

Introduction

Sustainable Development

The Industrial Revolution marked itself in the world's history as a stepping stone, however together with the development of heavy machinery, transport and mass production, there appeared associated costs to the environment, such as severe pollution and land degradation (Sachs, 2015). It was only a couple of decades ago that people started to realize that current practices lead to irreversible changes on the planet. The term “sustainable development” was firstly highlighted in 1987 and defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). The supplement to that definition is a belief that this development has to be equal in three separate parts: social, economic and environmental, following the three-legged stool (Watts, 2011) – a sustainability model, which convinces that the sustainable society should reinforce all of the three above-mentioned dimensions. The concept of sustainable development has been invented in response to new geospatial challenges and the complexity of contemporary problems (Koutsopoulos et al. 2019). Today's issues, aggravated by growing population and associated shrinking space, force humanity to make decisions, the consequences of which will be faced by future generations (Sachs, 2015).

Brownfields

In Poland, after the political transformation at the turn of 1990s, as a result of restructuring process of existing mills, technological progress, and successive mines closure, the extent of brownfields began to quickly expand, particularly in the southwestern part of the country – Silesia (Wilkoś-Mamcarczyk, 2018). The definitions of brownfields slightly differ in literature, however this work will draw on the one constructed by the Polish Ministry of the Environment (2004), for which brownfields are “degraded, unused or underexploited areas originally intended for an industrial activity which has been completed” (Zagórska, 2012).

In the Revitalization Act (Dz. U. 2015), the process of revitalization is defined as “bringing out degraded areas, brought about in a comprehensive way, through integrated action for the local community, space and economy” and it aims to reincorporate greenery, shape positive image of the place, improve the quality of landscape, reduce land contamination, re-use land and attribute it with various functions. Wójcik (2015) underlines the importance of adapting new areas to the historical character of the region and preserving the traditional features of the landscape, whereas Brandt et al. (2002) emphasizes the importance of

multifunctionality in the process of revitalization, explaining the need to integrate different operations within one place.

Why golf?

With more than 32,000 golf courses around the world (Briassoulis, 2010) and each taking on average 54 ha of land (Terman, 1997), golf is the only sport managing such vast areas (Gange et al. 2003). The game is often subject to controversy with regards to its environmental impact, listing water consumption, habitat disruption, the use of fertilizers and pesticides, and valuable land loss, among the biggest problems (Markwick, 2000). However, supporters of the game respond to criticism, showcasing its numerous positives such as multiple ecosystem services (like carbon absorption or soil retention) (Dai et al. 2015), greening of urban areas and supporting biodiversity in ecologically poor landscapes (Colding & Folke, 2009; Saarikivi, 2016), improvement of health and creation of supportive communities, allowing intergenerational interactions (Murray et al. 2017). Building golf courses on brownfields can therefore occur to be an ideal remedy, both for the society and for the landscape. Especially since modern societies demand recreational sites to commute with nature and spend time with family. They increasingly complain about lack of green areas in the cities, health issues due to air pollution, or stressful lifestyle (Douglas, 1983). In Poland the number of players has substantially grown in the last decade. Currently, there are around 12,000 officially registered golfers, playing on 29 golf courses around the country (Dutczak, 2015). Czech Republic, the neighbour characterized by similar climate and economic conditions, despite much smaller area, managed to gather 10 times more players and built numerous golf courses on post-industrial sites with impressive success (Slama et al. 2018). Therefore, due to the abundance of degraded land, golf has a potential in becoming a successful discipline in Poland. Moreover, golf courses were chosen as an example of brownfields revitalization due to the author's passion for this sport and to promote this discipline, drawing attention to its remarkable potential.

Structure of work

This work analyses an example of implementing recreational function on the post-industrial site, in the form of a golf course. There are some studies on golf course development and its influence on landscape regeneration, such as course built on former coal mine site in Scotland (WRAP, 2019) or in the Czech Republic (Slama et al. 2018). However, Polish literature is very limited in the area of golf and its impact on the environment and landscape. This paper aims to answer, “to what extent is building golf courses on brownfields sustainable?”, discussing the geographical problems associated with land use change in time,

urban regeneration, place identity, broadening the conceptual framing with sustainable development, which allows a holistic approach, taking into account environmental, economic and social aspects. It firstly introduces the topic of brownfields revitalization, drawing attention to the existing research gap. Then it briefly explains the methodology, presents and discusses the results, and finally concludes with the reflection on obtained results and recommendations for future research.

Methods

The chosen methods included conducting interviews and collecting existing data of land use. Eight interviews with key informants were conducted (with representatives of local government, a world-renowned golf organization - the R&A, Polish Golf Union (PGU), and golf courses management, as well as a golf course architect). The choice of purposive sampling technique was tailored to the specific needs of the research, determined in the design phase. Each participant was asked the same open-ended questions (Appendix 1), however some of them had to be adjusted to the interviewee's position and competences. After conducting eight interviews, most answers started to repeat, therefore a stage of saturation was reached. The interviews were recorder using Dictaphone and then transcribed verbatim. Such method facilitated in-depth analysis, because transcripts contained hesitations, repetitions, as well as comments about emotions or discourse flow. It was necessary to consider limitations such as self-reported bias or selective memory issues. Due to limited timeframe, the questionnaires were not scoped insightfully, which could be avoided in the future by piloting the questionnaires and identifying potential lack of clarity. Collective interviews were coded inductively, acknowledging themes that emerged from the participants (Thomas, 2006). To illustrate the potential of brownfields in Poland, numerical data were obtained from the Central Statistical Office. These data were made available on request and were further analysed and developed by the author.

Results & Discussion

Sustainability of brownfield courses

Shifting away from heavy industry leaves vast areas of degraded brownfields in urban locations. Since there is a growing demand for recreational sites among the society and golf has been experiencing rapid growth in the recent decades, constructing new golf facilities on brownfields seems to be a reasonable solution. It was acknowledged by the representative of

the R&A, “the main benefit is that there is plenty of land. Certainly, in terms of this land’s quality, building a golf course would improve it”. According to a golf course architect, “building on post-industrial site is better than elsewhere because you don’t use ecologically rich habitats”. Degraded lands for many years have not been used, unnecessarily occupying space in good urban locations. Due to their previous exploitation, they cannot be used for agriculture, and have limited alternative options of re-management. A deputy mayor, while interview, stressed the importance of the multifunctional character of these areas, which ties well with previous studies of Brandt et al. (2002), who emphasized the need to integrate various functions within one site. However, he also drew attention to restraints, "we are restricted by non-cohesive soils, where due to low-bearing capacity possible activities are limited, and no heavy constructions can be done". Therefore, the development of recreational site is a proper reuse of brownfields, especially since it does not only introduce new functions, but also contributes to land regeneration. According to key informants, even a heavily degraded area, when sown with grass, regenerates within five years.

A natural benefit of converting brownfields into golf courses is re-incorporation of green areas, which improves air quality and perception of landscape (Wilkoś-Mamcarczyk, 2018), providing multiple ecosystem services such as carbon absorption or soil retention (Dai et al. 2015). Saarikivi (2016) additionally highlights the enhancement of biodiversity and creation of wildlife protection sites on courses. Both of these factors were confirmed by interviewee “construction of golf course on brownfields brings wildlife back and provide green space, which is key in urban locations”. Interviewed greenkeeper further confirmed that “golf courses are very rich in biodiversity, especially close to urban areas where there’s not much space for wildlife”, which clearly proves sustainability of post-industrial courses in this aspect. Nonetheless, it is necessary to note that some studies examined the negative effect of golf on wildlife. Referring to the Wheeler & Nauright (2006), the golf course construction poses a threat to existing habitat and disrupts aquatic species due to mud and chemicals spillages. Responding to these findings, on brownfields there is usually no prior existing habitat that could be significantly threatened by course construction.

Moreover, there are multiple social benefits of such sites. Location close to cities makes them accessible to local community, creating a place for interactions of people of all ages, as suggested by Murray et al. (2017).

During interviews, economic advantages were also pointed out on multiple occasions. R&A representative drew attention to “increasing the value of not only land, but of the properties around”. The interviewee from PGU admitted with full enthusiasm that “brownfields

are the only chance for golf development in Poland”, justifying his opinion by the fact that the prices of agricultural land are too high for potential golf investors, therefore purchasing significantly cheaper degraded areas should be seriously considered, however bearing in mind costs of site clearance.

Unsustainability of brownfield courses

One of the biggest challenges of brownfields revitalization is to ensure appropriate clearance of the site. Gasidło (1998) mentioned the identification of contamination to be the first necessary process of post-industrial area transformation. Information obtained from the R&A representative present similar thoughts “the main difficulties are in developing the land, particularly in terms of contamination from its former use”. Moreover, clearance of the site is time-consuming and expensive. This delays the return of investment, which is certainly not sustainable in economic aspect.

Golf courses pose significant threat to the environment due to fertilizers and pesticides use and their leakage into ground water tables (Markwick, 2000). Brownfields are particularly dangerous for this reason, as their underlying soil is poorly fertile and difficult to grow, therefore in order to maintain good quality of greens¹, substantial amounts of chemical substances are used, as explained by a manager of such site “because the fairways are sandy, they do not have any nutrients. Sand has no properties to retain these nutritional values, so they pass through soil like through a sieve. So, in terms of fertilizers, we need to use them. And automatically here is also the problem of irrigation, because water flows through the sand as well”.

Figure 1 presents the summary of advantages of a brownfield golf course (marked by green tick) and potential problems of such sites (marked by red cross). Some of the aspects are not directly dependent on the location of the course, but rather on the management and individual concern about sustainability (marked by hyphen).

¹ Area of a golf course consists of: tee (low-mowed grass), fairways (low-mowed grass of different type than tee or green), green (the most demanding type and the lowest grass), rough (area slightly moved or left unmanaged).

Environmental	Social	Economic
<ul style="list-style-type: none"> ✓ protect landscape and regional heritage ✓ enhance biodiversity and protect wildlife habitat 	<ul style="list-style-type: none"> ✓ provide education about historical, cultural or archeological designations of a site ✓ protect cultural heritage ✓ incorporate public access ✓ promote golf among the youngest participants ✓ improve community health and well-being ✓ enhance change in public perception of golf 	<ul style="list-style-type: none"> ✓ create job places for local community ✓ create partnerships with governments, NGOs and associations ✓ ensure economic viability
<ul style="list-style-type: none"> - use sustainable sources of water and energy - engage with waste reduction and management - prevent pollution from on-site operations - use locally-sourced and life-cycle materials 	<ul style="list-style-type: none"> - enhance social awareness in the area of sustainability - ensure social equality and "access for all" - engage with local community groups - promote environmentally-friendly behaviours and raise ecological awareness 	<ul style="list-style-type: none"> - use resource-efficient solutions by engaging with new technologies - create appropriate management plan (including risk management, especially with regards to water scarcity and extreme weather conditions)
<ul style="list-style-type: none"> ✗ ensure sensitive site clearance ✗ minimise resource consumption (particularly water) ✗ use fertilizers and pesticides responsibly ✗ protect water and soil quality (preventing chemical spillages and soil erosion) 		

Figure 1. Table summarizing the components of a sustainable golf course. Green ticks highlight aspects fulfilled by golf courses on brownfields; hyphens symbolize aspects, which can be fulfilled (but not necessarily depend on location); red crosses indicate problems faced by golf courses on brownfields. Own elaboration.

Potential of brownfields

According to obtained data, the extent of degraded land in Poland amounts to 64.7 thousand ha, which constitutes 0.2% of the total country area. As presented in the Figure 2, the area of land requiring revitalization has been gradually decreasing, since the beginning of the century, however the degree of revitalization and management is still unsatisfactory and in 2016 amounted to 2.2% of degraded land.

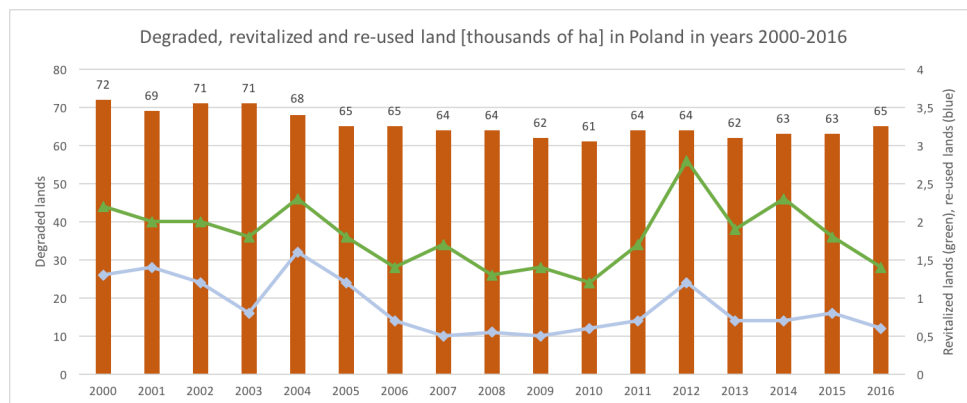


Figure 2. Degraded, revitalized and re-used land in Poland in years 2000-2016. Own elaboration based on data collected from the Central Statistical Office.

Figure 3 shows the ratio of degraded to the total voivodeship area, ranking Silesia the most degraded region, with 4900 ha requiring revitalization.

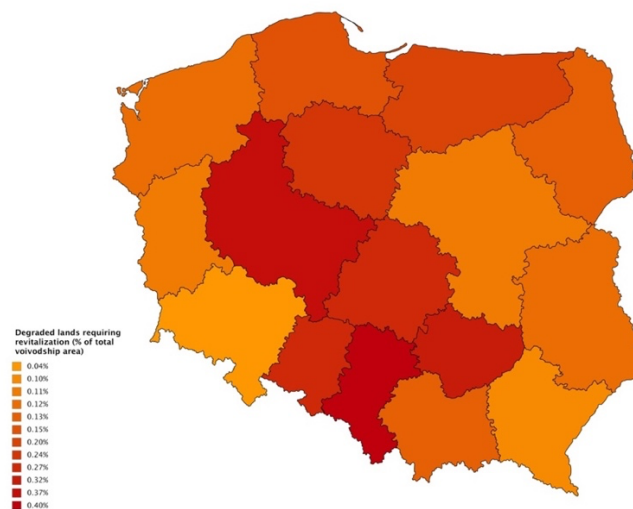


Figure 3. Map presenting percentage of degraded land across all 16 Polish voivodeships. Own elaboration based on data collected from the Central Statistical Office.

Land requiring revitalization within Polish borders is extensive. All the key informants shared positive opinions about brownfields as a potential site for golf courses development, with leading strong voices from PGU and R&A representatives proclaiming brownfields, respectively, “the only hope for golf in Poland” and “the best place for golf to grow in the future”. A golf course architect drew attention to the benefits for both the environment and for

golfers, “it’s better to use these post-industrial sides, instead of ecologically rich countryside. That could be a win-win situation”. The aspect of environmental benefits was also touched by greenkeeper, “there is a large potential, because it’s hard to manage brownfields in other way, and golf course additionally cleanses it”.

Case Study – real-life transformation of lunar landscape

Armada Golf Club was officially opened in 2013 and constructed on post-industrial site, where several years earlier coal mine KWK Szombierki had been closed. Currently, there is a 9-hole golf course, together with adherent golf amenities, surrounded by housing estate. The investment continues to develop aiming to create a complex, which will eventually include an 18-hole course and accompanying commercial and service facilities.

According to a project manager, when the site was bought from the MRC² in 2011, it was partially cleared from contamination, however further findings determined that collected before the construction samples of soil and water indicated high concentration of heavy metals and significant acidity of groundwater (Appendix 2). In terms of the visible degradation, representative of local government called it “a lunar landscape, sad, black, with no green fragments”, which was further confirmed by a deputy mayor “landform was strongly degraded with numerous post-industrial heaps”.

Armada GC in the past 5 years contributed to significant improvements for the environment and community. Information obtained during an interview with golf course architect illustrated particular ameliorations in biological aspect “due to greening of this site, there is many more habitats living in roughs and forest”, whereas other key informants indicated the dominant meaning of the improved landscape quality, which “changed from black to green”. Juxtaposition of photos in the Figure 4 illustrates a very impressive transformation.



Figure 4. Photos presenting the transformation of post-industrial land due to Armada GC construction (provided by one of the interviewees. Left photos took in 2011, right in 2013.

² Mine Restructuring Company is a state body responsible for land revitalization in Poland. All the land awaiting revitalization is governed by MRC, which makes decisions regarding land clearance and further selling or leasing it.

The uniqueness of Armada GC is particularly manifested by its post-mining landform, but also by successful attempt to preserve the regional heritage. An interview with representative of local government revealed that the plan was to create a "Silesian course", preserving the natural shape of the area and surrounding post-industrial buildings. This was achieved through the creation of elements relating to history, such as paths made of the post-mining aggregate, plates with written hole number made of railway sleepers, or the maintenance of the Krystyna mineshaft. Interviewees expressed strong opinions that Armada GC reflect the history of mining region. Course architect admitted such design to be deliberate, speaking proudly about his achievement "being on course, it feels like Silesia, there are many things, which still remember of the past, like elements of coal mine", whereas representative of local government emphasized the preciousness of cultural heritage "traditions should never be destroyed, they should be continued and combined with modernity".

One of the biggest problems of Armada GC arises from the fears of visitors, which result from negative stereotype about post-industrial sites. An interviewee revealed that the course management tries to conceal the fact of the former land use, because "if people hear "post-industrial" they think - you have the entire Mendeleev table in the soil, it is dangerous – and they don't want to come". This point naturally touches upon another big problem, which is low social awareness around sustainability. When asked about sustainable development, three of the Polish key informants admitted they have never heard of the concept before, whereas others shared opinions that, "Polish government represents anti-sustainable development behaviour" or "for the majority of population, sustainability concept is completely unknown". Finally, there is also an issue of poor environmental regulations or lack of their enforcement. An interview with a deputy mayor show that law is very often violated and there is not enough governmental control, which was further admitted by a greenkeeper "in practice we, indeed, use fungicides, but illegally. Similarly, with herbicides. But no one even checks it. As you can see, there are regulations, but they are not enforced like in the West".

Conclusions

This work explored brownfields revitalization on the example of golf courses, looking holistically at the problem of land degradation and sustainability issues of golf. Currently, in the developed countries, there is a growing need for naturalness and green spaces, and the observed shift away from fossil fuels, which leaves vast degraded areas. At the same time there is 7 billion people in the world, who must meet their basic needs, therefore fertile land should

be preserved for the agriculture, whereas brownfields need to be revitalized and wisely re-used. One could consider whether it is ethical to sacrifice scarce land for recreation purposes, instead of managing it differently, however, this research emphasizes that present processes of revitalization must be carried out in a sustainable manner i.e. caring for the environment while responding to the needs of modern society. Findings proved brownfields golf courses to be sustainable to a large extent, however, suggested paying particular attention to appropriate clearance of the site and minimizing environmental impact through reasonable resource consumption and confined use of chemicals. The analysis of a case showed that Armada GC changed post-industrial landscape beyond recognition, reincorporating green spaces and wildlife to urban area, providing recreational site for community, while preserving the natural landform and cultural heritage of Silesia. This study makes an original empirical contribution highlighting the importance of tradition and heritage preservation during the process of land revitalization. However, certain issues have been recognized, particularly poor awareness around sustainable development, lack of transparency in terms of land contamination and substantial use of resources. Improvement in these aspects will ameliorate the environment, overcome the negative stereotype about post-industrial areas, attract new players and bring considerable savings.

Future research

Although this work focuses primarily on the golf courses, it is necessary to bear in mind the importance of multifunctionality in the process of land revitalization. Therefore, in the future, it would be worth extending this project to investigate other possible investments, which would be worth considering on brownfields such as parks or other sports facilities. Although, this research examined a particular region, it should be understood in a wider context. In the next years, the area of degraded land will be increasing in developed countries, posing challenges for urban planning and governance. Therefore, concepts of place identity, the importance of green areas in the urban jungle and reconciliation of the shrinking space with modern society's needs will become the most significant aspects for achieving the sustainable development in the next decades.

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Appendix 1 – Interviews questions

- What is your role and for what organization do you work? How long have you worked there for?
- What have you heard about the concept of “sustainability”? What is your approach to sustainability in your work?
- In what ways is your golf course/organization/company involved in sustainable practices?
- Which governmental regulations drive sustainability practices? Are there any environmental regulations regarding the construction on post-industrial land?
- Are there any benefits due to building course on this site? Are there any disadvantages?
- How much was the land of Armada GC degraded before? To your knowledge, were there any measurements about that before the construction of the course? Are there any data about current state of the environment (e.g. soil or water contamination)?
- Why have you decided to work on this particular course built on the post-industrial land?
- How do you feel about the fact that this course in Armada was built on post-industrial land?
- Do players realize that the course was built on brownfield? Is there anything different in this experience for players?
- What was the biggest challenge of this project before and during the construction?
- Are you aware if the value of adjacent land risen due to the construction of golf course?
- What are the biggest environmental challenges now that the course (or golf industry) encounters?
- Have you perceived significant changes in the landscape and state of post-industrial environment due to the construction of golf course?
- Are there any initiatives to make your golf course more open to public?
- Are pro-ecological behaviors promoted among golfers on the course?
- Does the existing golf course reflect the historical character of the region?
- Are you planning on expanding your operations e.g. creating paths for non-golfers, investing in other sports activities?
- There are plans to build more courses on brownfields – how do you feel about that? Do you see the potential in building golf courses in other similar sites?
- Would you like to add anything?

Appendix 2 – Water sample from the site of Armada GC

OKRĘGOWA STACJA CHEMICZNO-ROLNICZA W GLIWICACH

ul. Sowińskiego 26
44-100 Gliwice
tel/fax (032) 231 26 31, (032) 231 74 19
www.schr.gov.pl e-mail: schr@schr.gliwice.pl

Gliwice, 10.03.2011 r

Dotyczy WO/3/1

ARMADA DEVELOPMENT S.A.
41-907 Bytom
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POPRAWKA DO ZALECENIA NR 17/DA/2011 ZALECENIE NR 20/DA/2011

Próbka WO/3/1

Dopuszczalne maksymalne zawartości składników w wodzie używanej do fertygacji (nawadniania z nawożeniem):

Azot (NO_3^- , NH_4^+)	5 mg/l
fosfor	5 mg/l
potas	5 mg/l
wapń	120 mg/l
magnez	25 mg/l
chlor	100 mg/l
siarczany	200 mg/l
sód	30 mg/l
żelazo	5 mg/dm ³
bor	0,5 mg/dm ³
cynk	0,05 mg/dm ³
mangan	1,0 mg/dm ³
miedź	0,2 mg/dm ³

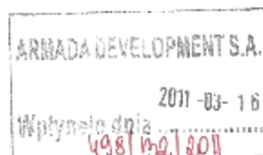
Badana próbka wody posiada odczyn zasadowy; bardzo wysokie zawartości sodu, chlorków i siarczanów; wysokie zawartości potasu, wapnia, magnezu i boru; niskie azotanów, jonów amonu, żelaza, cynku manganu i miedzi; nie zawiera fosforu.

Charakteryzuje się bardzo wysoką twardością.

Ogólna suma jonów wyrażona przez EC jest bardzo wysoka, czynnik ten dyskwalifikuje badaną wodę do celów nawadniania roślin w tym trawy. Dopuszczalne wartości EC < 2 mS.

Zasolenie zbiornika spowodowane jest najprawdopodobniej przez chlorek sodu używany do zimowego utrzymania dróg lub wody dołowe. Sugeruję znalezienie i wyeliminowanie źródła zasolenia, woda w zbiorniku po jakimś czasie mogłaby ulec samoczynnemu uzdatnieniu.

Telefon kontaktowy 601434657



SPECJALISTA
mgr inż. Barbara Błotnicka

1 z 1