ended on the 6th of July 2009. The results from the survey were analyzed using the Reporter of the Perception Enterprise Manager of QMP4. The individual answers could be retrieved as well as a summary of the results. For a detailed analysis, results were exported to the excel format.

4 RESULTS

4.1 An estimation of the spatial importance of horses

Table 2 summarizes the area taken up by horses within the different case studies. An average is calculated for the different case studies as well as a weighed average, taking into account the area taken up by each cluster. The percentages in Table 5 have to be interpreted as a minimum, because it is possible that during the fieldwork, some pasture were not recognized to be pasture for horses.

When the average of 5.1% is translated to the level of Flanders, an area of 69,300 ha is taken up as pasture for horses. If an average density of 2 horses per ha is assumed (based on the internet survey and a density rule of the manure policy), the number of horses in Flanders is estimated to be at least 140,000. Therefore, the expert-estimation of 150,000 horses mentioned before seems to be a realistic one.

Table 2: Area taken up by horses within the different case studies.

Case study	Pasture for horses/total area (%)	Pasture for horses/total area open space (%)	Pasture for horses/total area of pasture (%)
Balen	6.6	9.7	39.6
Lebbeke	6.1	11.4	24
Lendelede-Ledegem	1.8	2.6	11
Leuven	2.1	4.9	36.1
Lubbeek	4.5	6.4	31
Zoutleeuw	5.2	6.2	27.1
Average	4.4	6.9	28.1
Weighed average	5.1	8.0	30.3

4.2 Associations with environmental characteristics

The horse density *per km*^{2} and *per km*^{2} *pasture* is calculated for each cluster and summarized in Table 3. The average concentration of horses per km^2 is the highest in the cluster that is characterized by urbanization, agricultural fragmentation and relatively low forest and pasture areas (1). The concentration is the lowest in the cluster that is characterized by cattle and horticulture (6) and in the cluster with mainly arable land, a low fragmentation and a low urbanization (3). Especially in the more fragmented, woody and urbanized clusters (1 and 4), the existing pastures seems to be more used by horses, compared to less urbanized clusters.

According to the logistic regression, based on the field work, a significant relationship is found between the presence of horses and parcel area, distance to gardens and distance to forest. The chance that a pasture parcel is used to keep horses is higher, the smaller the parcels and the smaller the distance to gardens and forest are. No multicollinearity was found between the independent variables, with VIF-values <<2 (Table 3). The output of the logistic regression is shown in table 4. R^2 is a measurement for the strength of association, but is generally low in logistic regressions (Table 4).

Table 3. Average horse density per km^2 and per km^2 pasture, per cluster.

Cluster description	Average number of horses per km^2	Average number of horses per km^2 pasture
1. Urbanized, agricultural fragmentation, relatively high forest and pasture areas	10.1	80.9
2. Mainly cattle and fodder crops, relatively high forest areas	8.4	63.1
3. Mainly arable land, a low agricultural fragmentation and urbanization	6.2	45.0
4. Strongly urbanized	7.1	90.2
5. Mainly fruit orchards	6.7	65.1
6. Mainly cattle and horticulture	6.1	39.1

Table 4. Multicollinearity test and outputs of the logistic regression.

Independent variable	Tolerance	VIF	B	S.E.	df	Sig.	Exp(B)	R^2
Fragmentation	1.027	0.305	−0.001	0.000	1	0.016	0.999	Cox & Snell: 0.197; Nagel-kerke: 0.263
Distance to forest	−3.250	0.001	−0.011	0.004	1	0.005	0.989	
Distance to gardens	−3.750	0.000	−1.207	0.317	1	0.000	0.299	
Parcel area	−4.311	0.000	/	/	/	/	/	
Constant			1.957	0.341	1	0.000	7.077	

The Hosmer–Lemeshow (H–L) tests goodness-of-fit. If the H–L statistic is greater than 0.05, the null hypothesis 'that there is no difference between observed and model-predicted values' is not rejected, implying that the model's estimates fit the data at an acceptable level (Table 5).

To test the significance of each predictor variable in the model, the change in −2 Log Likelihood is used. When the significance of change is below 0.05, the hypothesis that 'there is no effect of the predictor' is rejected. In this case, the three predictor variables have a significant influence (Table 6).

For validation, 70% of the observations were used to create the model, 30% for validation. According to Table 7, an overall percentage of 75% was predicted correctly (Table 7).

4.3 Internet survey: horsification and motivation

Almost 2,000 people started the survey, with a drop out of 48%. 1,001 responses were useful for further analysis. The ages of the respondents varied from 10 to 72, with the majority around 25 and 45 years. 1/3rd of the respondents is younger than 30.

4.3.1 Number of horses and evolutions

The total number of horses included in this survey is 3,564 (2,762 horses, 788 ponies, 14 donkeys). The majority of the respondents has 2–5 horses (53%) and 33.5% has only 1 horse (Fig. 6).

Table 5: Hosmer–Lemeshow statistic.

Step	Chi-square	df	Sig.
3	8.370	8	0.398

Table 6. Change in −2 log likelihood.

Variable	Model log likelihood	Change in −2 log likelihood	df	Sig. of the change
Distance to forest	−141.433	6.166	1	0.013
Distance to gardens	−142.716	8.733	1	0.003
Parcel area	−148.694	20.688	1	0.000

Table 7: Validation of the model.

Observed			Predicted: Selected cases: Horse present 0	Predicted: Selected cases: Horse present 1	Predicted: Selected cases: Percentage correct	Predicted: Unselected cases: Horse present 0	Predicted: Unselected cases: Horse present 1	Predicted: Unselected cases: Percentage correct
Step 3	Horse present	0	61	50	55.0	31	19	62.0
		1	26	101	79.5	8	50	86.2
	Overall percentage				68.1			75.0

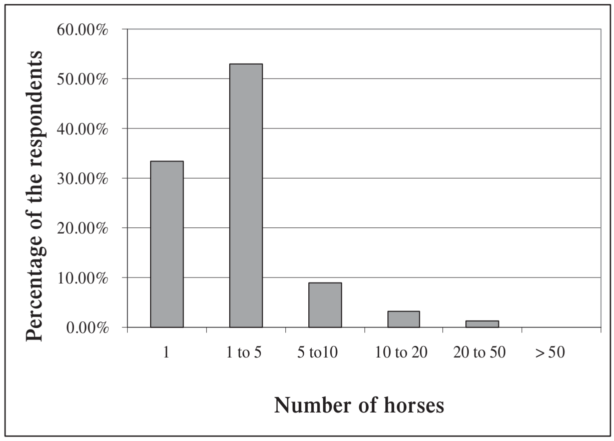

Figure 6: Frequency distribution of the number of horses per respondent.

The majority of the respondents keep horses since 1990 or later (71%). More than 1/5th of the respondents (21.1%) keeps horses less than 5 years (since 2005 or later) (Table 8).

For most of the respondents, the number of horses increased (47%) or remained unchanged (40%). Only 10% talk about a decrease and 3% did not give a response. This trend of increase was also obtained (R^2 = 0.5808) when plotting the number of horses per respondent in 2005 against the number in 2009.

Most of the parcels that are now used as pasture for horses, were in the past pasture for cattle (29%), pasture for horses of someone else (25%) or arable land (20%). Therefore, almost 50% of the present pastures for horses are certainly formal agricultural land (pasture for cattle or arable land). The results are summarized in Table 9.

4.3.2 Motivation of horse holders and identified problems

The majority of the respondents (86%) keep horses as a hobby, only 12% keeps them for professional activities and 2% did not give a response.

Respondents were asked to fill in a matrix that checks to what extent horse holders see themselves as part of recreation, agriculture, nature, sport, commercial activities and cultural heritage (Table 10).

Sport and recreation seem to be the most important reasons to keep horses (99% and 96%). The fact that most of the people keep horses as a hobby corresponds to the fact that only 27% agrees with 'commercial activity'. It is striking that many horse holders see themselves linked with nature (41%), while much less of them make this connection with agriculture (25%). About 1/3rd (36%) see a link with cultural heritage.

Although an increase in area for horses was noticed in this survey, respondents also mentioned different problems they experience to gain sufficient land for their animals. The main reasons they quote for this are:

- Urbanization: residential areas or industry replace pasture areas
- The land is too expensive
- The presence of lots of other horse holders makes it more difficult to find land
- People do not want to rent their land because they hope the land will be converted to building land
- The agricultural holding act makes it impossible to compete for land against a farmer

Table 8: Frequency distribution of the year when the respondents became horse owners.

Horse holder since …	Percentage
1900–1950	0.23
1950–1960	0.91
1960–1970	2.61
1970–1980	10.00
1980–1990	15.23
1990–2000	34.20
2000–2009	36.82

Table 9: Land use changes due to horsification.

Former land use	Percentage	Number of respondents
Pasture for horses of someone else	25.37	220
Pasture for cattle	29.30	254
Arable land	20.42	177
Fallow	11.07	96
Other land use*	10.50	91
No response	3.34	29

*Other land use, mentioned by a few respondents, includes space for sheep (17 respondents), garden (16), fruit orchard (14), meadow (6), building land (5), vegetables (3), space for chicken (3), forest (2), recreation area (2), space for pigs (1), greenhouse (1), tree cultivation (1) and a florist business (1).

Table 10: Horse holders' opinion on their place within different domains.

Domain	Totally agree	Agree	Not agree	Totally not agree	Total	% Agree	% Not agree
Recreation	798	128	8	4	938	98.72%	1.28%
Agriculture	45	130	163	361	699	25.04%	74.96%
Nature	86	204	114	300	704	41.19%	58.81%
Sport	652	228	12	23	915	96.17%	3.83%
Commercial activity	53	140	156	361	710	27.18%	72.82%
Cultural heritage	81	172	142	310	705	35.89%	64.11%

- Farmers do not rent or sell their land because:
  - They need the land themselves for production
  - They receive subsidies to leave the land fallow
  - They need their land in the framework of manure policies
  - They hope the land will be converted to building land
  - They think horses damage the land too much
- Rules in Flemish spatial planning policy makes expansion often difficult

5 DISCUSSION AND CONCLUSION

In this paper, different information sources were combined: census data, field samples and an internet enquiry. The internet survey applied, cannot just be considered as yielding a statistically representative sample of Flanders, but the high number of respondents (1,001) makes the results very useful for interpretation of the horsification phenomenon. Next to new quantitative, temporal and spatial information this survey essentially yielded qualitative information about motivations.

The conclusions drawn from the different information sources are similar, concerning the geography and the evolution of the use of pastures for horses. The amount of space, used for horses in Flanders was estimated to be at least 69,300 ha. This is higher than a previous estimation by Viaene et al. [4]. The area corresponds to about one-third of the grassland in Flanders and therefore horses take up a significant part of the open space. The average horse density per cluster clearly depicts a spatial relation with urbanisation and a fragmented agricultural area. This was also mentioned by Van de Sype [29] who noticed a high number of horses in the fragmented Flemish municipality of Sint-Katelijne-Waver, where significant areas of vegetables were transformed to pasture for horses.

Because horses mainly replace former agricultural activities, areas with a more stable and less fragmented agricultural sector are characterized by less pasture for horses. At the scale of a parcel, the logistic regression showed significant associations with the distance to gardens and forest areas and with the parcel area. Small pasture parcels at a low distance to gardens and to forest areas have a higher chance to be pasture for horses. Van der Windt [9] also pointed to the small scale of parcels with horses in the Netherlands. Because gardens are mainly associated with urban and semi-urban areas [30], the results per cluster, where the more urbanized clusters show a higher concentration of horses, are confirmed. Also Myhr and Johansson [2] and Verburg et al. [1] talk about this relation with urbanized areas.

Horse keeping and grazing has physical and managerial characteristics of animal husbandry in agriculture. Therefore, it could be considered as one compartment of agriculture. However, unlike the period before the ’60s of former century, when horsekeeping was predominantly linked to agriculture the essential motivation for people to keep horses nowadays is linked to sport, free time and recreation. It was striking that the majority of the respondents do not see themselves to be part of the agricultural sector. Horsification is clearly an evolution that cannot be considered as an agricultural one, despite the physical and ecological similarity of this with farming grazing systems. In the internet survey, the respondents made explicit that their social and cultural linkage to agriculture is low. At the contrary, there is rather a competition with agriculture, essentially in matters of acquisition and preservation of land.

In the current land use planning system in Flanders, the dichotomy of urban versus rural areas is explicitly maintained, despite the strong degree of peri-urbanisation. Furthermore and within the rural areas, the practice of land use planning essentially boils down to the quantitative allocation of land to the two major ‘official’ stakeholders: agriculture and nature conservation, and design it in such way that further spatial fragmentation is minimized for both functions. Other functions and services are considered rather as modulations and complements to the major destinations. Horsification can be seen as a phenomenon that crosses the current principles of land use planning in different ways and it is strongly linked to the fringe of urban and residential areas. These areas decreasingly match the model image of segregated urban and rural areas, giving fuel to the concept that semi-urban areas should be considered as plan areas in their own right [31]. Within these transition areas, horsekeeping adds not only to the preservation of open space, but also to the fragmentation of land: farmers find it harder to assemble or maintain cohesive field clusters and moreover suffer from raising prices in a fiercely competitive land market. Given the divide between horsekeeping stakeholders and farming, in lesser degree also forestry and nature conservation, horsekeeping should be considered as a complementary sector of open space, despite the legitimate interpretation that it also is some form of 'soft urbanisation', since spatially and functionally linked to residential areas, and a consumer of space in competition with the more traditional rural sectors.

How then should land use planning proceed in order to provide space for bottom-up generated demands such as horsekeeping as a specific subsector of open air recreation whilst at the same time safeguarding and enhancing demands for long-term sustainability and multifunctionality? There is a risk to remain stuck in traditional and generic ideas on how to allocate and manage open space. In addition to the desirability of preserving existing landscape identity, the protection of existing elements, space and functions should not blindly rule out the possibility of new developments emerging with new values [32]. A more creative planning – taking into account structures, functions and values, different from the traditional ones – could face the challenge that we have to decide how much traditional landscape and land use functions we will take in future [33]. Therefore, region-specific and integrated design projects are of growing importance in developing the open space in a sustainable way. Design has the capacity to strengthen this creative aspect of planning as it is more directed towards transformation and creation of new landscapes. The major design challenges within the context of this paper are (i) to avoid increasing functional and spatial fragmentation of rural landscapes, (ii) to assure enough space for societal necessity urgencies such as food or energy self efficiency, (iii) to increase positive interactions of horse keeping with other sectors such as agriculture, nature conservation and others and (iv) to develop a proper visual and cultural landscape strategy, helping in setting up guidelines for fencing and other infrastructural elements that do not deteriorate the landscape character. More research on the environmental impact of horsification is necessary to take up these challenges.

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