

Environmental analysis of land use changes in green infrastructure of a city, with particular emphasis on allotment gardens: Poznań and Salzburg case study

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*I would like to
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1. Information concerns STSM

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2. Abstract

The allotment gardens are the elements of the green infrastructure of the city, important to humans as well as to the urban areas. They are very important for inhabitants in terms of their leisure activities and personal experience of sowing, growing, cultivating and harvesting healthy vegetables, and resting from work stress. On the one hand, the conditions in the allotment gardens in the city of Poznań were difficult due to their locations in the vicinity of wetlands, bogs and swamps. On the other hand, a direct influence of noise, binding dust and pollutions has an impact on their functioning. The crucial issue is to show how the location of the allotment gardens in the relation to other forms of use in the city influences the changes in the nearest neighbourhood. The aim of the presented research was to analyse the similarities and differences in the modifications of the green infrastructure with particular emphasis on the allotment gardens and their neighbourhood between two cities: Poznań and Salzburg. Cartographic method was used for the comparative analysis of the land use changes in a 1-km length buffer and in the neighbourhood of the allotment gardens in the Poznań and Salzburg cities. One of the most common modifications observed in both cities was meadow-built-up area type. Salzburg is more stable with regard to a scale of the changes in the period of 2000 – 2011. In the case of Poznań more changes on a larger territory were observed.

3. Introduction

The allotment gardens are important elements of the green infrastructure of the city protected by law. Because of diverse functions, which have been changing and developing over time, these objects are crucial to humans as well as to the city. From environmental point of view they allow to preserve the biotopes. For inhabitants they are important in terms of the leisure activity and for personal experience of sowing, growing, cultivating, harvesting healthy vegetables among the city buildings, and resting from work stress.

Therefore, a synthetic analysis of the use changes in their vicinity is worth to be considered. The key question is to ask how the location of the allotments against the background of the other forms of use has influenced the changes in the vicinity. On the one hand the conditions in the allotment gardens in Poznań were difficult due to their location on the wetlands and marshes. On the other hand a direct influence of noise, dust and pollutions has an impact on their functioning.

The aim of this study was to analyse the use change of green infrastructure of the city, with particular emphasis on the allotments and their neighbourhood. The crucial question is how the location of the allotment gardens in the relation to the other forms in the city influence the changes in the land of the nearest neighbourhood.

The aim of the presented research was to investigate use changes of the green infrastructure, with a particular emphasis on the allotment gardens and their neighbourhood (a comparative study of Poznań and Salzburg). Moreover, an analysis of similarities and differences in modifications of the green infrastructure, with a particular emphasis on the allotment gardens and their neighbourhood between the cities of Poznań and Salzburg was done.



Figure 1. Photography of a private allotment garden complex(left) and a railway allotment garden complex (right) in Salzburg

3.1. Characteristic of the material under study

The material under study from both cities was slightly different as different were the studied cities (table 2). On the territory of the Poznań city, there are significantly more allotment garden (AG) complexes and their average areas are much larger than in Salzburg. The complexes of AG cover a bigger part of the city of Poznań than the city of Salzburg. There are also less inhabitants per ha of the AG here than in Salzburg.

Table 1.Characteristic of the Poznań and Salzburg cites

feature	Poznań	Salzburg
number of AG (2011)	83	19
AG area (ha; 2011)	848,5	27,9
city area (ha)	26 153	6 568
AG area in total city area (%)	3,2	0,4
area of 1km buffer (ha)	16 657,3	4 325,3
buffer area in total city area (%)	63,7	65,9
number of inhabitants (2011)	553 564	145 270
number of inhabitants per AG	652	5207
area (person per ha)		

sources: Polish Central Statistical Office website, Austrian Central Statistical Office website

Comparing both cities, a type of the ownership of the AG complexes is dissimilar (table 2). Now, there are 3 types of the allotment gardens in Salzburg (table2, figure 3), while in Poznań there is only one – each allotment gardener belongs to the organization. In the case of Salzburg the AGs are located in the external part of the city (table 2, figure 3), whereas in Poznań they are spread within the urban area (table 2, figure 2).

Table 2. Basic characteristic concerning the allotment gardens in Poznań and Salzburg

feature	Poznań	Salzburg
number of AG (2000/1)	86	20
number of AG (2011)	83	19
mean area of AG (ha; 2011)	10,2	1,5
type of the ownership (number of AG) in 2011	organisation	organisation (8) railway AG (6) private(5)
location in general	spread in the city	rather in the external part of the city

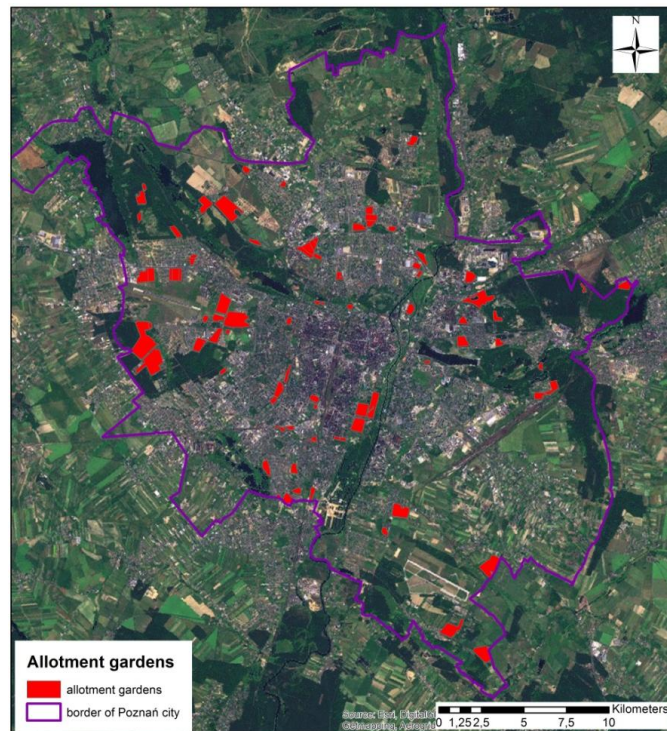


Figure 2. Map of the allotment gardens in Poznań, 2011

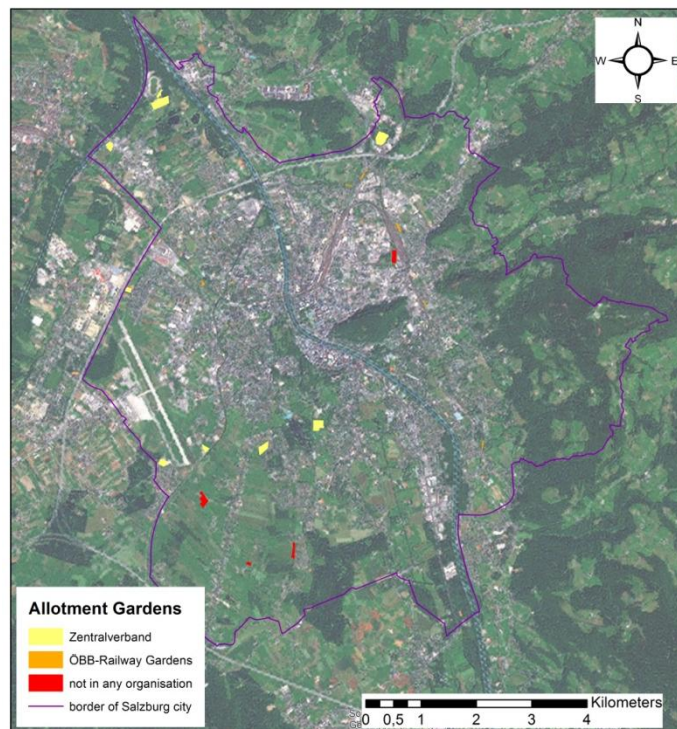


Figure 3. Division of the allotment gardens in Salzburg, 2011

4. Materials

The use was made based on the following sources:

- Aerial photo of Salzburg from years: 2000 and 2011
- Aerial photo of Poznań from 2011
- European Urban Atlas
- Google Earth aerial photo of Poznań from 2001
- Polish Central Statistical Office website
- Austrian Central Statistical Office website

5. Methodology

The research procedure was divided into three steps: a preliminary work, a field work and a chamber one.

First, a preliminary work was focused on the study of literature, planning documents and legal acts as well as the data collection. The most significant point of this step was to mark out the limits of the allotment gardens. The buffer for this analysis was a 1-km length.

Next, with regard to Salzburg study, the gathered information was verified and actualized concerning the radius of a 200-meters length.

The last step was focused on an analysis of the land use in buffer of a 1-km and in the nearest neighbourhood of the allotment gardens. The latest one was examined by the investigation of the land types within the border of a 1-meter radius. The types of land taken into account during the study were as follows:

- allotment garden (AG)
- build-up area
- construction site
- meadow
- blue infrastructure
- cemetery
- mine and dump
- Public Urban Green Areas (PUGA)
- agriculture

- forest
- communication

For a cartographic analysis the program ArcGIS 10.1 created by ESRI Company was used. The results were presented using the basic statistic measures and graphs. All statistic investigations concerning the land changes in the vicinity of a 1-km buffer and in the nearest neighbourhood were done with Microsoft Office Excel 2007 program. The draft of the research procedures, separately for the Poznań and Salzburg cities, are shown on the figure 4. Above-mentioned methodology was chosen based on the project realized in cooperation between both the Poznań and the Salzburg Universities.

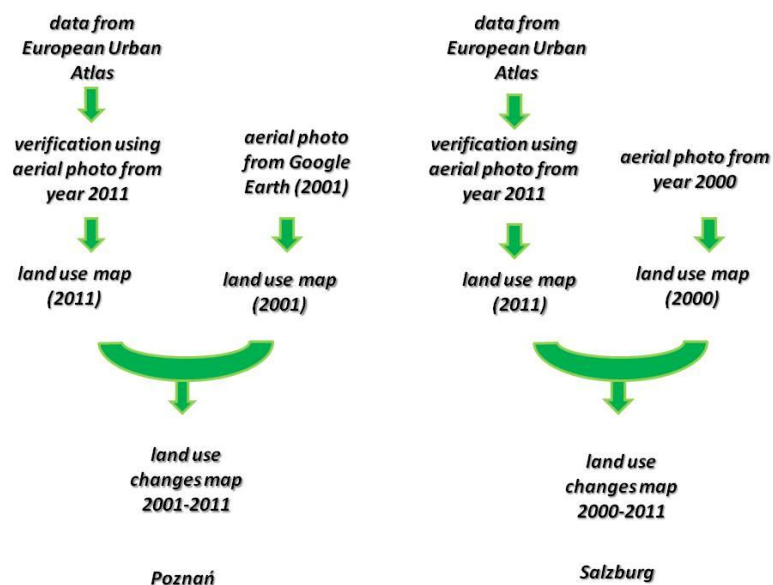


Figure 4. The draft of a chamber work

5.1. Mapping

In parallel with a field work, a mapping of the neighbourhood of the allotment gardens was done. A tool for territorial identification of biotypes was elaborate based on the guide for the city of Frankfurt (Bönsel et al. 2007). The buffer in the study was that of a 200m length. The detailed steps of the examination are presented in Appendix I.

5.2. Socio-ecological map

A part of the field work was a collection of information necessary to create a socio-ecological map. The buffer of the research was the same as that used for the mapping (200m).

A sociological map is a thematic map containing a quality and quantity information about a state, a degradation of the environment and its factors and a counteraction against natural environment degradation (Wytyczne techniczne GIS-4). What is significant is the fact that the map is fulfilled into actual data about a direct human impact on environment. The idea of the environment components selection introduced to the study based on the Polish methodological guide (Wytyczne techniczne GIS-4). The snapshot of the environment condition is usually in large scale (1:50 000) therefore in the field work a modification of the used categories was indispensable.

Below the adjusted division of the gathered data:

- Natural resources
- Form of environment protection
- Form of natural environment degradation
- Form of counteraction against natural environment degradation
- Other elements

5.3. Survey

The last element of the field work was a visual survey based on a simple assessment of the allotment gardens state. This part of the study fitted very well into the knowledge on the AGs and their reaction on a pressure coming from the environment. The survey was based on the questionnaire created by Dr. Annette Voigt to interview allotment gardeners. The questionnaire was divided into sections concerning a dominated type used, a blue infrastructure, recreational facilities, compost, ecological facilities, green barriers around single parcels and whole complexes of allotment gardens, and a potential impact from the neighborhood and buffers against dangers..

5.4. Comparative analysis

The last and important step of the change use analysis in the neighbourhood of the allotment gardens was an investigation of the similarities and differences in the modifications between the cities of Poznań and Salzburg. Results obtained for both cities were presented

with the basic changes in a 1km buffer and in the nearest neighbourhood using Microsoft Office Excel 2007 program.

6. Results

The results from the above-described analysis are presented according to the studied cities in the sections below. Every section is divided into chapters giving a picture from a general view to more detailed one.

6.1. Salzburg

6.1.1. Land use changes within 1km buffer of the allotment gardens

The changes of land use of Salzburg in a 1-km buffer of the allotment gardens since the year 2000 are shown on the figure 5. Figure 6 presents the land use of the allotment gardens since 2011 in Salzburg in a 1-km buffer. It is clear that closer to the city centre more built-up areas and Public Urban Green Areas are observed. With regard to the agriculture territories, forest and meadows a reverse trend was noted. Any kind of gradient were noted for cemeteries.

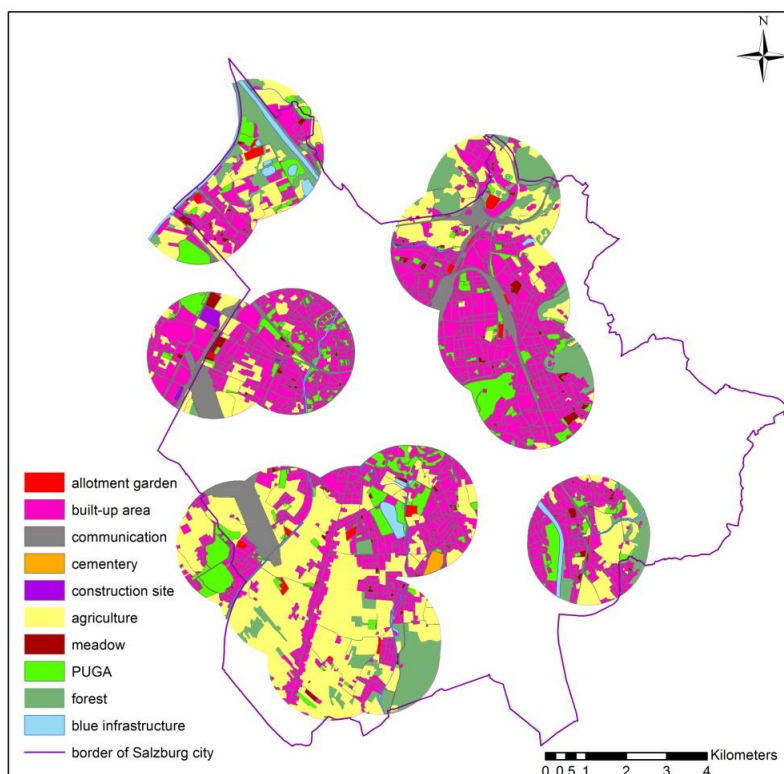


Figure 5. Land use map of Salzburg in a 1-km buffer of the allotment gardens, 2000

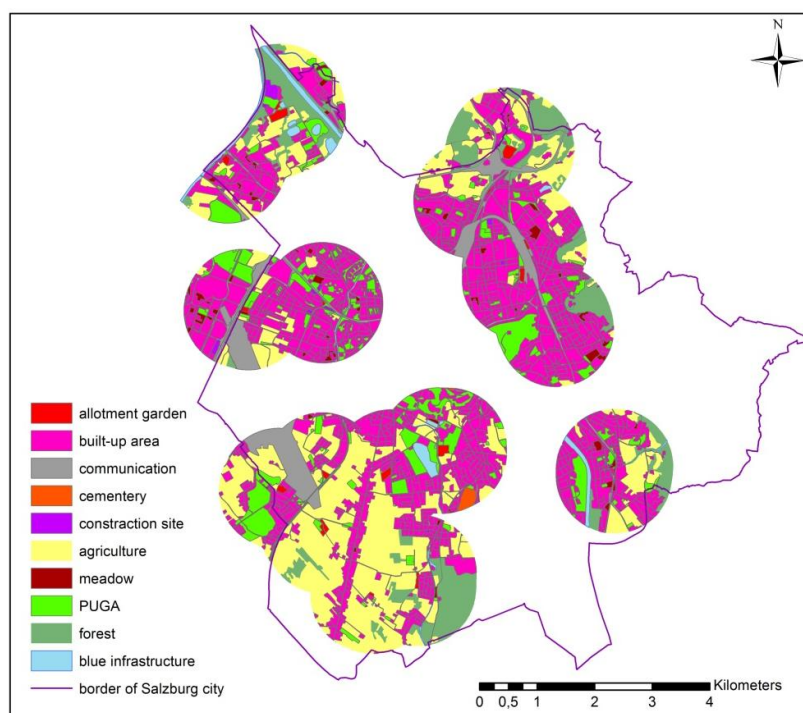


Figure 6. Land use map of Salzburg in a 1-km buffer of the allotment gardens, 2011

Results of the cartographic analysis of the changes of land use in a 1-km buffer of the allotment gardens are presented on figures 7. Any direction of the changes are found.

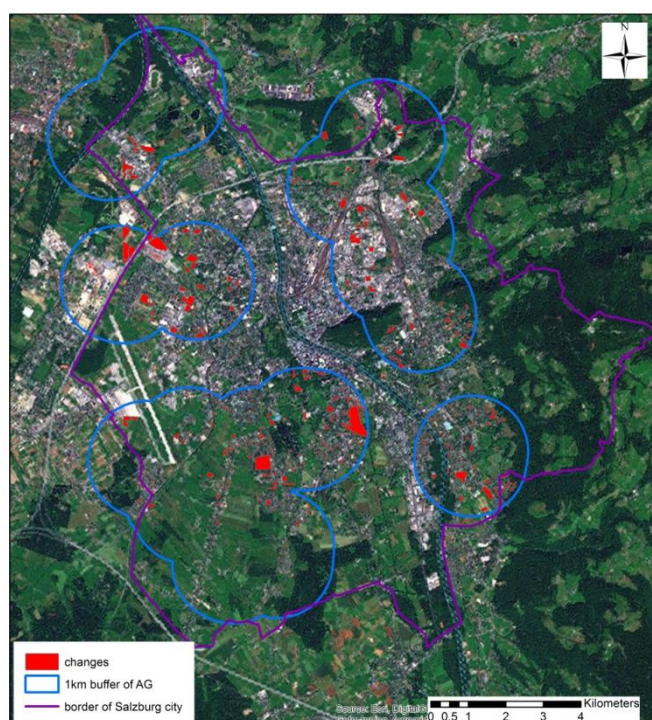


Figure 7. Map of the land use changes in Salzburg in a 1-km buffer of the allotment gardens, 2000-2011

The dominated types of the land in a 1-km buffer of the allotment gardens in 2000 were the built-up area and agricultural one, constituted almost 70% of a total land use (figure 8). The minor part of the city, less than 5 %, is covered by cemeteries, allotment gardens, blue infrastructure and meadows.

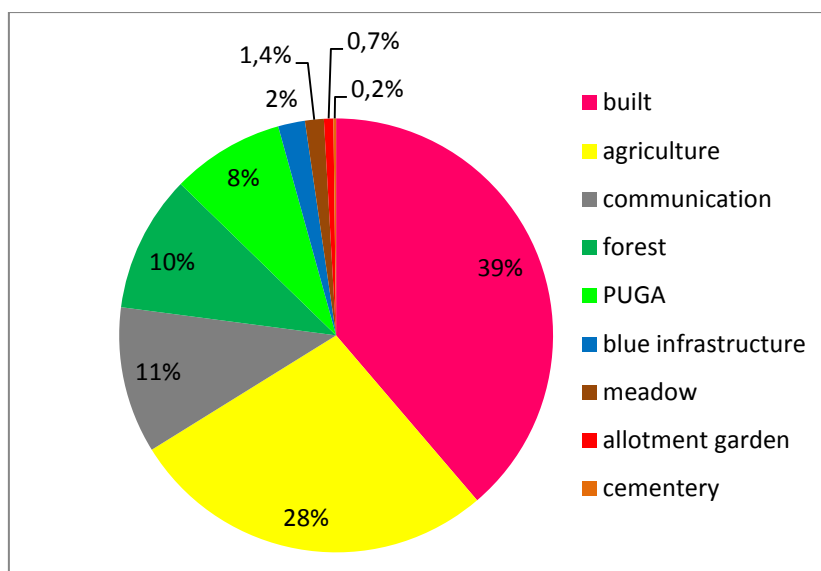


Figure 8. Land use in Salzburg in a 1-km buffer of the allotment gardens (in %), 2000

In comparison with 2000 year, a decrease of the land use in Salzburg in a 1-km buffer of the allotment gardens in the meadows and agriculture areas was noticed while in 2011 an increase percentage of the construction site and built-up areas in the total territory was observed (figure 9).

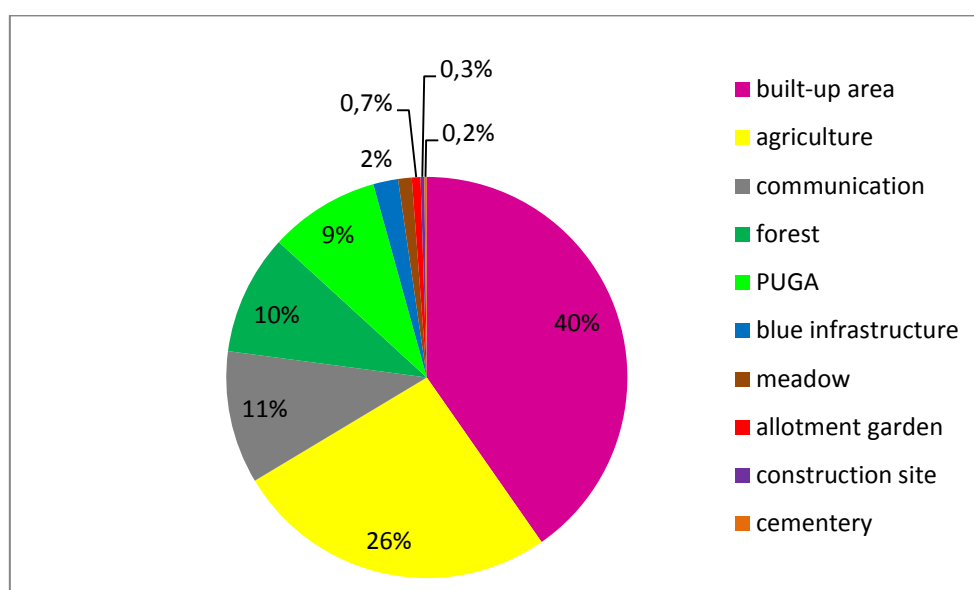


Figure 9. Land use in Salzburg in a 1-km buffer of the allotment gardens (in %), 2011

Table 2 and figure 10 present a specific changes of the land use in a 1-km buffer of the allotment gardens. In the period of 2000-2011 a transformation from agriculture areas into buildings was very frequent, constituting 30% of the total changes. An area of approximately 11,5 ha of agriculture territories to meadow ones was changed, what stated 20% of these modifications.

Table 3. Specific changes of the land use in a 1-km buffer of the allotment gardens in Salzburg, 2000-2011

Type of changes		Salzburg	
From	To	Quantity	Area (ha)
meadow	agriculture	4	2,57
agriculture	built	22	17,98
meadow	built	27	7,9
PUGA	built	1	0,17
allotment garden	built	1	1,25
agriculture	communication	2	1,73
meadow	communication	1	4,3
agriculture	construction site	2	4,46
agriculture	meadow	17	11,56
agriculture	PUGA	5	2,88
meadow	PUGA	2	4,66

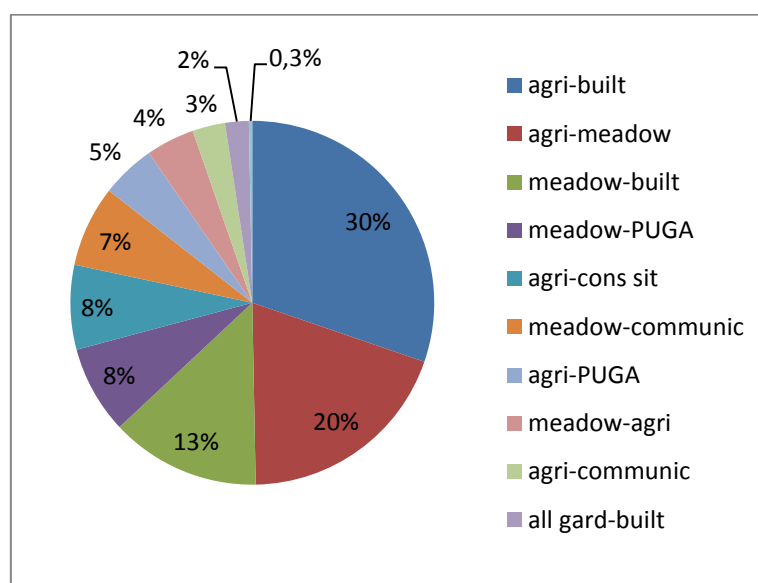


Figure 10. Specific changes of the land use in a 1-km buffer of the allotment gardens in Salzburg (in %), 2000-2011

6.1.2. Land use changes in the nearest neighborhood of the allotment gardens

In the case of the nearest neighborhood of the AG in Salzburg, the analysis was carried out for 2013 based on data collected through fieldwork. The land use of the nearest neighborhood of the allotment gardens since 2000 year is visible on the figure 11. The figure 12 shows the land use of the nearest neighborhood of the allotment gardens since the year 2013. With regard to 2000, a significant portion of the AG bordered with communications was noted. The border of the latest one was longer than the total length of borders shared with agriculture areas, PUGA, forest, meadow and blue infrastructure.

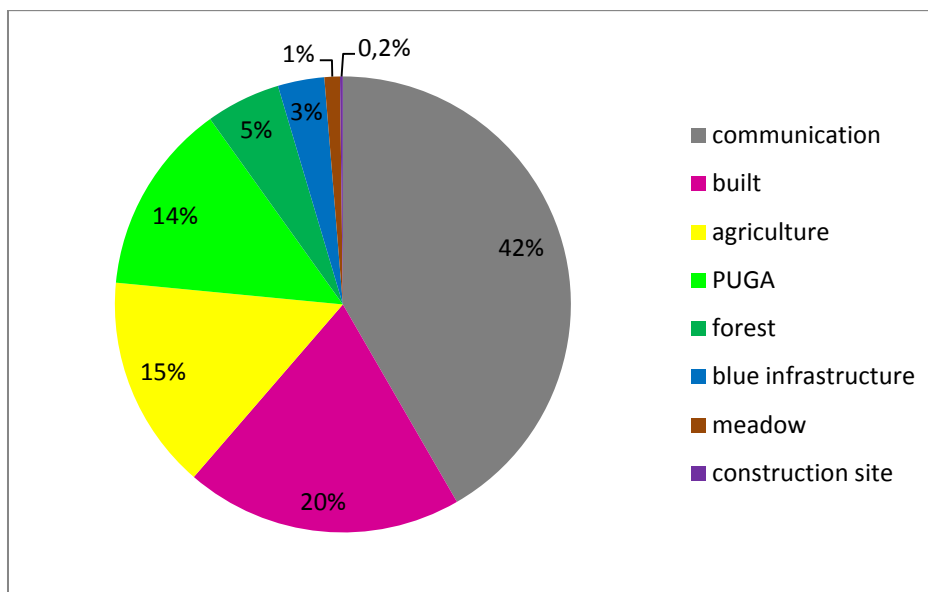


Figure 11. Land use of the nearest neighborhood of the allotment gardens (in %), Salzburg 2000

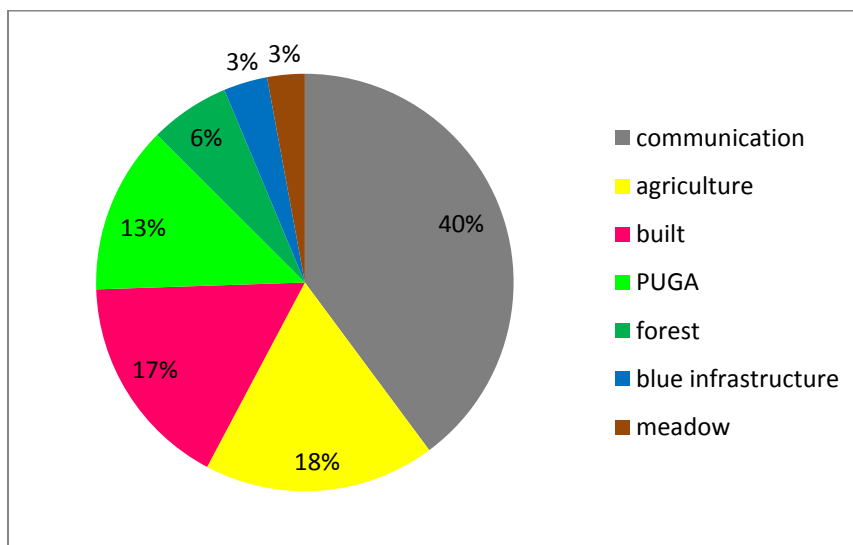


Figure 12. Land use of the nearest neighborhood of the allotment gardens (in %, Salzburg 2013)

The changes of the land use in the nearest neighborhood of the allotment gardens are presented on the table 3. The highest increase in the length of the border was observed on the built-up territory. The increase for a meadow, forest and blue infrastructure was also noted. The limits of the AG shared with agriculture, communication, Public Urban Green Areas was shorted.

Table 4. Differences in the land use of the nearest neighborhood of the allotment gardens in Salzburg (in %), 2000-2013

land use	difference (%)
built	2,7
meadow	1,8
forest	0,9
blue infrastructure	0,1
construction site	-0,2
PUGA	-0,6
communication	-1,9
agriculture	-3

A distribution of the allotment gardens the nearest neighborhood in 2000-2013 were observed are presented on figure 13. Lack of specific trends in the direction of the location of allotment gardens with changes of the land use within their borders are noted.

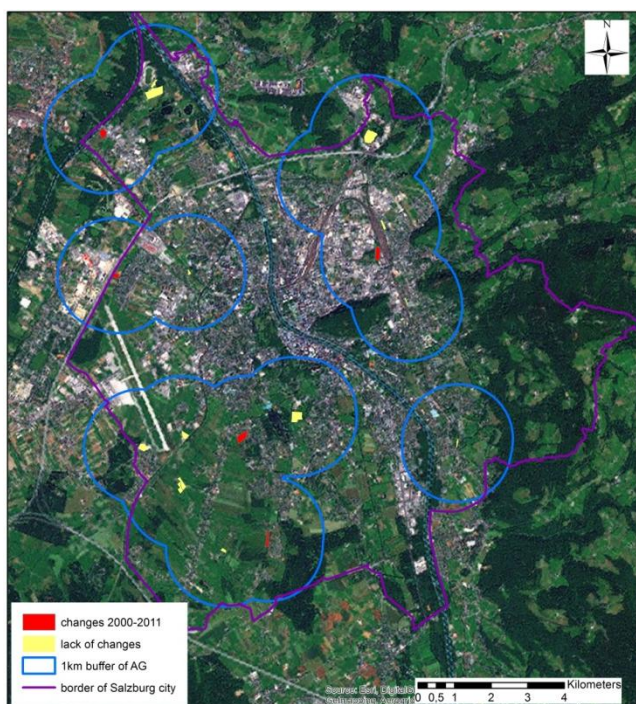


Figure 13. Map of the allotment gardens with the observed changes in the nearest neighborhood in Salzburg, 2000-2013

Some examples of the changes of land use and the lack of changes in the nearest neighborhood of the allotment gardens in the period of 2000-2013 are presented on figures 14-16. In the Kneisslweg AG an increased length of a border shared with a built-up area and agriculture one was noted while that between a neighborhood and communication zone was shortened (figure 14).

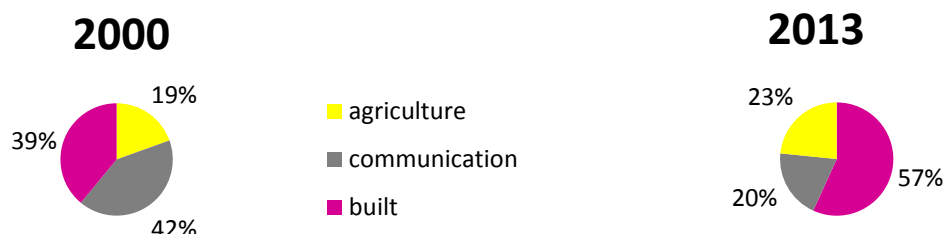


Figure 14. Land use changes in the nearest neighborhood of the allotment gardens, the Kneisslweg AG, Salzburg (in %), 2000-2013

The Leopoldskron AG example showed that a border between a forest area and the built-up terrains has disappeared (figure 15).

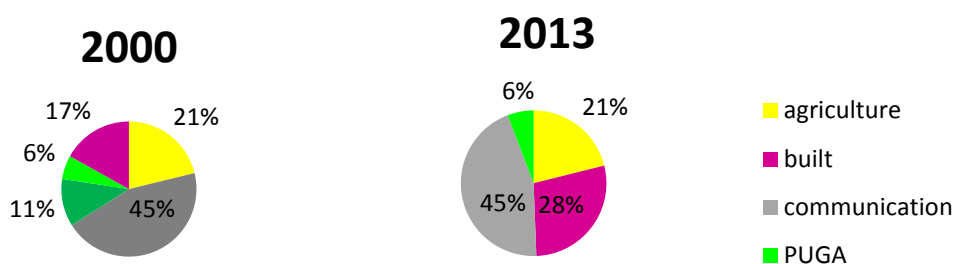


Figure 15. Changes of the land use in the nearest neighborhood of the allotment gardens (in %), the Leopoldskron AG, Salzburg, 2000-2013

No changes of the land use in the nearest neighborhood of the Aigen allotment garden in 2000-2013 were observed (figure 16).

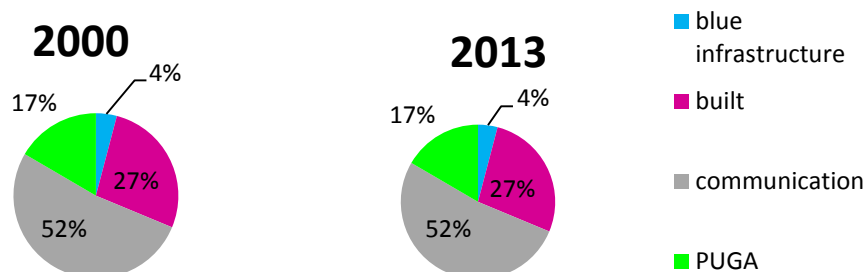


Figure 16. Lack of the changes of land use in the nearest neighborhood of the allotment gardens (in %), Aigen AG, Salzburg, 2000-2013

6.1.3. Mapping

The mapping area of the field work was done for the allotment gardens of the neighbourhood in the 2 selected AG. A key for a terrain identification was attached to the appendix I.



Figure 17. Results of the mapping areas of the Walter Mastnak AG in a 200-m buffer

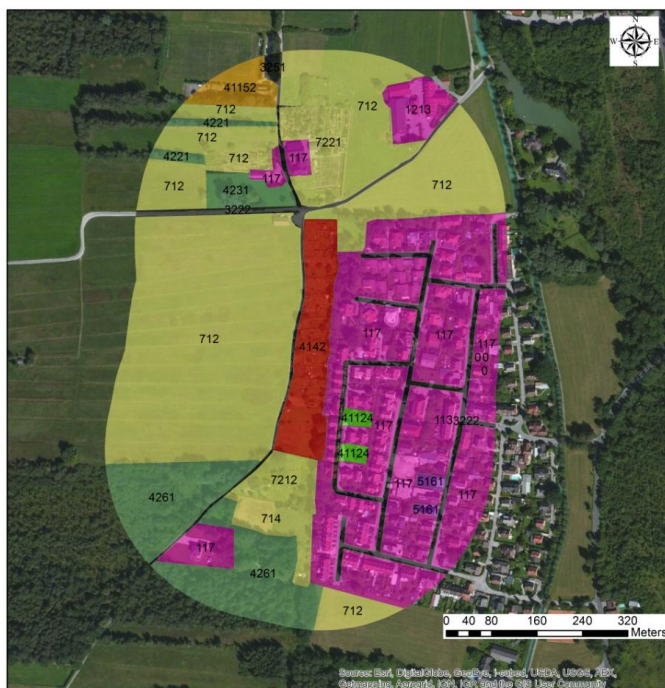


Figure 18. Results of the mapping area of the Kneisslweg AG in a 200-m buffer

6.1.4. Socio-ecological map

During the field work the data necessary to create the socio-ecological maps in a 200-meter buffer of the AG was collected. Figures 19 – 20 show the socio-ecological maps in the neighbourhood of 2 selected AG.

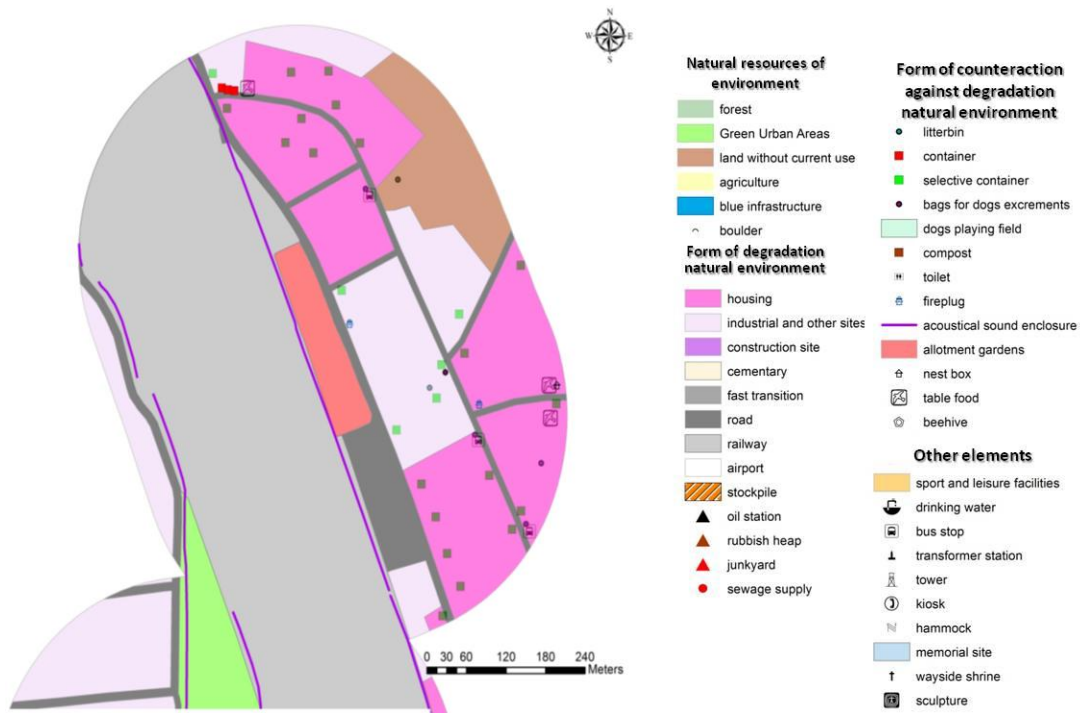


Figure 19. Socio-ecological map of the Walter Mastnak AG in a 200-m buffer

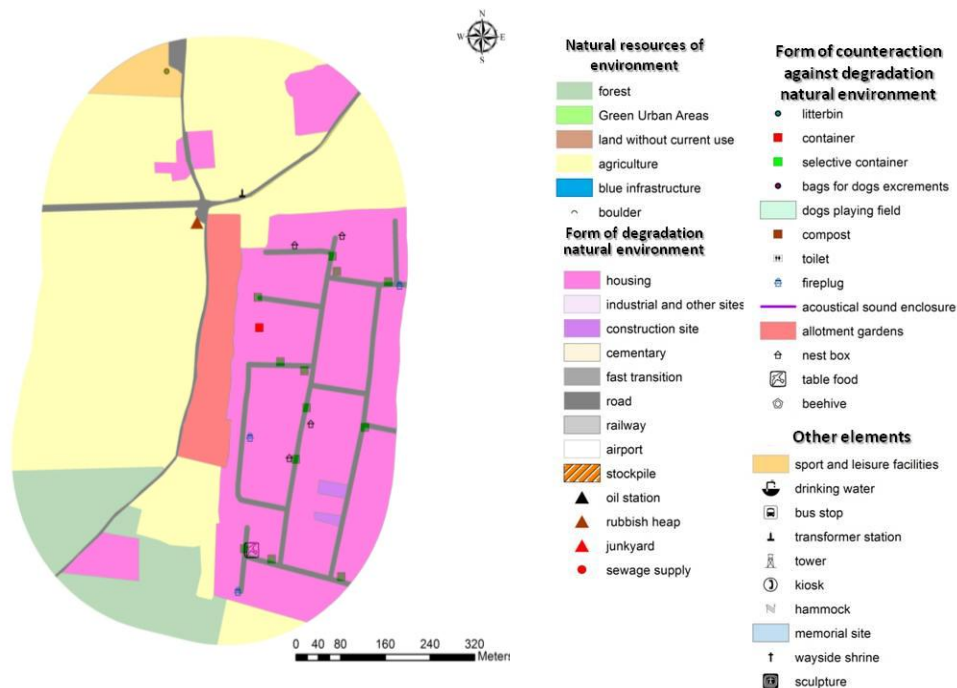


Figure 20. Socio-ecological map of the Kneisslweg AG in a 200-m buffer

6.1.5. Survey

A visual assessment of the allotment gardens on areas of the railway AG and the private ones was done. Each type of the allotment gardens consisted of 5-group complexes of the AG.

Figures 21-28 present the results of a survey concerning a dominated type of use, a blue infrastructure, recreational facilities, compost, ecological facilities, green barriers around single parcels, whole complexes of allotment gardens, and a potential impact of the neighbourhood and buffers on dangers. The allotment gardens are cultivated for food, ornamental and for unspecified purposes. In each complex it was impossible to observe a dominated type of the use (figure 21).

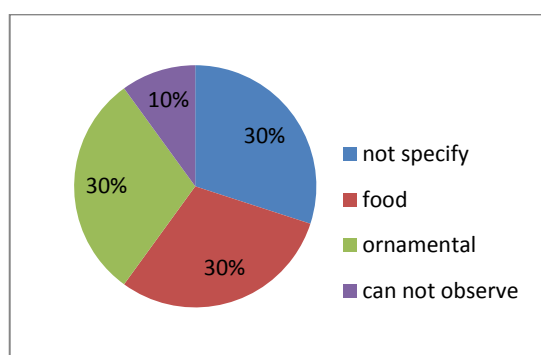


Figure 21. Dominated type of the use of allotment gardens

Much more AG complexes (40%) was described as a half-descent (figure 22). The railway allotment gardens were under the best care, which means to be well maintained, tidy and proper, without weeds. The minor group consisted of the allotment gardens, weeds and portrayed as wild areas.

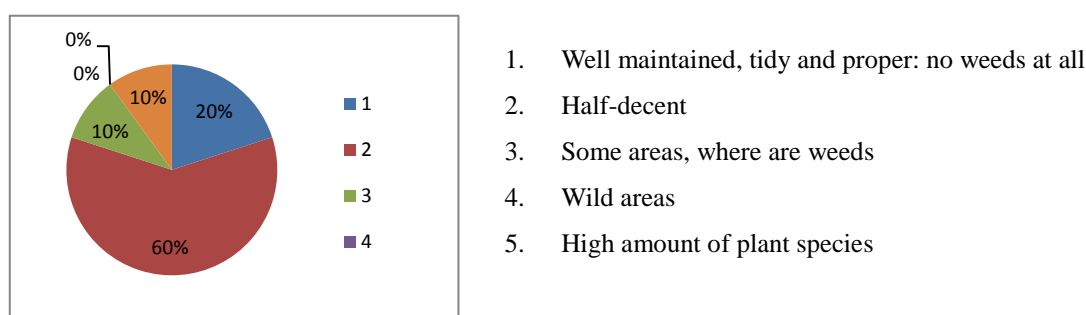


Figure 22. Description of the allotment gardens

With relation to the compost used in the AG, no common compost was observed. Around 60% of single parcels of the AG have individual compost (figure 23).

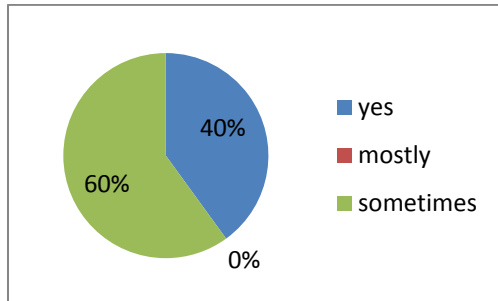


Figure 23. Frequency of individual compost in single parcels of the allotment garden

On the area of the AG some ecological facilities, bird table and nest box were found, among them bird table were more often (figure 24).

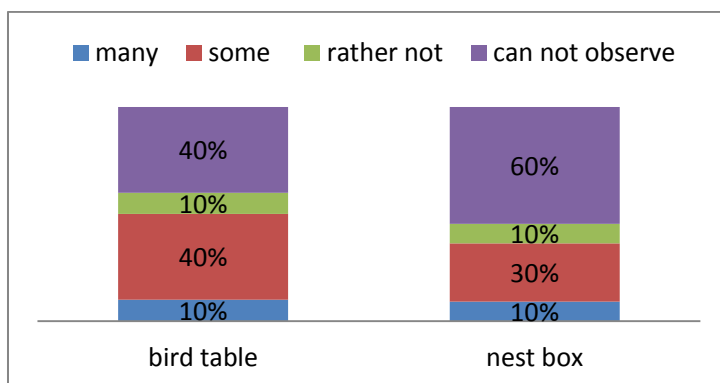


Figure 24. Ecological facilities on a single parcel of the allotment garden

Around a single parcel of the allotment gardens a green roof or a wall was no often, what is shown on figure 25. The green roofs or walls around the AG complexes were observed much frequently (figure 26).

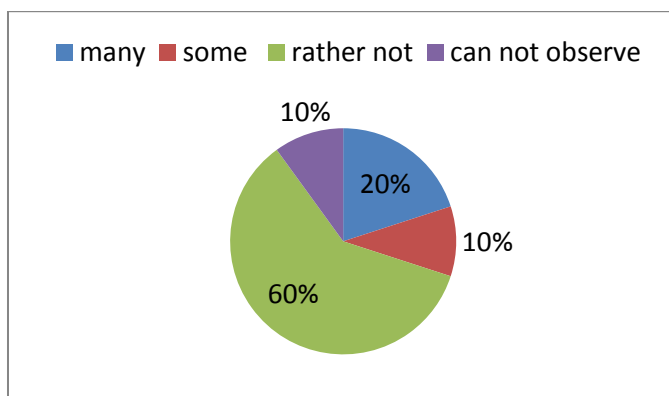


Figure 25. Green roof/walls around a single parcel

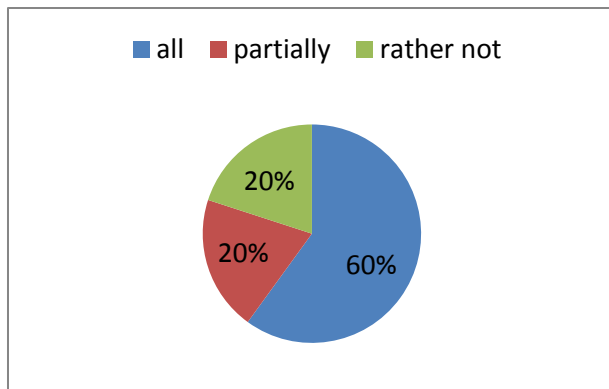


Figure 26. Green roof/walls around the allotment garden

The important part of the survey was an identification of a potential impact from the neighbourhood. The most common factors influencing the AG were railways, however 2 allotment gardens with no potential affecting objects were found (figure 27).

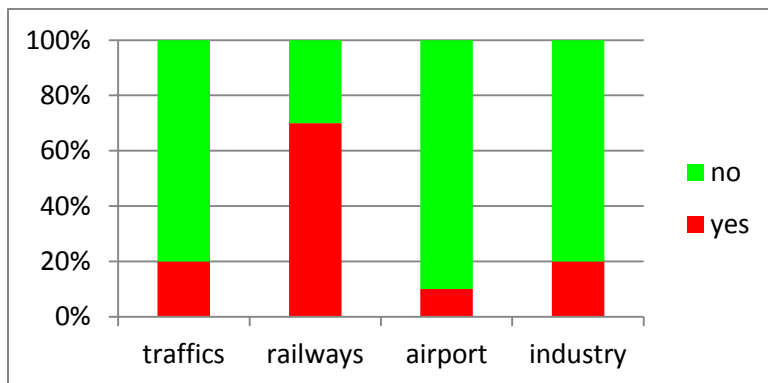


Figure 27. Potential impact from the neighbourhood

Some of the allotment gardens have buffered to protect against the above-mentioned impact from the neighbourhood. Almost all the AG complexes have hedges against noise and pollution, which are presented on figure 28.

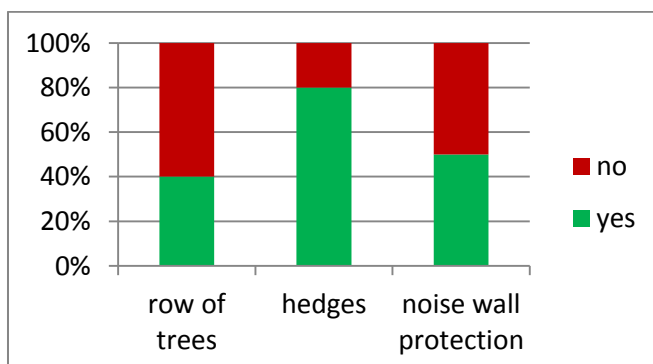


Figure 28. Buffers against noise/pollution/flood

6.2. Poznań

6.2.1. Land use changes in a 1-km buffer of the allotment gardens

The land use of Poznań in a 1-km buffer of the allotment gardens since 2001 is presented on the figure 29. Figure 30 shows the land use of Poznań in a 1-km buffer of the allotment gardens since 2011. With the neighbourhood of the city centre, more abundant, built-up areas are observed opposite to agriculture and meadows ones. The Public Urban Green Areas and forest create a ring, which has a very specific structure. The cemeteries are more often noticeable in the external part of the urban area.

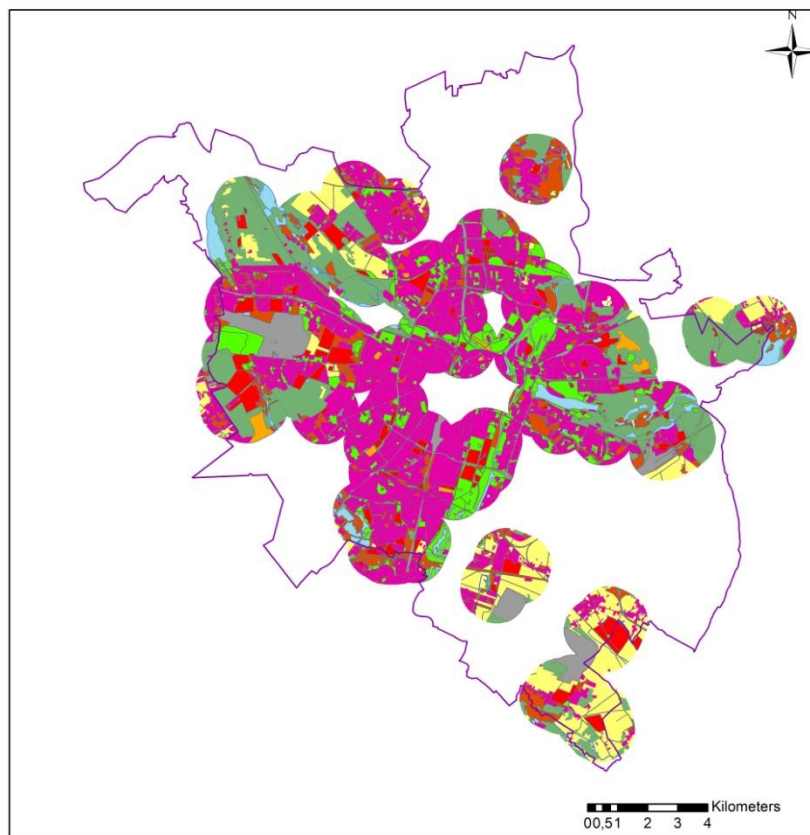


Figure 29. Land use map of Poznań in a 1-km buffer of the allotment gardens, 2001

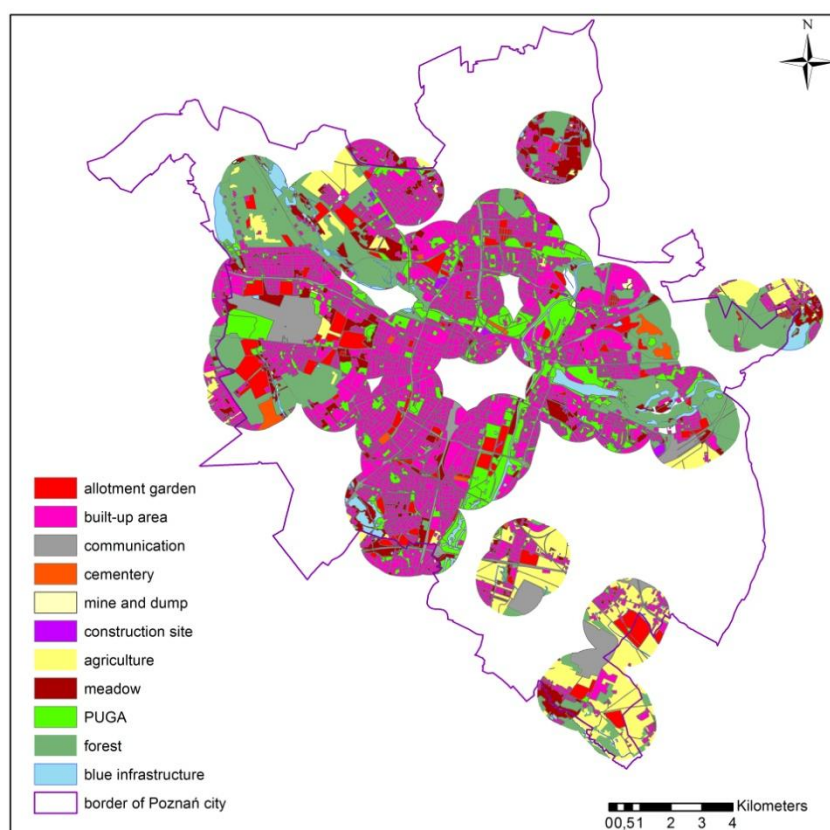


Figure 30. Land use map of Poznań in a 1-km buffer of the allotment gardens, 2011

The map of changes of the land use in a 1-km buffer of the allotment gardens is shown on figures 31. Since 2001-2011 more changes have occurred in the external part of the city.

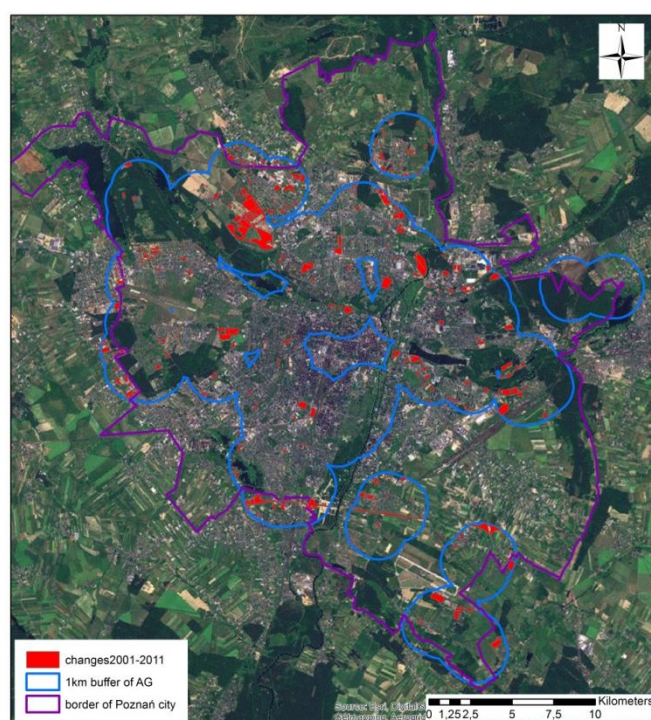


Figure 31. Map of the changes of and use in Poznań in a 1-km buffer of the allotment gardens, 2001-2011

The dominated types of the land use in a 1-km buffer of the allotment gardens in 2001 were a built-up area and a forest one covering over a half of the total land use (figure 32). The minor part of the city, amounting to 1 percent, was covered by cemeteries, construction sites and mine, and dumps.

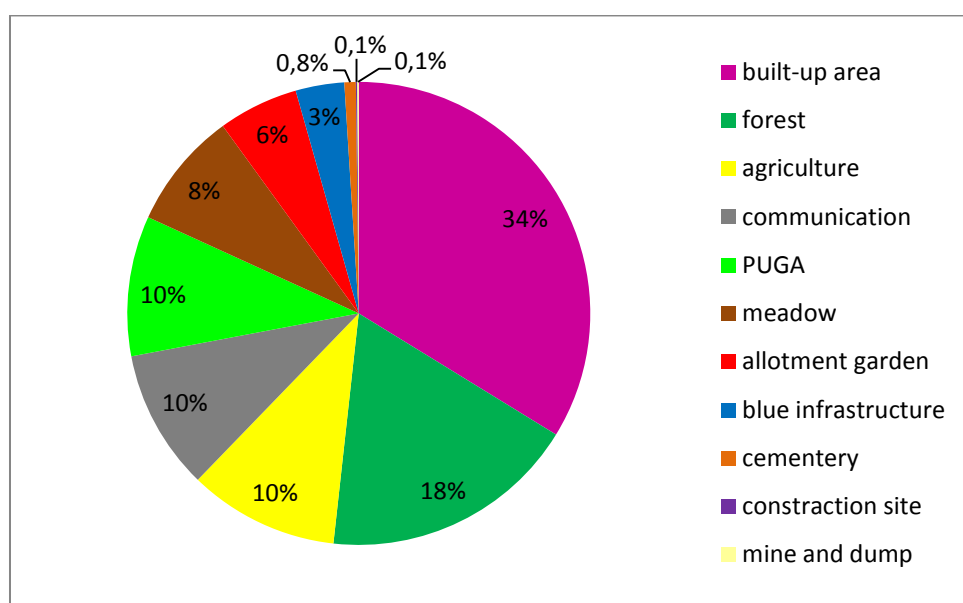


Figure 32. Land use of Poznań in a 1-km buffer of the allotment gardens (in %), 2001

According to the investigation on the changes in land use in period of 2001-2011 in a 1-km buffer of the allotment gardens in Poznań, a decrease of meadow was observed, whereas an increase of construction site and built-up area was noted (figure 33).

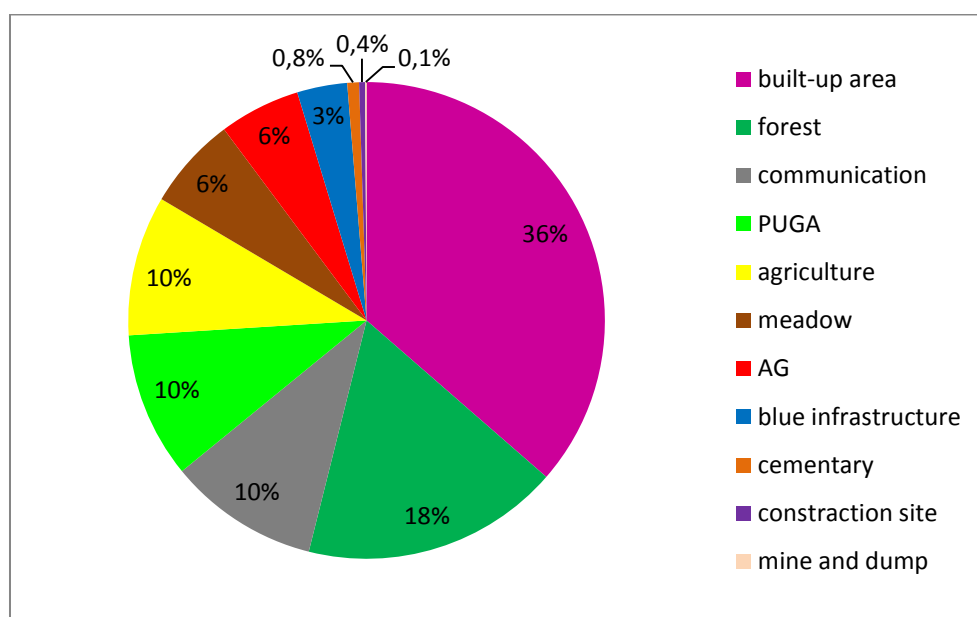


Figure 33, Land use in Poznań in a 1-km buffer of the allotment gardens (in %), 2011

Table 4 and figure 34 present specific changes in the land use in a 1-km buffer of the allotment gardens. In Poznań in the years 2001-2011 the most common modification of meadows were to convert them to urban areas. This accounted for almost half of all changes. The significant transformations were to change the fields into the meadow, covering 100ha, which accounted for 14% of changes.

Table 5. Specific of changes in the land use in Poznań in a 1-km buffer of the allotment gardens, 2001-2011

Type of changes		Poznań	
From	To	Quantity	Area (ha)
forest	agriculture	1	1,1
meadow	built-up area	264	335,9
agriculture	built-up area	36	57,4
forest	built-up area	37	58,5
PUGA	built-up area	5	17,9
meadow	cemetery	1	4,1
forest	communication	1	10,9
agriculture	communication	1	1,6
meadow	communication	8	51,5
forest	construction site	6	6,6
PUGA	construction site	1	5,5
meadow	construction site	13	26,8
agriculture	construction site	4	5,6
AG	meadow	4	10,6
agriculture	meadow	14	98,5
forest	PUGA	4	13,3
meadow	PUGA	11	10,4
agriculture	PUGA	2	1,9

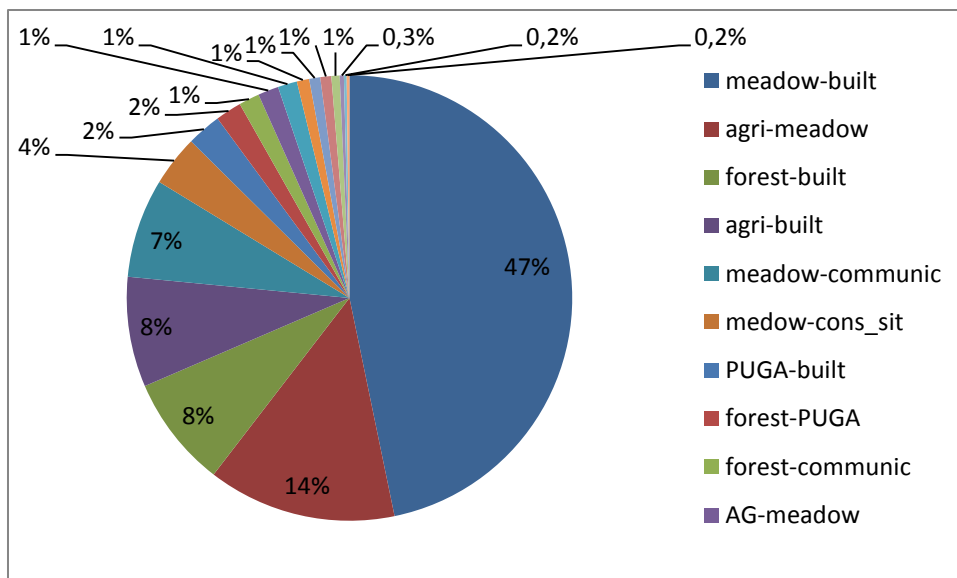


Figure 34. Specific of changes in the land use in Poznań in a 1-km buffer of the allotment gardens (in %), 2001-2011

6.2.2. Land use changes in the nearest neighbourhood of allotment gardens

The land of the nearest neighbourhood of the allotment gardens since 2001 is shown on the figure 35, while figure 36 presents the land in the nearest neighbourhood of the allotment gardens since 2011. Similarly to the past, the most significant part of the AG border is shared with other allotment garden. A built-up area constituted in 2001 only 12% and in 2011 - 13%. The same was true with regard to the forest.

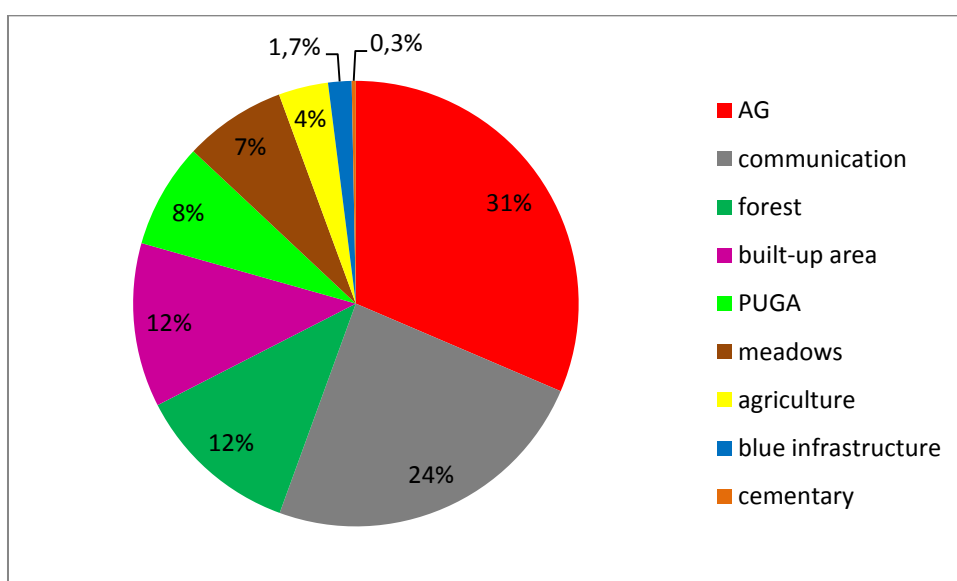


Figure 35. Land use of the nearest neighbourhood of the allotment gardens (in %), Poznań, 2001

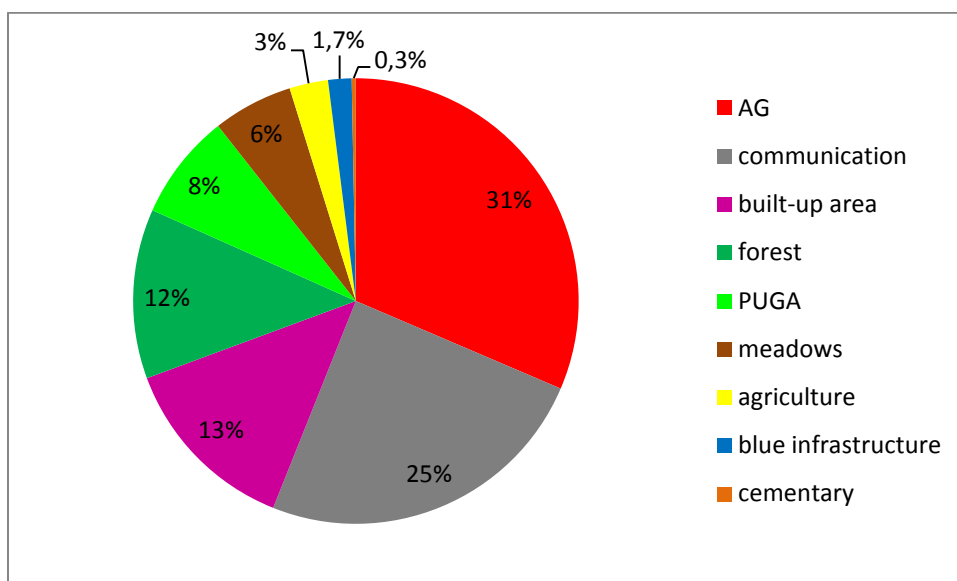


Figure 36. Land use of the nearest neighbourhood of the allotment gardens (in %), Poznań, 2011

The changes of the land use of the nearest neighbourhood of the allotment gardens are presented on the table 5. The strongest increase in the length of a border was observed in the built-up areas. An increase was noted for communication, forest and Public Urban Green Areas. The limits of the AG shared with agriculture and meadows were shortened.

Table 6. Differences in the land use of the nearest neighbourhood of the allotment gardens (in %), 2001-2011, Poznań

land use	difference (%)
built-up area	1,4
communication	0,5
forest	0,4
PUGA	0,1
AG	0
blue infrastructure	0
cementary	0
agriculture	-0,8
meadows	-1,6

Figure 37 presents a distribution of the allotment gardens. The changes in the nearest neighbourhood in the period of 2001-2011 were observed. There is a trend towards more frequent appearance of modified territories within the allotments located the outside the city.

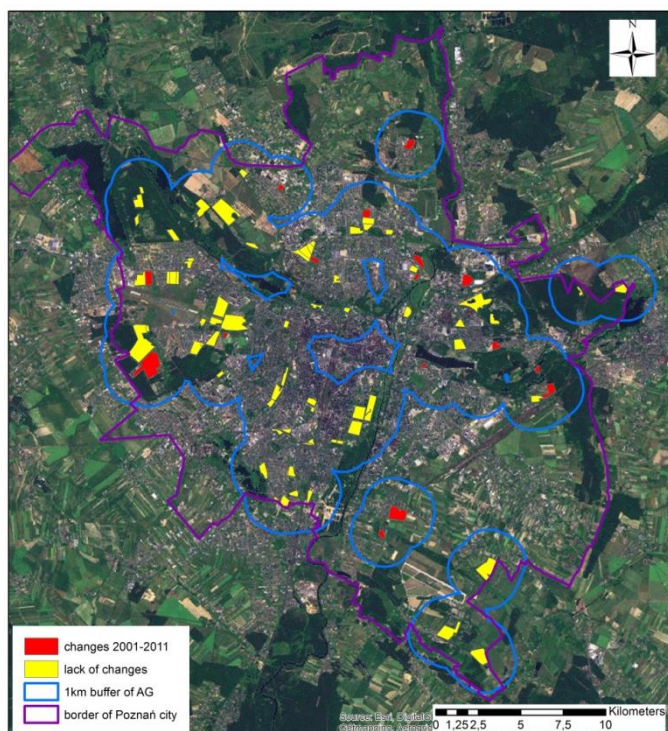


Figure 37. Map of the allotment gardens and changes in the nearest neighbourhood in 2001-2011, Poznań

The examples of the changes in land use and lack of changes in the nearest neighbourhood of the allotment gardens in the period of 2000-2013 are presented on figures 39-40. The AG presented on figure 38 showed a disappearing border between the allotment garden and meadow areas.



Figure 38. Changes in land use in the nearest neighbourhood of the allotment gardens in the period of 2001-2011 (in %) on the example of number 55, Poznań

In the case of the AG an increase length of a border shared with a built-up area is shown on the figure 39. A neighbourhood with a meadow was shortened.

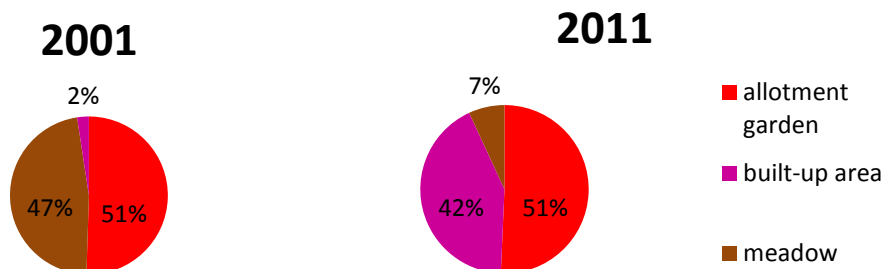


Figure 39. Changes in land use in the nearest neighbourhood of the allotment gardens in the period of 2001-2011 (in %) on the example of number 45, Poznań

Figure 40 shown no changes in the nearest neighbourhood of the allotment garden in the period of 2001-2011.

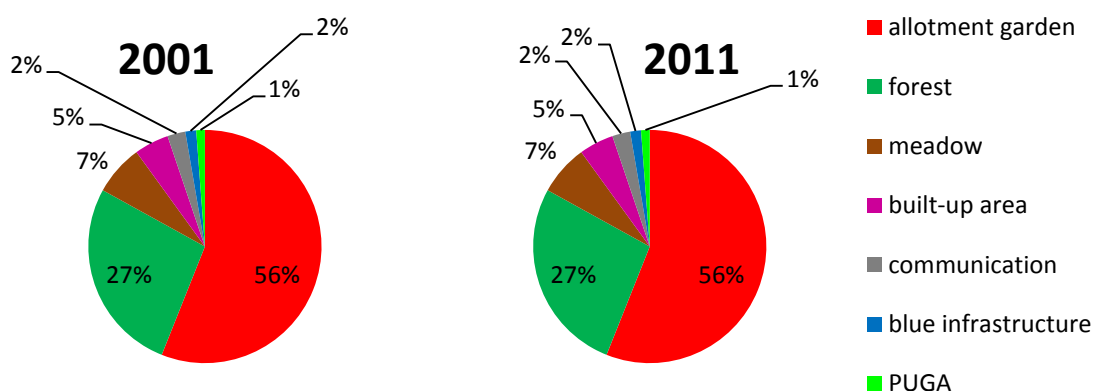


Figure 40. Lack of the changes in land in the nearest neighbourhood of the allotment gardens in the period of 2001-2011 (in %) on the example of number 36, Poznań

6.2.3. Mapping

A comparative study with the same criteria as that described in the methodological section were also realized in Poznań. Due to the arrival of the autumn survey has been postponed to spring.

6.2.4. Socio-ecological map

A field work necessary to create a socio-ecological map of the neighbourhood of the allotment gardens in a 200m buffer has been postponed to spring.

6.2.5. Survey

A terrain work has been postponed to spring.

6.3. Comparative analysis of the changes in land use in the neighbourhood of the allotment gardens in the city of Poznań and Salzburg

The important differences in the changes in land use in the neighbourhood of the allotment gardens in the cities of Poznań and Salzburg are presented on the table 7. In Salzburg an average area of the changes were much smaller than that in Poznań. The number of changes and their total area were smaller as well. Taking into account the nearest neighbourhood, a scale of the changes differed between the cities. Despite a larger number of the allotment gardens in Poznań, the percentage of the AG with the changes along shared borders was almost as smaller as a half (table 7).

Table 7. General comparison between the changes in land use in the neighbourhood of the allotment gardens

feature	Poznań	Salzburg
land use changes		
number of changes	414	84
total changed area (ha)	718,1	59,4
mean changed area (ha)	1,7	0,7
the closest neighborhood changes		
number of AG 2001-2011/ 2000-2013	83	18
number of AG with changes in the closest neighborhood	16	7
percentage of AG with changes in the closest neighborhood	19,3	38,9

A comparison of the specific changes in land use in a 1 -km buffer between Salzburg and Poznań in the period of 2000/2001-2011 is presented on the table 8. In both cities the biggest changes in a 1-km buffer are represented by a build-up area. In Salzburg the most common transformation was that from agriculture, while in Poznań from meadow. The second most frequent modification was an agriculture-meadow type. In Poznań a stronger diversity in changes were observed than in Salzburg: 18 vs. 11, respectively.

Table 8. Comparison of a specific changes in the land use in a 1-km buffer between Poznań and Salzburg, 2001-2011/2000-2011

Type of changes		Poznań		Salzburg	
From	To	Quantity	Area (ha)	Quantity	Area (ha)
meadow	agriculture	0	0	4	2,57
forest	agriculture	1	1,1	0	0
meadow	built-up area	264	335,9	27	7,9
agriculture	built-up area	36	57,4	22	17,98
forest	built-up area	37	58,5	0	0
allotment garden	built	0	0	1	1,25
PUGA	built-up area	5	17,9	1	0,17
meadow	cemetery	1	4,1	0	0
forest	communication	1	10,9	0	0
agriculture	communication	1	1,6	2	1,73
meadow	communication	8	51,5	1	4,3
forest	construction site	6	6,6	0	0
PUGA	construction site	1	5,5	0	0
meadow	construction site	13	26,8	0	0
agriculture	construction site	4	5,6	2	4,46
allotment garden	meadow	4	10,6	0	0
agriculture	meadow	14	98,5	17	11,56
forest	PUGA	4	13,3	0	0
meadow	PUGA	11	10,4	2	4,66
agriculture	PUGA	2	1,9	5	2,88

7. Conclusion

Without any doubt the changes in land use have influenced the allotment gardens. For instance, an increase of a built-up area or communication influences the increase of the level of noise or pollution caused by traffics. This in turn affects both the well-being allotment gardens as the places of rest and recreation as the urban nature.

The conducted comparative study has shown the changes in land use in the cities of Poznań and Salzburg in a 1-km buffer of the allotment gardens and the nearest neighbourhood of the AG. Despite the differences between the studied cities some similarities were observed. In Salzburg, agriculture is the most frequent in a 1-km buffer of the allotment gardens. With the greatest probability were transformed into a built-up area, while meadow was modified to communication, a built-up area or a Public Urban Green Area. Taking into account a 1-km buffer of the allotment gardens, meadow is the most change of land use in Poznań. The most frequently it was changed into a built-up area or to communication. Agriculture and forest areas are the other type of the use, commonly modified. Both usually changed into the built-up areas. Nevertheless, a more integrated, multidimensional and comparative studies are needed to understand this phenomenon in a full manner.

What is worth emphasizing is the fact this report is to present very preliminary outcomes in in a concise and brief manner. More detailed study will be presented at the meeting in Lisbon.

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10. Appendices

Appendix I. Mapping codes used during field work

1. Housing

1.1. Urban fabric

- 1.1.1. Modern inner city**
- 1.1.2. Old town**
- 1.1.3. Block development**
- 1.1.4. Ribbon development**
- 1.1.5. High buildings and large forms**
- 1.1.6. Single and terraced buildings (without parking)**
- 1.1.7. Old houses with park-like gardens**
- 1.1.8. (Public) Buildings with open and green spaces**

1.2. Rural areas

- 1.2.1. Village settlements**
 - 1.2.1.1. Farm**
 - 1.2.1.2. Shed, barn, stable**
- 1.2.2. Agricultural production / large companies (including residential buildings and outdoor facilities)**
- 1.2.3. Rural residential forms**
- 1.2.4. Urbanized village areas**

1.3. Singular buildings

2. Industrial areas

2.1. Industrial areas and sealed supply systems with waste disposal facilities

- 2.1.1. Open areas with mostly horticultural green**
- 2.1.2. Open areas with mainly spontaneous vegetation**
- 2.1.3. Open areas with horticultural green as well as spontaneous green**
- 2.1.4. Open areas almost free of vegetation**

2.2. Commercial areas and farms

- 2.2.1. Very strong commercial sealed surfaces (mainly buildings, parking, storage areas, etc.)**
- 2.2.2. Sealed commercial areas with low shares of open space**
 - 2.2.2.1. Open areas with mostly horticultural green**
 - 2.2.2.2. Open areas with mainly spontaneous vegetation**
 - 2.2.2.3. Open areas with horticultural green as well as spontaneous green**
 - 2.2.2.4. Open areas almost free of vegetation**

2.3. Small sealed industrial sites with water installations and waste disposal facilities

- 2.3.1. Wastewater treatment plant**

- 2.3.2. Construction waste / mountain of debris
- 2.3.3. Sorted landfill
- 2.3.4. Industrial landfill
- 2.3.5. Waterworks (wells, pumping stations, water tanks)
- 2.3.6. Sewer
- 2.3.7. Composting area

3. Traffic areas

3.1. Railway facilities

- 3.1.1. Unsealed open areas, railway tracks, railway embankments and track fields
 - 3.1.1.1. More or less without vegetation
 - 3.1.1.2. Spontaneous vegetation
- 3.1.2. Built up area
 - 3.1.2.1. Open areas with mostly horticultural green
 - 3.1.2.2. Open areas with mainly spontaneous vegetation
 - 3.1.2.3. Open areas with horticultural green as well as spontaneous green
 - 3.1.2.4. Open areas almost free of vegetation
- 3.1.3. Tram systems
 - 3.1.3.1. Sealed
 - 3.1.3.2. Not sealed

3.2. Road facilities

- 3.2.1. Motorways, motorway-like multi-lane highways
 - 3.2.1.1. Mostly horticultural green of roadside belt
 - 3.2.1.2. Roadside belt with mainly spontaneous vegetation
 - 3.2.1.3. Roadside belt with horticultural green as well as spontaneous green
 - 3.2.1.4. More or less free of vegetation
 - 3.2.1.5. Mostly with single trees
 - 3.2.1.6. Mainly with trees on both sides (Avenue)
- 3.2.2. Roads (with asphalt)
 - 3.2.2.1. Mostly horticultural green of roadside belt
 - 3.2.2.2. Roadside belt with mainly spontaneous vegetation
 - 3.2.2.3. Roadside belt with horticultural green as well as spontaneous green
 - 3.2.2.4. More or less free of vegetation
 - 3.2.2.5. Mostly with single trees
 - 3.2.2.6. Mainly with trees on both sides (Avenue)
- 3.2.3. Pavement (for bikes and pedestrian)
 - 3.2.3.1. Mostly horticultural green of roadside belt
 - 3.2.3.2. Roadside belt with mainly spontaneous vegetation
 - 3.2.3.3. Roadside belt with horticultural green as well as spontaneous green
 - 3.2.3.4. More or less free of vegetation
 - 3.2.3.5. Mostly with single trees
 - 3.2.3.6. Mainly with trees on both sides (Avenue)
- 3.2.4. Footpath (not sealed)
 - 3.2.4.1. More or less free of vegetation
 - 3.2.4.2. Poor vegetation
 - 3.2.4.3. More or less dense vegetation occurs
- 3.2.5. Parking

- 3.2.5.1. **Mainly unsealed, more or less free of vegetation**
- 3.2.5.2. **Mainly unsealed, some with spontaneous vegetation or planted green**
- 3.2.5.3. **Mainly sealed with planted green, rarely spontaneous vegetation**
- 3.2.5.4. **Completely sealed**

3.3. Airport facilities

- 3.3.1.1. **Mainly unsealed, more or less free of vegetation**
- 3.3.1.2. **Mainly unsealed, some with spontaneous vegetation or planted green**
- 3.3.1.3. **Mainly sealed with planted green, rarely spontaneous vegetation**
- 3.3.1.4. **Completely sealed**

4. Green Areas

4.1. Green spaces, parks and recreation facilities

4.1.1. (Public) Green and parks as well as low-sealed sports and recreation facilities

- 4.1.1.1. **most intensively cultivated or used (public) parks and parking areas**
 - 4.1.1.1.1. mainly with old trees
 - 4.1.1.1.2. mainly with trees average age structure
 - 4.1.1.1.3. predominantly young planting or shrub plantings
 - 4.1.1.1.4. more or less without trees
 - 4.1.1.1.5. mixed age of trees
- 4.1.1.2. **mainly extensively maintained (public) parks and parking areas**
 - 4.1.1.2.1. mainly with old trees
 - 4.1.1.2.2. mainly with trees average age structure
 - 4.1.1.2.3. predominantly young planting or shrub plantings
 - 4.1.1.2.4. more or less without trees
 - 4.1.1.2.5. mixed age of trees
- 4.1.1.3. **Castle or Parks around**
 - 4.1.1.3.1. mainly with old trees
 - 4.1.1.3.2. mainly with trees average age structure
 - 4.1.1.3.3. predominantly young planting or shrub plantings
 - 4.1.1.3.4. more or less without trees
 - 4.1.1.3.5. mixed age of trees
- 4.1.1.4. **outdoor pools with large green areas or unpaved areas of water**
 - 4.1.1.4.1. mainly with old trees
 - 4.1.1.4.2. mainly with trees average age structure
 - 4.1.1.4.3. predominantly young planting or shrub plantings
 - 4.1.1.4.4. more or less without trees
 - 4.1.1.4.5. mixed age of trees
- 4.1.1.5. **campsites**
 - 4.1.1.5.1. mainly with old trees
 - 4.1.1.5.2. mainly with trees average age structure
 - 4.1.1.5.3. predominantly young planting or shrub plantings
 - 4.1.1.5.4. more or less without trees
 - 4.1.1.5.5. mixed age of trees
- 4.1.1.6. **golf courses**
 - 4.1.1.6.1. mainly with old trees
 - 4.1.1.6.2. mainly with trees average age structure

- 4.1.1.6.3. predominantly young planting or shrub plantings
- 4.1.1.6.4. more or less without trees
- 4.1.1.6.5. mixed age of trees
- 4.1.1.7. football fields and sports grounds**
 - 4.1.1.7.1. mainly with old trees
 - 4.1.1.7.2. mainly with trees average age structure
 - 4.1.1.7.3. predominantly young planting or shrub plantings
 - 4.1.1.7.4. more or less without trees
 - 4.1.1.7.5. mixed age of trees
- 4.1.1.8. playgrounds**
 - 4.1.1.8.1. Park and forest playground
 - 4.1.1.8.2. playground in the settlement area
- 4.1.1.9. other sports and leisure areas with sealing degree <40%**
 - 4.1.1.9.1. riding
 - 4.1.1.9.2. Dogs Playing Field
- 4.1.2. Strong sealed sports and recreational facilities with building area shares (including sports halls)**
 - 4.1.2.1. Swimming pools (concrete pools, buildings, lawns, etc.)
 - 4.1.2.2. Olympic games and ball game facilities (soccer fields, etc.)
 - 4.1.2.3. riding arenas, racetracks
 - 4.1.2.4. sports shooting, statuses
 - 4.1.2.5. tennis and squash courts
 - 4.1.2.6. commercial leisure and amusement facilities
 - 4.1.2.7. gymnastics and sports halls, Sports Club building, more or less without further grounds
 - 4.1.2.8. driver training courses and test stretch
 - 4.1.2.9. skate, skater or skating rinks and ice rinks
- 4.1.3. Cemeteries**
 - 4.1.3.1. Park Cemeteries
 - 4.1.3.2. city cemeteries with dense occupancy
 - 4.1.3.3. forest cemeteries
 - 4.1.3.4. cemetery new plants and extensions
 - 4.1.3.5. Pet Cemetery
- 4.1.4. Gardens**
 - 4.1.4.1. Allotment gardens (with cabin)
 - 4.1.4.2. settlers Gardens (without cabin)
 - 4.1.4.3. Abandoned Gardens
 - 4.1.4.4. small animal breeding facility
- 4.1.5. Botanical and Zoological Gardens**
- 4.2. Trees, hedgerows, thickets, forests**
 - 4.2.1. Mainly single tree landscape**
 - 4.2.2. row of trees**
 - 4.2.2.1. mainly deciduous trees
 - 4.2.2.2. mainly coniferous
 - 4.2.2.3. mixed stand
 - 4.2.3. group of trees**
 - 4.2.3.1. mainly deciduous trees
 - 4.2.3.2. mainly coniferous
 - 4.2.3.3. mixed stand

- 4.2.4. bushes, shrub, shrub group (height 2 m max.)**
 - 4.2.4.1. mainly deciduous shrubs
 - 4.2.4.2. mainly coniferous
 - 4.2.4.3. mixed stand of deciduous and coniferous shrubs
 - 4.2.4.4. mainly fruit trees
- 4.2.5. row of trees in damp wet locations**
 - 4.2.5.1. Willow and alder groves
 - 4.2.5.2. wooded shore waters accompanying strip
 - 4.2.5.3. wetlands and riparian woodlands
- 4.2.6. Forests**
 - 4.2.6.1. mainly deciduous trees
 - 4.2.6.2. mainly coniferous
 - 4.2.6.3. mixed stand
 - 4.2.6.4. key corridors and pioneer forest
 - 4.2.6.5. afforestation, plantations
 - 4.2.6.5.1. predominantly deciduous shrubs
 - 4.2.6.5.2. mainly coniferous
 - 4.2.6.5.3. mixed stand
 - 4.2.6.6. Glade

5. Construction sites and land currently without use

5.1. Urban land and ruderal areas

- 5.1.1. More or less devoid of vegetation fallow land, unsealed open spaces**
- 5.1.2. wastelands with predominantly short-lived ruderal vegetation**
 - 5.1.2.1. on rather lean, dry locations pioneer
 - 5.1.2.2. in more nutrient-rich, fresh pioneer sites
- 5.1.3. wastelands with predominantly perennial ruderal vegetation**
 - 5.1.3.1. rather fresh on location, species-rich
 - 5.1.3.2. on fresh to moderately moist location, species-poor
 - 5.1.3.3. in rather dry site
 - 5.1.3.4. Ruderal meadows
- 5.1.4. Structurally rich fallow land with small scale vegetation change
various stages of succession**
- 5.1.5. trailer courts**
- 5.1.6. Areas where digging have taken a place**
 - 5.1.6.1. more or less without vegetation
 - 5.1.6.2. with young spontaneous vegetation
 - 5.1.6.3. with old spontaneous vegetation
- 5.1.7. Waste rock pile**
 - 5.1.7.1. more or less without vegetation
 - 5.1.7.2. with young spontaneous vegetation
 - 5.1.7.3. with old spontaneous vegetation

6. Blue infrastructure

6.1. Stagnated water

6.1.1. Lakes

- 6.1.1.1. Vegetation types in the lake**
 - 6.1.1.1.1. Abundant submerged vegetation
 - 6.1.1.1.2. poor submerged vegetation
 - 6.1.1.1.3. Abundant emergent vegetation

- 6.1.1.1.4. poor emergent vegetation
- 6.1.1.1.5. abundant floating rooted vegetation
- 6.1.1.1.6. poor floating rooted vegetation

6.1.1.2. shore vegetation

- 6.1.1.2.1. no vegetation
- 6.1.1.2.2. dominated by spontaneous vegetation
- 6.1.1.2.3. dominated by horticultural vegetation
- 6.1.1.2.4. spontaneous and horticultural vegetation
- 6.1.1.2.5. poor bushes
- 6.1.1.2.6. dense bushes
- 6.1.1.2.7. single trees
- 6.1.1.2.8. group of trees

6.1.2. Ponds

6.1.2.1. Vegetation types in pond

- 6.1.2.1.1. Abundant submerged vegetation
- 6.1.2.1.2. poor submerged vegetation
- 6.1.2.1.3. Abundant emergent vegetation
- 6.1.2.1.4. poor emergent vegetation
- 6.1.2.1.5. abundant floating rooted vegetation
- 6.1.2.1.6. poor floating rooted vegetation

6.1.2.2. shore vegetation

- 6.1.2.2.1. no vegetation
- 6.1.2.2.2. dominated by spontaneous vegetation
- 6.1.2.2.3. dominated by horticultural vegetation
- 6.1.2.2.4. spontaneous and horticultural vegetation
- 6.1.2.2.5. poor bushes
- 6.1.2.2.6. dense bushes
- 6.1.2.2.7. single trees
- 6.1.2.2.8. group of trees

6.2. Running water

6.2.1. River

6.2.1.1. Vegetation types in the river

- 6.2.1.1.1. Abundant submerged vegetation
- 6.2.1.1.2. poor submerged vegetation
- 6.2.1.1.3. Abundant emergent vegetation
- 6.2.1.1.4. poor emergent vegetation
- 6.2.1.1.5. abundant floating rooted vegetation
- 6.2.1.1.6. poor floating rooted vegetation

6.2.1.2. banks vegetation

- 6.2.1.2.1. no vegetation
- 6.2.1.2.2. dominated by spontaneous vegetation
- 6.2.1.2.3. dominated by horticultural vegetation
- 6.2.1.2.4. spontaneous and horticultural vegetation
- 6.2.1.2.5. poor bushes
- 6.2.1.2.6. dense bushes
- 6.2.1.2.7. single trees
- 6.2.1.2.8. group of trees

6.2.2. Stream

6.2.2.1. Vegetation types in the stream

- 6.2.2.1.1. Abundant submerged vegetation

- 6.2.2.1.2. poor submerged vegetation
- 6.2.2.1.3. Abundant emergent vegetation
- 6.2.2.1.4. poor emergent vegetation
- 6.2.2.1.5. abundant floating rooted vegetation
- 6.2.2.1.6. poor floating rooted vegetation
- 6.2.2.2. banks vegetation**
 - 6.2.2.2.1. no vegetation
 - 6.2.2.2.2. dominated by spontaneous vegetation
 - 6.2.2.2.3. dominated by horticultural vegetation
 - 6.2.2.2.4. spontaneous and horticultural vegetation
 - 6.2.2.2.5. poor bushes
 - 6.2.2.2.6. dense bushes
 - 6.2.2.2.7. single trees
 - 6.2.2.2.8. group of trees
- 6.2.3. Channel (artificial)**
 - 6.2.3.1. Vegetation types in the channel**
 - 6.2.3.1.1. Abundant submerged vegetation
 - 6.2.3.1.2. poor submerged vegetation
 - 6.2.3.1.3. Abundant emergent vegetation
 - 6.2.3.1.4. poor emergent vegetation
 - 6.2.3.1.5. abundant floating rooted vegetation
 - 6.2.3.1.6. poor floating rooted vegetation
 - 6.2.3.2. banks vegetation**
 - 6.2.3.2.1. no vegetation
 - 6.2.3.2.2. dominated by spontaneous vegetation
 - 6.2.3.2.3. dominated by horticultural vegetation
 - 6.2.3.2.4. spontaneous and horticultural vegetation
 - 6.2.3.2.5. poor bushes
 - 6.2.3.2.6. dense bushes
 - 6.2.3.2.7. single trees
 - 6.2.3.2.8. group of trees

7. Agricultural areas

7.1. Fields

7.1.1. intensively cultivated fields

7.1.2. extensively intensively cultivated fields

7.1.3. fallow land

7.1.3.1. young

7.1.3.2. old

7.1.4. wild fields

7.2. Horticulture and agricultural special use

7.2.1. Agricultural special use

7.2.1.1. Medium and low standard of fruit crops

7.2.1.2. vegetable crops

7.2.1.3. vineyards

7.2.1.4. Small scale use change (various special uses, grave Country)

7.2.2. Horticulture

7.2.2.1. Nurseries

7.3. Strong sealed land agriculture or horticultural business

7.3.1. Glass, greenhouse areas and other buildings and sealed land of horticulture (including residential buildings)

7.3.2. utility sheds, barns, stables

7.3.3. silage spaces / Areas, dunghill

7.4. Orchards

7.4.1. Understory (UW) intensively used grassland

7.4.2. UW extensively used grassland

7.4.3. Strong bushes

8. Meadows

8.1. Fresh grassland sites (Arrhenatheretalia)

8.1.1. extensively used, most species-rich stocks

8.1.2. intensively used, rather species-poor stocks

8.1.3. unexploited stocks

8.2. Alternating wet grassland sites (Molinion)

8.2.1. extensively used, most species-rich stocks

8.2.2. intensively used, rather species-poor stocks

8.2.3. unexploited stocks

8.3. Moist to wet grassland sites (Calthion)

8.3.1. extensively used, most species-rich stocks

8.3.2. intensively used, rather species-poor stocks

8.3.3. unexploited stocks

8.3.4. flooded

8.4. Heavily degraded intensive grassland

8.5. Not specify type

8.5.1. highly productive

8.5.2. lean, poor in species variety

8.6. Reedbeds, wet wasteland, vegetation of stagnated water and periodically dried up areas

8.6.1. Reedbeds

8.6.2. Wetland sites and forbs

8.6.3. small harrows swamps

8.6.4. vegetation of periodically dried up sites

9. Other