



Work package T4 Activity 1 Deliverable 1.1

# **Inventory Report on Market Research on RDFs– (Demand Chain) in the Recreational Area/Private Sector**

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Authors: Dr Aoife Egan<sup>a</sup> and Dr Niamh Power<sup>a</sup>

<sup>a</sup> Sustainable Infrastructure Research and Innovation Group, Munster Technological University  
Cork, Bishopstown, Cork, Ireland.

Partners:



## Summary

With a gap in the market identified through the ReNu2Farm project for the use of mineral fertiliser alternatives in the agriculture sector and a further market identified in the horticulture sector (Egan and Power, 2023), this report aimed to explore the potential market for Recycling Derived Fertilisers (RDFs) in the private/recreational sector in North-West Europe (NWE). With the demand for sustainably produced and locally sourced fertilisers increasing due to rising fertiliser costs that can be attributed to Covid-19, the China export ban and sanctions imposed on Russia, there is an excellent opportunity for RDFs to be used by the private/ recreational sector.

Regarding the demand for RDFs in the private/ recreational sector, due to the increase in fertiliser costs and their lack of availability across NWE, there is a considerable gap in the market for their use. There is a significant amount of land used in this sector across NWE, with Brussels in Belgium having over 8,000ha of green spaces, Germany having up to 1.4m organised allotment gardens covering an area of nearly 47,000ha, the Netherlands, having 36,000ha of sports grounds, 33,000ha of parks and public gardens recorded in 2017 and the UK has up to 9,276 public parks or gardens, covering an area of up to 44,040ha.

Though global and European statistics are available with information on land use in the private/ recreation sector, there is a lack of current and up-to-date data publicly available. Through this research, the Netherlands proved to have the best quantity and quality of publicly available data, including data for parks and public gardens, sports grounds, allotment land use, and the number of football fields in the Netherlands. This type of information is important for predicting future trends in fertiliser use and gives insights into the potential demand for RDF use in the Netherlands. However, often this data was only available up to 2017 and in some cases not even as recent as that. On the other hand, the amount of publicly available data on the recreation sector in Luxembourg was lacking the most of all seven countries investigated, with a combination of data on land use for the arts, entertainment and recreation sector available up to 2018. This indicates that there is a lack of current information on land used in the recreation sector in the Netherlands, Luxembourg and the countries investigated, contributing to the knowledge gap observed across NWE. Considering how important open green spaces, sports pitches, allotment gardens and private outdoor spaces are to people, and equally the availability of sustainable and affordable mineral fertiliser alternatives such as RDFs it can be concluded that there is a considerable gap in the market for the use of RDFs in the private/ recreation sector. Furthermore, RDF use in this sector would contribute to closing the nutrient cycle loop, increase sustainability in the fertiliser industry, and contribute to the circular economy.

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## Abbreviations

CAP	Capitalisation
CSO	Central Statistics Office
EU	European Union
ha	Hectares
m	Million
NA	Not applicable
NUTS	Nomenclature of Territorial Units for Statistics
NWE	North-West Europe
RDFs	Recycling-Derived Fertilisers
UK	United Kingdom

# 1 Introduction

Interreg North-West Europe (NWE) funded project ReNu2Farm aims to assess the potential use and demand for RDFs in new markets such as the private/recreation sector.

Recreational land is defined as land that is used for purposes of recreation, such as sports fields, gymnasiums, playgrounds, public parks and green areas, public beaches and swimming pools, and camping sites according to the Organisation for Economic Co-operation and Development. In 2018, up to 50.7b euros of government expenditure was put into recreation and sport, this government input has remained relatively stable since 2001 (Eurostat, 2020). Overall, 6% of the total area of the EU was used for services and residential purposes (including recreation, leisure and sport; Eurostat, 2018).

Phosphorus (P), potassium (K) and nitrogen (N) in terms of mineral fertilisers are essential elements for plant nutrition and growth. However, the mineral reserves of rock phosphate are being depleted globally and in 2014, the European Commission added rock phosphate to its critical raw materials list (EC, 2014) as the supply security is at risk. Furthermore, the world's reserves of K are recovered by underground mining methods and N fertiliser is heavily dependent on natural gas for its production via the Haber-Bosch process (Tanabe et al., 2013) that incurs high fuel costs, which in turn drives up the costs of mineral fertiliser.

The cost of fertilisers globally is rising and is increasing more rapidly since 2019 due to import and energy costs, distribution and supply chain, and as a result of a shortage of labour and the shutdown of several fertiliser plants due to the Covid-19 pandemic. The Russia-Ukraine war has also impinged on fertiliser sales due to sanctions imposed by the European Union, therefore affecting the fertiliser supply globally (Polansek et al., 2022). In addition, the China export ban, first imposed in October 2021 was extended into 2022, which has increased global demand for mineral fertiliser due to restricted supply. As a result, recycling derived fertilisers (RDFs), sustainably sourced and locally produced mineral fertiliser alternatives would be an excellent substitute as they are rich in NPK.

As the agricultural sector is becoming more aware of the importance of mineral fertiliser alternatives, such as RDFs, their demand is also increasing. Previous research by Egan et al. (2022) explored the desired properties and acceptance of RDFs by farmers and found that farmers are interested in using RDFs, if not already using them to some degree. However, the private/ recreation sector including sports pitches, public parks, allotments or private gardens, is an excellent potential market for the use of RDFs. This research aims to explore the potential demand for RDFs in the recreation/private sector across NWE by examining European Statistics on land use in this sector.

## 2 Methodology

The data for this report were sourced from various European and national statistical databases and are recorded in Table 1 along with the unit of measurement. Where the data was available, it was displayed at a NUTS 2 level (see the report by Egan and Power, 2023 for an explanation of NUTS levels). In terms of land area, the data was displayed where possible in thousands of hectares for consistency. Specifically, the land use data for the arts, entertainment and recreation sectors and recreation land use in Germany was available in square kilometres and were converted to thousands of hectares (see Table 1). In addition, the data source for the recreational area and other spaces in Belgium; land used for recreation, parks and public gardens, sports grounds and allotment gardens in the Netherlands; the extent of urban green spaces in Great Britain and the extent of functional green space by type of function and the number of sites in Great Britain was available in hectares, which were converted to thousands of hectares for continuity. The data for green spaces in Dublin were presented in this report as meters squared due to low numbers.

*Table 1: Summary of the sources, distribution and statistical level of data used in this report.*

Region	Data	Statistical Level	Unit	Data Source
All NWE countries	Arts, entertainment & recreation land use	NUTS 2	'000 ha	Eurostat
	% Public green space including parks and gardens in capital cities	*NA	%	World Cities Culture Forum
Belgium	Recreational areas and other spaces	NA	** '000 ha	Statbel
France	Number of golf courses	NA	NA	Statista
Germany	Recreation land use	NA	'000 ha	Destatis
	Recreation sectors in different states	NA	'000 ha	Destatis
Ireland	Area of green spaces per inhabitant in Dublin	NA	***m <sup>2</sup>	Statista
Netherlands	Land used for recreation	NUTS 2	'000 ha	Eurostat
	Parks and public garden land use	NUTS 2	'000 ha	Eurostat
	Sports ground land use	NUTS 2	'000 ha	Eurostat
	Number of football fields (including grass fields)	NA	NA	Statista
United Kingdom	Allotment gardens land use	NUTS 2	'000 ha	Eurostat
	Extent of urban green spaces in the UK	NA	'000 ha	Office for National Statistics
	Extent of functional green space & number of sites	NA	'000 ha	Office for National Statistics

\*NA- Not applicable, \*\* '000ha – thousands of hectares, \*\*\* m<sup>2</sup> – meters squared

The land use data for NWE for the arts, entertainment and recreation sectors for the seven countries of interest in this study, Belgium, France, Germany, Ireland, Luxembourg, the Netherlands and the United Kingdom were obtained from Eurostat, the statistical

office of the European Union. Information on land use for the recreation sector alone in NWE was difficult to obtain and in many cases throughout this report, the data represents the combined land use for the arts, entertainment and recreation sectors. Although this is the official land category, this information does not give an accurate indication of the area of land which may be suitable for RDF because it includes land use data for the arts and entertainment sectors also.

### 3 RDF Demand in the Recreation Sector in NWE

In 2018, up to 5.7% of the total area of the EU is used for services and residential purposes including recreation, leisure and sport; and nature reserves (Eurostat, 2018). More than half of this total was dedicated to residential use (51%) and recreation, leisure and sport (35%) (Eurostat, 2018). Services and residential land use rose to a level above 10.0% of the total area in Belgium and the Netherlands in 2018 (Eurostat, 2018). In the Netherlands, this was due to a particularly large share available for recreational, leisure and sports purposes - almost half of the total, 48.9% (Eurostat, 2018). Land use for the arts, entertainment and recreation sectors overall decreased in NWE between 2015 and 2018 (Figure 3.1). According to Figure 3.1, the largest area of land used for this sector is in Germany with 820,000ha available in 2018. The next largest area is in the UK, with 576,000ha followed by France with 501,000ha used for arts entertainment and recreation in 2018.

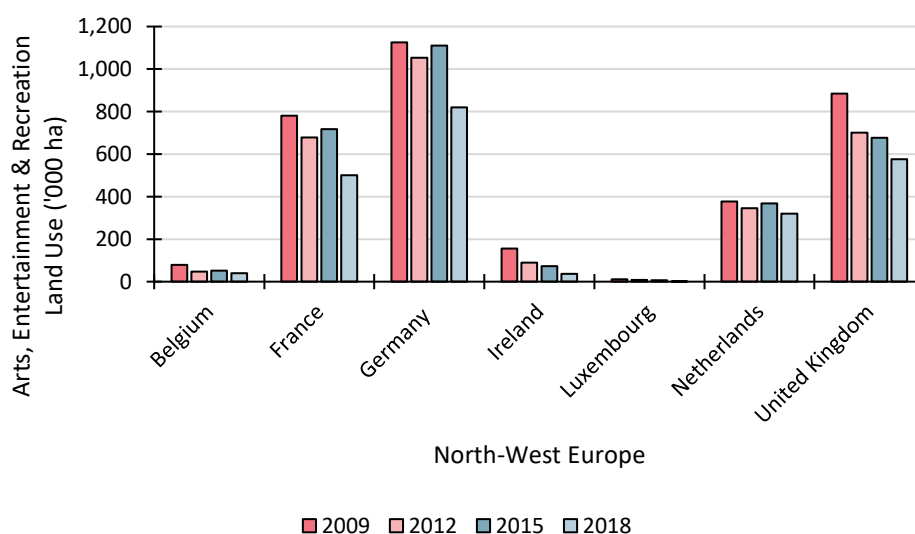


Figure 3.1: Land used for the arts, entertainment and recreation sectors in NWE (Source: Eurostat, 2021). Displayed in thousands of hectares.



In the past 25 years, the greenness of European cities has increased by 38% (European Commission, 2019). Furthermore, 44% of Europe's urban population are currently living within 300 metres of a public park (European Commission, 2019). This statistic is surprising, as according to the European Environment Agency (2022) the availability of urban green areas varies across neighbourhoods, with less and lower quality green space typically found in lower socio-economic areas. The percentage of public green spaces in capital cities across NWE, including parks and gardens, is displayed in Figure 3.2 (World Cities Culture Forum, 2022). London in the United Kingdom has the highest percentage of public green space with 33%, followed by Berlin in Germany with 30% (Sustain Europe, 2019) and Dublin in Ireland with 26% (World Cities Culture Forum, 2022). The percentage of green spaces in Luxembourg was 25% and in Edinburgh in the UK and Brussels in Belgium was the same at 19% (World Cities Culture Forum, 2022).



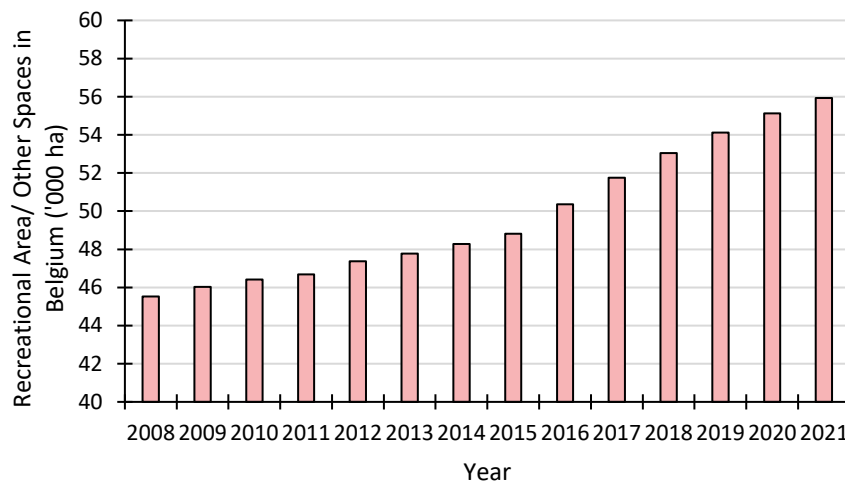
*Figure 3.2: Percentage of public green space including parks and gardens in capital cities across NWE and woodlands in Berlin (Sources: World Cities Culture Forum, 2022, Luxembourg city tourist office, 2023 and Sustain Europe, 2019).*

## 4 Belgium

Brussels is one of the greenest European capitals, with over 8,000ha of green spaces such as sports fields and up to 50 public parks, covering half the capital region in total (Be.Brussels, 2022). This statement contradicts the findings presented in Figure 3.2 which states that the percentage is less than 20, albeit Figure 3.2 does not include data for sports fields or playing grounds. However, the disparity in the two statements is indicative of the differences between the two sources and the lack of current official data in the

recreation sector in Belgium, supporting the knowledge gap. Furthermore, there is an unequal distribution of green spaces around Brussels, with 70% of spaces located in the outer suburbs, while only 10% are found in the city centre (Be.Brussels, 2022).

The land used for recreational areas and other spaces in Belgium is increasing with a gradual incline evident in Figure 4.1 between 2008 and 2021 (Statbel, 2021). In the space of ten years, between 2011 and 2021, the land used in this sector increased by 23% from 46,000ha to 56,000ha (Statbel, 2021). Furthermore, in the past five years between 2016 and 2021, land use increased by 12% from 50,000ha to 56,000ha in this sector (Statbel, 2021). The type of recreational areas is not defined in Figure 4.1, therefore, it is unknown if some of the areas include artificial grass surfaces or playing fields. In addition, the data displayed in Figure 4.1 is not indicative of the green area percentage, further indicating a gap in knowledge of land use in the recreation sector.



*Figure 4.1. Recreational areas and other spaces in Belgium (Source: Statbel, 2021). Displayed in thousands of hectares.*

The increase in the area of land used in Belgium is also evident in certain regions more so than others, in Figure 4.2, at a NUTS 2 level, Prov. Limburg (BE) had the largest area of land used in this sector with 22,300ha available in 2009, however, it had decreased by 53% to 10,500ha by 2018 (Eurostat, 2021). The land used for the arts, entertainment and recreational sector in Prov. Antwerpen increased by 8% between 2015 and 2018 to 6,800ha (Eurostat, 2021). However, the trends observed between Figure 4.1 and 4.2 differ. In Figure 4.1, the area used for recreation is consistently increasing from 2009 to 2021, however, in Figure 4.2 most NUTS 2 regions have a lower land area used for the arts, entertainment and recreation sector in 2018 than in 2009. Again the disparity in the available data is indicative of knowledge gaps present on land use in the recreation sector in Belgium.

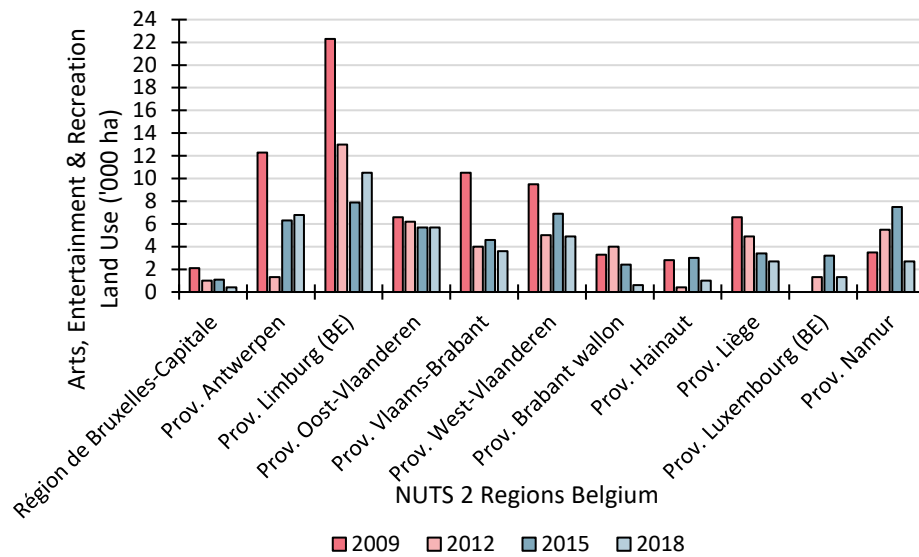


Figure 4.2: Belgium's land use for the arts, entertainment and recreation sectors (Source: Eurostat, 2021). Displayed in thousands of hectares.

In summary, the recreation sector in Belgium is thriving, with land use increasing by 23% between 2011 and 2021 in the area, however, there are still knowledge gaps present on land use in the recreation sector in Belgium. With rising fertiliser costs due to the Russian-Ukraine war and supply chain issues, there is excellent potential for the use of more sustainably sourced mineral fertiliser alternatives such as RDFs in Belgium in this sector.

## 5 France

France has the third most golf courses in Europe; according to Statista (2022a), there are over 574 official golf courses with up to 602 official and amateur golf courses recorded in 2017. The number of golf courses increased considerably between 2010 and 2014, going from 574 to 597 golf courses in just four years (Figure 5.1). In the year from 2016 to 2017, two more golf courses were built in France.

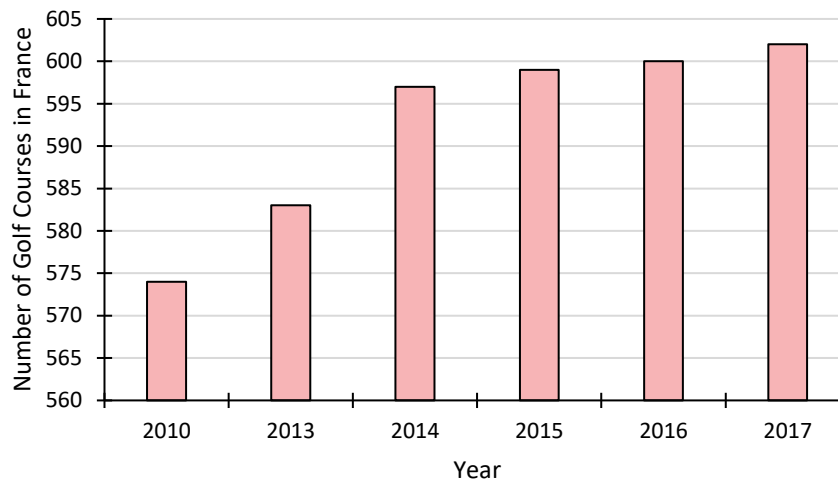


Figure 5.1: Number of golf courses in France from 2010-2017 (Source: Statista, 2022a).

In terms of public parks and green spaces, there are up to 480 gardens and parks in Paris alone, covering one-quarter of the city, making it one of the greenest cities in Europe (Paris info, 2022). However, this statement contradicts the findings presented in Figure 3.2 which states that less than 10% of Paris is public green space, including parks and gardens. Although the data displayed in Figure 3.2 does not include sports fields or playing grounds, the findings highlight the disparity between the two statements, which is indicative of a knowledge gap in land use for recreation in France. An example of public green space in France is the Bois de Boulogne Park in the West of Paris, once a forest and a royal hunting preserve were acquired by the city of Paris in 1852 and transformed into a recreational area, now occupying 873ha of land (Britannica, 2022a).

According to Figure 5.3, the land used for the arts, entertainment and recreation sectors in France fluctuated between the years 2009 and 2018, however, the area available continued to decrease (Eurostat, 2021). In 2009, 781,000ha were used in this sector, but within nine years the area used had decreased by 34% to 501,000ha (Eurostat, 2021). At a NUTS2 level, the land used for the arts, entertainment and recreation sectors has decreased in many regions except for example in Provence-Alpes-Côte d'Azur which had decreased to 47,000ha by 2015 and increased to 49,000ha by 2018 (Figure 5.4; Eurostat, 2021).

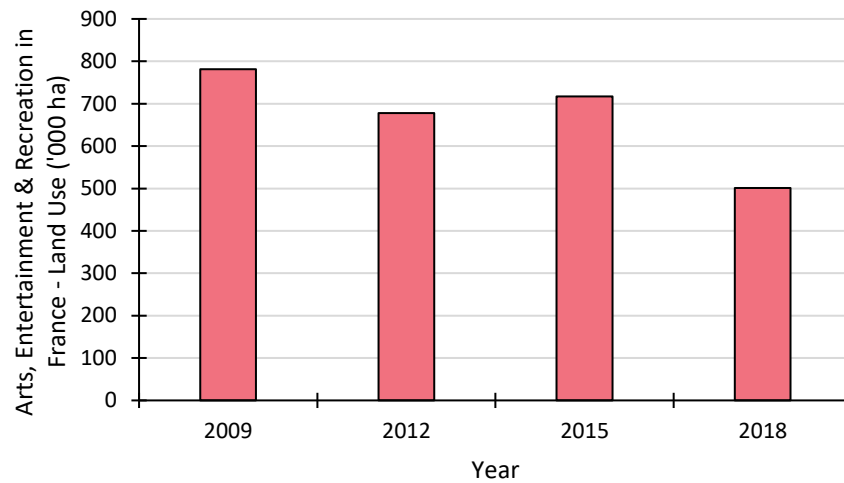


Figure 5.3: Land use for the arts, entertainment and recreation sectors in France from 2009 to 2018 (Source: Eurostat, 2021). Displayed in thousands of hectares.

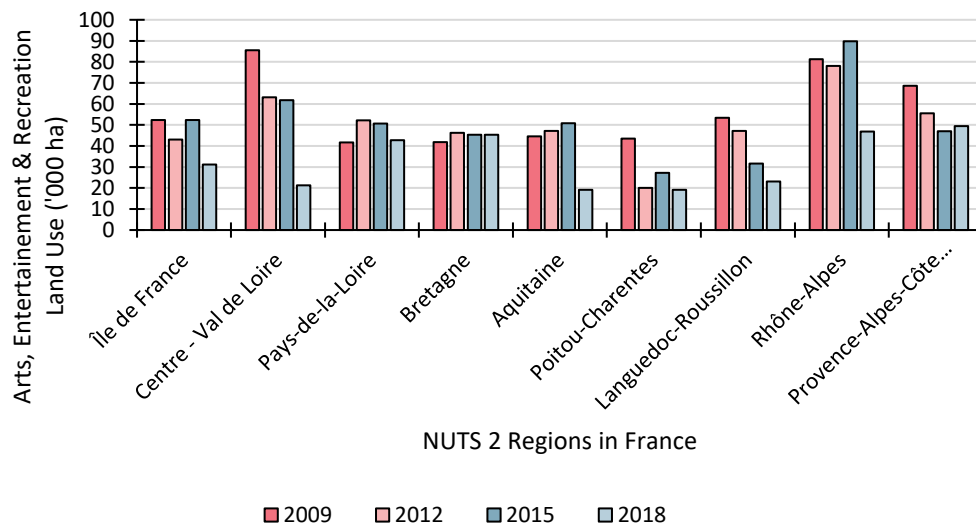


Figure 5.4: Land use for the arts, entertainment and recreation sectors in NUTS 2 regions of France. (Source: Eurostat, 2021). Displayed in thousands of hectares.

In summary, although land use in the arts, entertainment and recreation sector is decreasing in France, the data is only available up to 2018. There is, however, increasing land use in the golfing market, in particular. Furthermore, there are up to 480 gardens and parks in Paris alone. This indicates that there is excellent potential for the use of mineral fertiliser alternatives with a significant gap in the market for the use of RDFs in the private/recreational sector.

## 6 Germany

Recreation in Germany is a very important aspect of German life, with up to one-fifth of the household income in Germany's Western regions being spent on recreation activities (Britannica, 2022b). Golf is becoming more and more popular in Germany and according to the European Golf Participation Report 2019, there are up to 1,050 golf courses in Germany (European Golf Association, 2021). Also, there are more than 1.4m organised allotment gardens. Overall, they occupy an area of nearly 47,000ha, in addition to millions of private home gardens (Drescher, 2009).

Land use in Germany for the arts, entertainment and recreation sector has fluctuated since 2009. In 2009, 1,126,000ha of land was available, however, by 2018 this had decreased by 27% to 820,000ha (Figure 6.1; Eurostat, 2021). Exploring the land use in Germany for just the recreation sector, although the data is only available up to 2010, it shows a clear increase in land use over ten years, specifically an increase of 50% (Figure 6.2; Eurostat, 2021). Looking at both Figures 6.1 and 6.2, in 2009 there was approximately 1,100,000ha of land under art, entertainment and recreation alone, with around 375,000ha in 2008 and 400,000ha in 2010. Suggesting recreational land is about 35% of art, entertainment and recreation land.

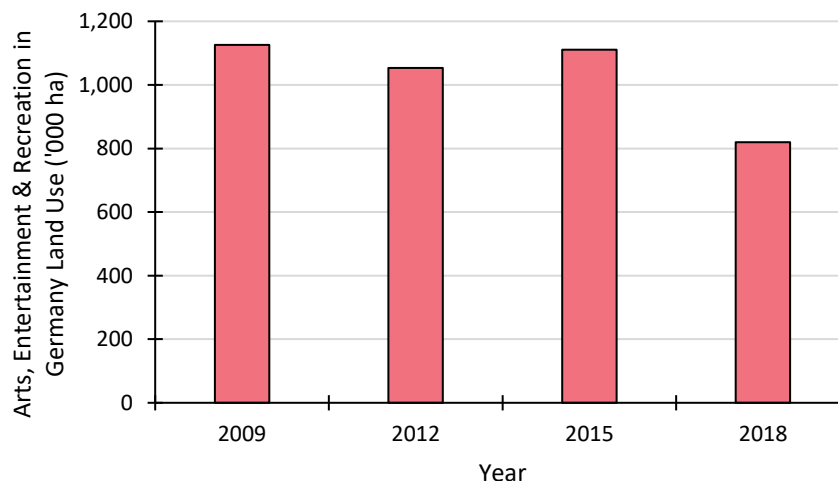


Figure 6.1: Land use for the arts, entertainment and recreation sectors in Germany from 2009 to 2018 (Source: Eurostat, 2021). Displayed in thousands of hectares.

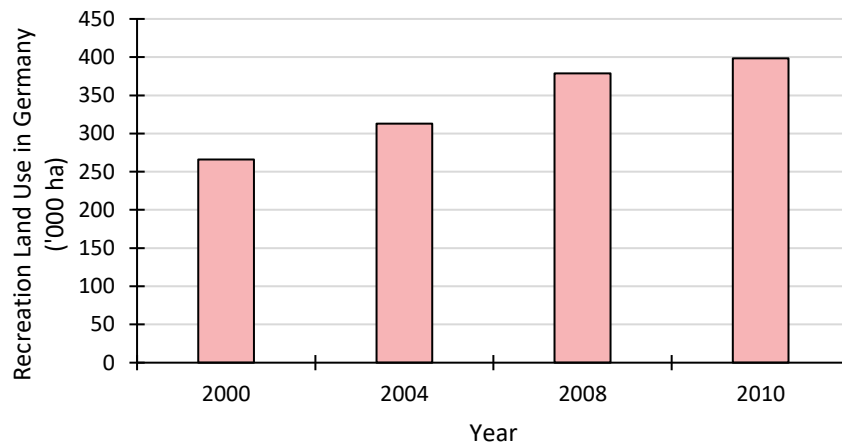


Figure 6.2: Land use for the recreation sector in Germany from 2000 to 2010 (Source: Destatis, 2022). Displayed in thousands of hectares.

The German capital city, Berlin is an exceptionally green city, with many green spaces, parks and grounds. Over 30% of the city area is made up of green spaces and woodland (see Figure 3.2; Sustain Europe, 2019). It includes over 2,500 parks and gardens, and 440,000 trees (Sustain Europe, 2019). Figure 6.3 describes the land used for sport/leisure and recreation and public green spaces in 2021. Overall, the German state of Nordrhein-Westfalen has the largest area of land used for these two recreation activities, with 87,859ha available for sport/leisure and recreation and 57,573ha available for public green space (Destatis, 2022). The region of Bayern had the next largest area of land used for sport/leisure and recreation with 56,453ha, whereas Sachsen-Anhalt had the next largest area used as public green spaces with 44,152ha (Destatis, 2022).

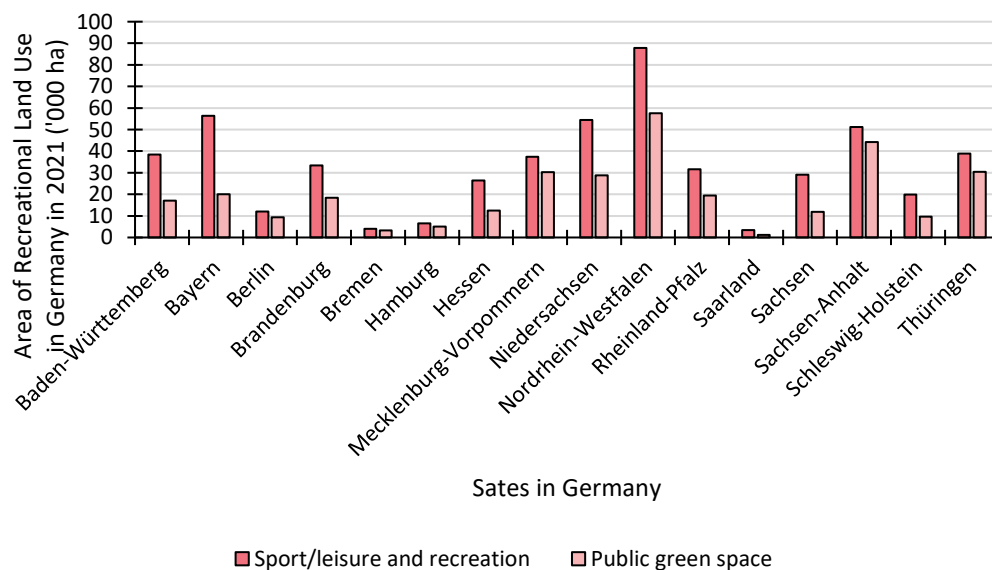


Figure 6.3: Land use for recreation sectors in different states in Germany (Source: Destatis, 2022). Displayed in thousands of hectares.

In summary, the overall land used for the recreation sector in Germany increased between 2000 and 2010, however, there are no recent statistics to confirm if this increase continued into the next decade. However, certain states have large areas of land use for recreation, although this information was only available for 2021, so it is uncertain if this has increased in previous years. Overall, considering this information and how important recreation is to the German way of life, RDFs would be an excellent mineral fertiliser alternative in this sector.

## 7 Ireland

Almost three-quarters of urban households visited green spaces in their local areas most weeks for recreational purposes between June and September 2021, according to a recent report from the Central Statistics Office (CSO, 2022). In Ireland, there are many public parklands across the country including Phoenix Park, which is over 700ha and is one of the largest enclosed public parks in any capital city in Europe (OPW, 2022). There is also St Anne's Park which is the second largest municipal park in Dublin, and Marlay Park which extends over 121ha (DLR coco, 2022).

In Ireland, there are approximately 2500 allotments and community gardens that are provided by local authorities (Wicklow, County Council) that range anywhere from 50 square metres up to 250 square metres in size. In Ireland's capital city Dublin, there was 30.16 m<sup>2</sup> of parkland per inhabitant in 2018, compared to 4.96 m<sup>2</sup> of nature reserves, 3.74 m<sup>2</sup> of golf courses and 0.78 m<sup>2</sup> of public gardens (Figure 7.1; Statista, 2022c).

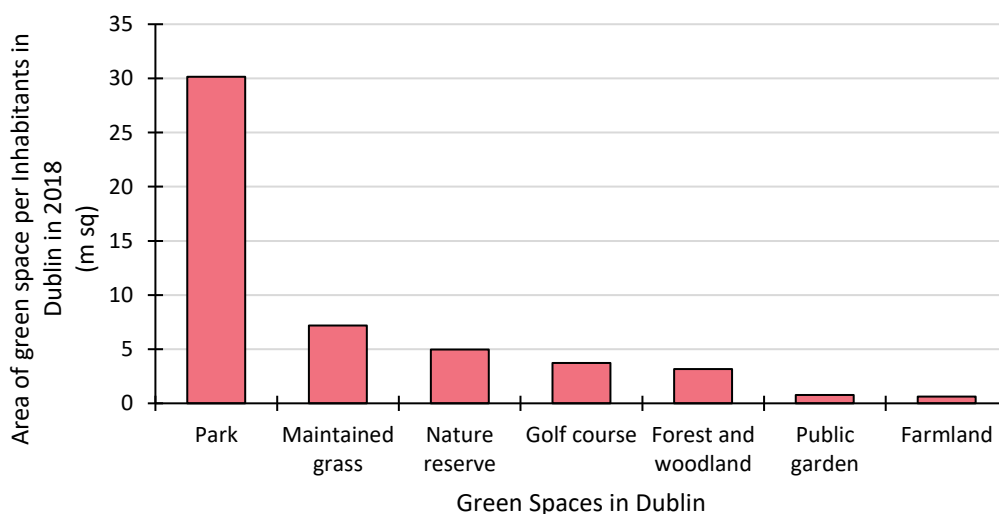


Figure 7.1: Area of green spaces per inhabitant in Dublin in 2018 (Source: Statista, 2022c). Displayed in meters squared.



Furthermore, according to European Golf Association, in the European Golf Participation Report 2021, there were 478 golf courses in Ireland (European Golf Association, 2021). However, the land used for the arts, entertainment and recreation sectors in Ireland is declining, with 156,000ha available in 2009, decreasing by 76% to 37,000ha by 2018 (Figure 7.2; Eurostat, 2021). In 2018, the largest area of land used in this sector was in the NUTS 2 region of Eastern and Midland with 18,000ha, with only 4,700ha in the Northern and Western regions in the same year (Figure 7.3; Eurostat, 2021).

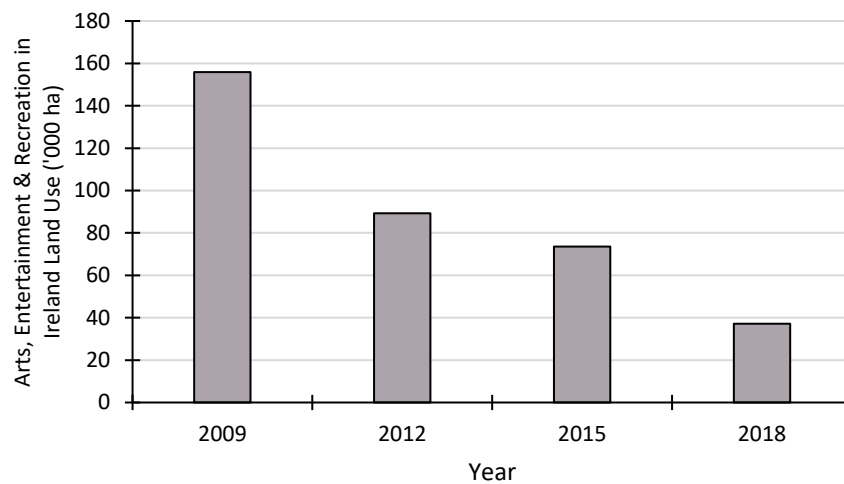


Figure 7.2: Land use for the arts, entertainment and recreation sectors in Ireland from 2009 to 2018 (Source: Eurostat, 2021). Displayed in thousands of hectares.

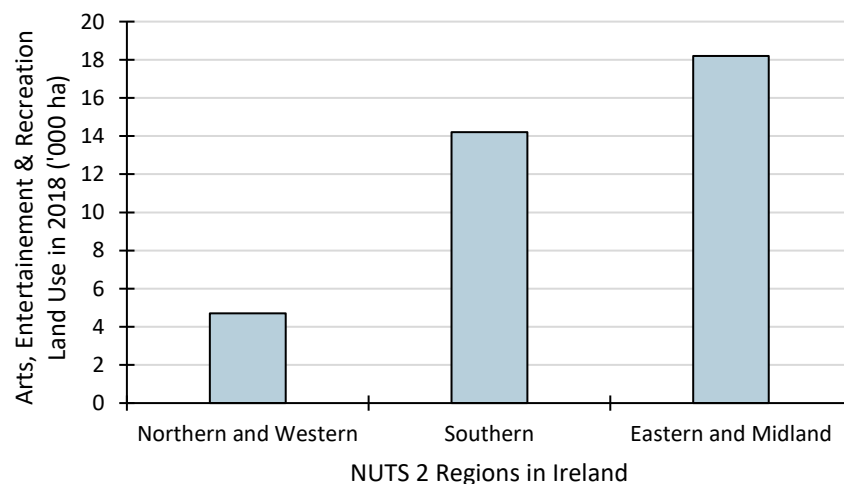


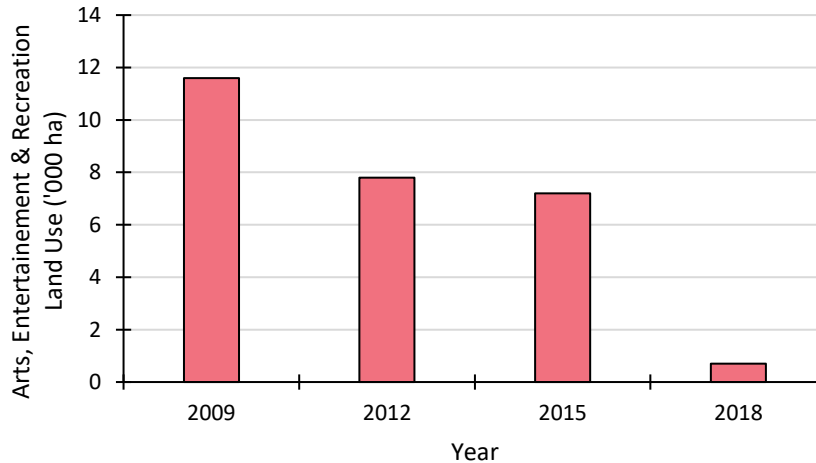
Figure 7.3: Land use for the arts, entertainment and recreation sectors in NUTS 2 regions of Ireland (Source: Eurostat, 2021). Displayed in thousands of hectares.

In summary, although land use for the arts, entertainment and recreation sector is decreasing in Ireland, the use of allotments and public parklands is very popular.

Furthermore, there are many golf courses and sports grounds in Ireland, suggesting that there is a potential market in Ireland for the use of RDFs in the private/recreation sector.

## 8 Luxembourg

According to the Municipal Office of the city of Luxembourg, the city covers a total surface area of 5,173ha and up to a quarter of that is green area spaces (see Figure 3.2). Overall, there are 212 recreational spaces in Luxembourg city, which include public playgrounds, multi-use sports fields and facilities for ball games, across the city's various districts (Luxembourg city tourist office, 2023). Furthermore, the city leases municipal land to residents, in the form of allotments, to grow their produce. However, according to Figure 8.1, the area of land used for the arts, entertainment and recreation sector has decreased by 92% in nine years between 2009 and 2018, from 12,000ha to 1,000ha (Eurostat, 2021). This is a dramatic decrease in the area of land and no specific information on why this drop occurred. This result is indicative of the knowledge gap evident in the recreation sector in Luxembourg.



*Figure 8.1. Land use for the arts, entertainment and recreation sectors in Luxembourg (Source: Eurostat, 2021). Displayed in thousands of hectares.*

Although Luxembourg is a small country and the demand for RDFs in the private/recreation sector would not be as much as its European counterparts, there is, however, still a potential gap in the market for their use albeit at a much lower rate.

## 9 The Netherlands

In the Netherlands, for every 89 in 100 Dutch residents, a green environment, such as a park or public garden, open natural space or a woodland area is within a distance of one kilometre (CBS, 2022). In many residential areas, the residents only have to cover 100 metres to reach the nearest park or public garden (CBS, 2022). In 2017, according to Figure 9.1, there was 36,000ha of sports grounds, 33,000ha of parks and public gardens and 24,000ha of holiday recreation areas, excluding hotels (CBS, 2022). However, not all of this land would be suitable for the application of RDFs as some of the sports grounds could include artificial surfaces.

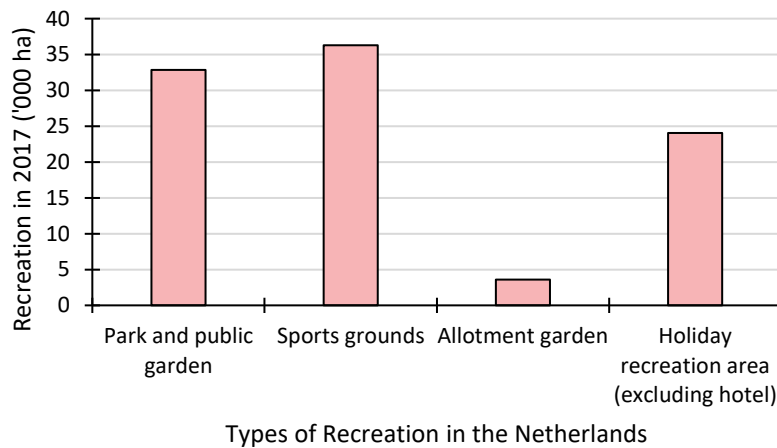


Figure 9.1. Land used for recreation in the Netherlands in 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

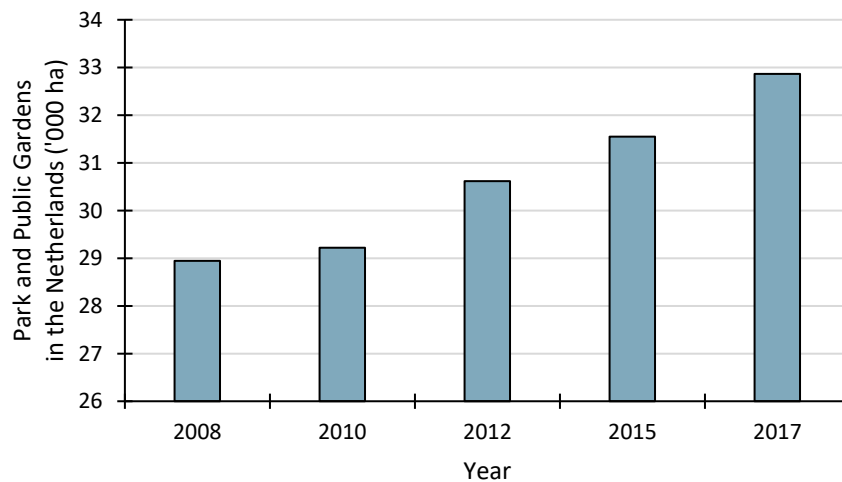


Figure 9.2. Land used for parks and public gardens in the Netherlands between 2008 and 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

In total, 26 botanical gardens are members of the Dutch Association of Botanical Gardens in the Netherlands (Netherlands, 2022). The area of land used for parks and public gardens increased gradually by 14% between 2008 and 2017 from 29,000ha to 33,000ha (Figure 9.2; CBS, 2022). The city park is an essential part of any Dutch city, with 50 parks in Amsterdam (Netherlands, 2022). The NUTS 2 region of West-Nederland had the largest land available for parks and public gardens, with 13,632ha available in 2008, increasing to 15,693ha by 2017 (Figure 9.3; CBS, 2022).

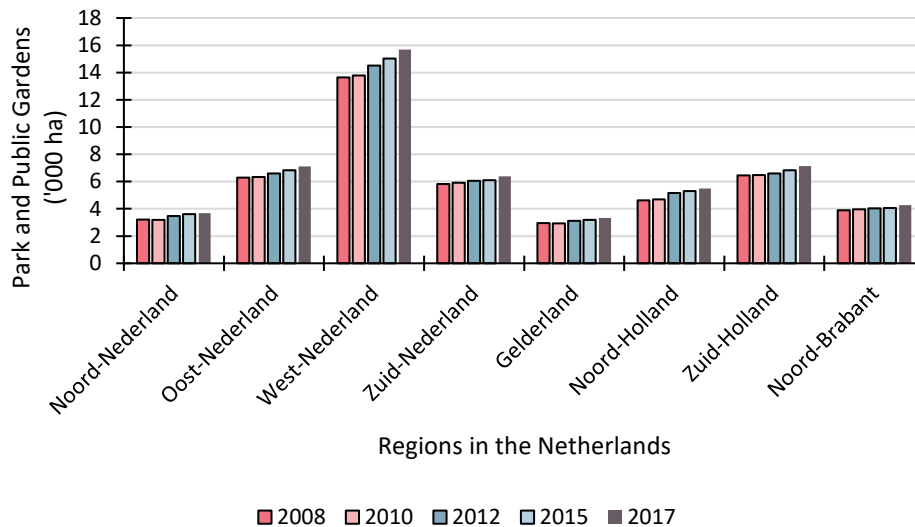


Figure 9.3. Land used for parks and public gardens in NUTS 2 regions of the Netherlands between 2008 and 2017 (CBS, 2022). Displayed in thousands of hectares.

The city of Amsterdam alone manages 26 sports parks with a variety of fields and over 100 smaller sports facilities in various neighbourhoods (CBS, 2022), however, it is unknown how many of these are artificial surfaces. It also manages over 100 football pitches and basketball courts, bowling greens, and more in public areas in neighbourhoods. However, there would not be a demand for the use of RFDs on artificial surfaces. The land used for sports grounds in the Netherlands increased gradually between 2008 and 2017, from 34,000ha to 36,000ha (Figure 9.4; CBS, 2022).

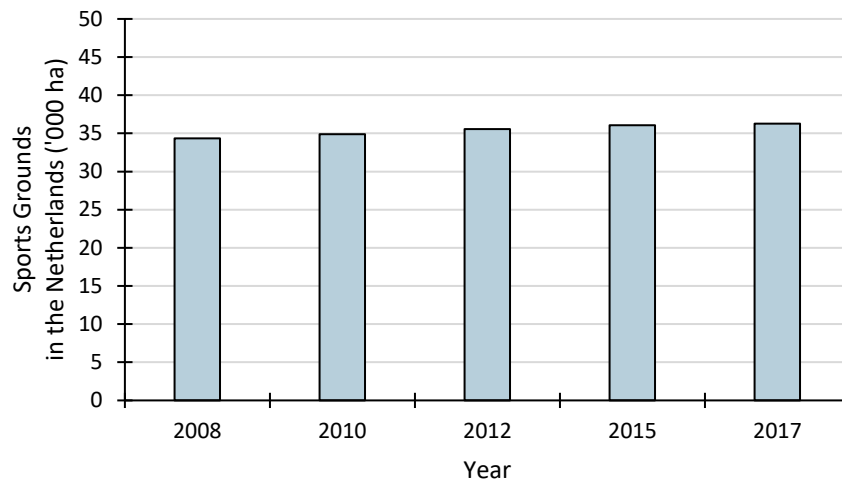


Figure 9.4. Land used for sports grounds in the Netherlands between 2008 and 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

In Figure 9.5, West-Nederland has the largest area used for sports grounds with 12,966ha in 2008, increasing to 13,619ha by 2017, with Oost-Nederland and Zuid-Nederland with large areas of land used for this recreation activity also (CBS, 2022). Furthermore, Figure 9.6 indicates that there were 5,859 grass football fields in the Netherlands in 2015 (Statista, 2022b).

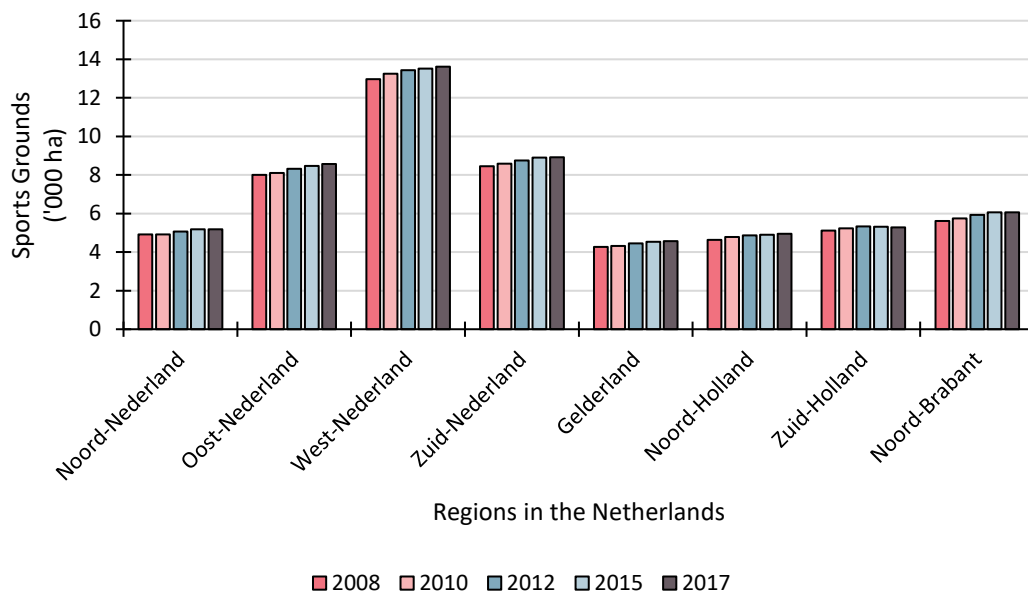


Figure 9.5. Land used for sports grounds in NUTS 2 regions of the Netherlands between 2008 and 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

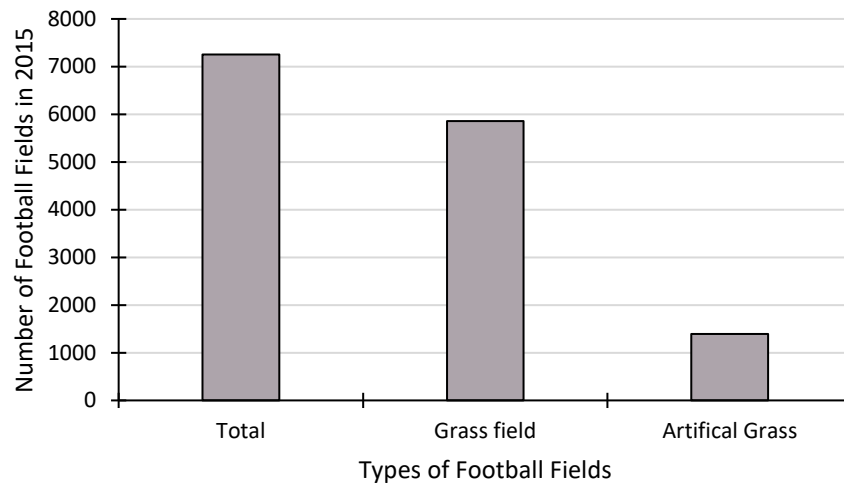


Figure 9.6. Number of football fields in the Netherlands in 2015 (Source: Statista, 2022b).

In 2009, there were 240,000 allotments recorded in the Netherlands, with 5,995 of them located in the Amsterdam area alone (Bole et al., 2009). Typically, they cover an area of 2.8 km<sup>2</sup> and are part of 29 allotment associations (Bole et al., 2009). According to Figure 9.7, in 2008 3,715ha of land was used for allotment gardens in the Netherlands, this decreased slightly to 3,607ha in 2017 (CBS, 2022). Overall, the NUTS 2 region of West-Nederland had the highest land used for allotment gardens (Figure 9.8) which has remained relatively stable over nine years between 2008 with 2,321ha and 2017 with 2,243ha (CBS, 2022).

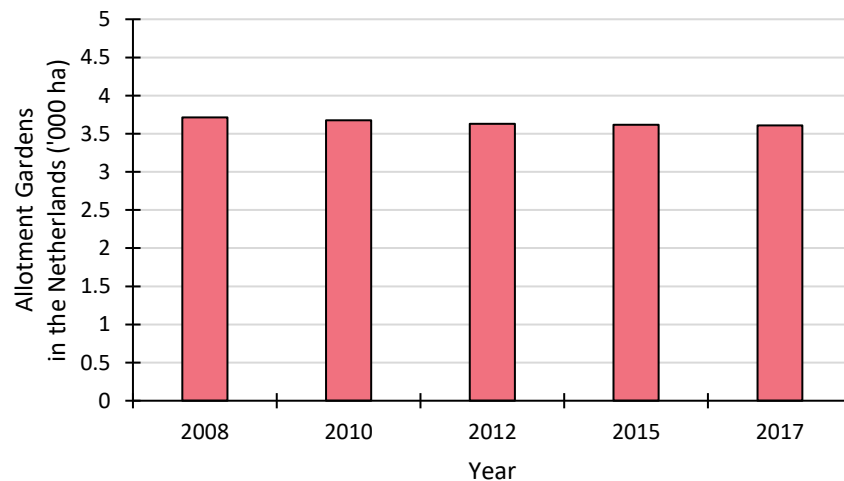


Figure 9.7. Land used for allotment gardens in the Netherlands between 2008 and 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

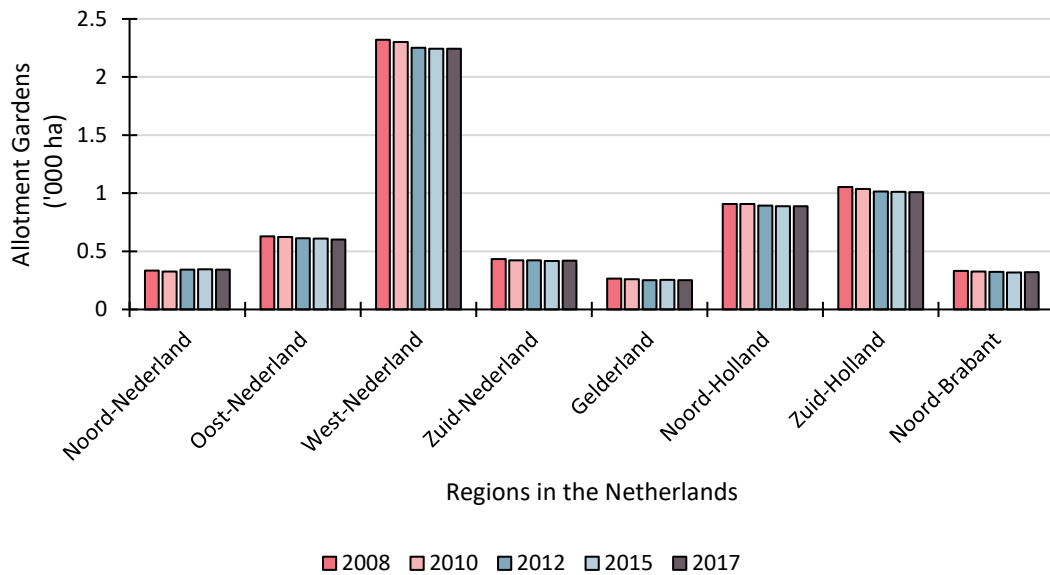


Figure 9.8. Land used for allotment gardens in NUTS 2 regions of the Netherlands between 2008 and 2017 (Source: CBS, 2022). Displayed in thousands of hectares.

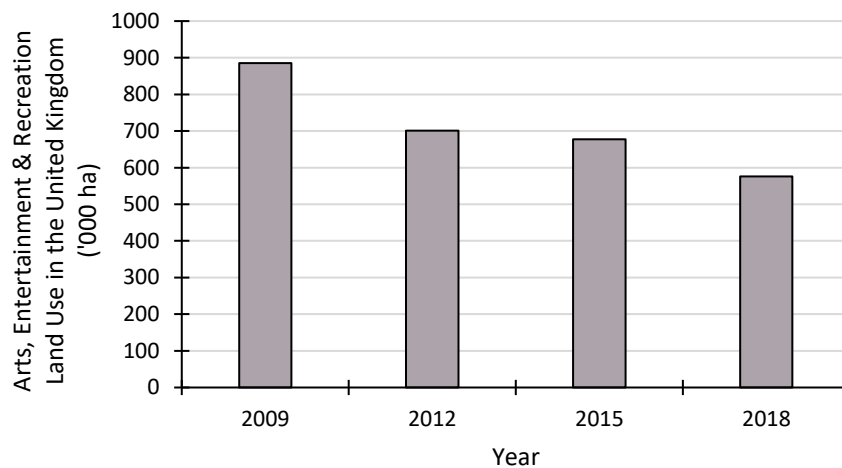
In summary, the Netherlands are very focused on having open green spaces nearby for the residents to frequent with many public parks, allotments and sports grounds. Furthermore, between 2008 and 2017 the land used for parks and public gardens, and sports grounds in the Netherlands increased however, there is no up-to-date data available. On the other hand, land used for allotment gardens in the Netherlands decreased slightly between 2008 and 2017. In addition, in 2015 there were 5,859 grass football fields in the Netherlands (Statista, 2022b). Considering the emphasis the Netherlands have on green spaces and the area of land they use for the private/recreation sector, there is an excellent opportunity in the Netherlands to market RDFs in this sector.

## 10 The United Kingdom

Considering the focus the British put on health, well-being, community and environment, some inhabitants only have access to half the green space as others. For example, those in Scotland enjoy 38.18m<sup>2</sup> of green space per person whilst for those in London the figure falls to just 19.53 m<sup>2</sup> (Fields in Trust, 2021).

The area of land used for the arts, entertainment and recreation sector in the UK has decreased by 35% between 2009 and 2018, with 885,300ha available for use in 2009 compared to 576,300ha available in 2018 (Figure 10.1; Source: Eurostat, 2021). It is clear

in Figure 10.2, that the Highlands and Islands had the largest area of land used for this sector in 2009 with 106,700ha, however, this reduced considerably by 77% in the nine years to 24,100ha in 2018 (Source: Eurostat, 2021). This is a significant decrease in the area of land and no specific information on why this drop occurred. This result is indicative of the knowledge gap evident in the recreation sector in the United Kingdom.



*Figure 10.1: Land use for the arts, entertainment and recreation sectors in Ireland from 2009 to 2018 (Source: Eurostat, 2021). Displayed in thousands of hectares.*

According to Fields in Trust (2021), there is 199,672ha of total green space provided in Great Britain, with 31.43m<sup>2</sup> of green space provided per person, however, this is not equally distributed where almost three million British people don't have access to green space close to where they live. On the other hand, the Office for National Statistics (2019) suggests, there is 212,249ha of green space in Great Britain, which can be divided into functional and publically accessible green spaces. Overall there have been 126,402ha of functional green space recorded in Great Britain excluding Northern Ireland, with 107,388ha in England, 14,663ha in Scotland and 4,351ha in Wales (Figure 10.3; Office for National Statistics, 2019). Furthermore, there is 85,847ha of publically accessible green space available in Great Britain excluding Northern Ireland, 73,400ha available in England, 9,407ha in Scotland and 3,041ha in Wales (Office for National Statistics, 2019). Therefore there is a discrepancy between the two sources of 12,577ha of green space in Great Britain further indicating there is a knowledge gap evident in the recreation sector.



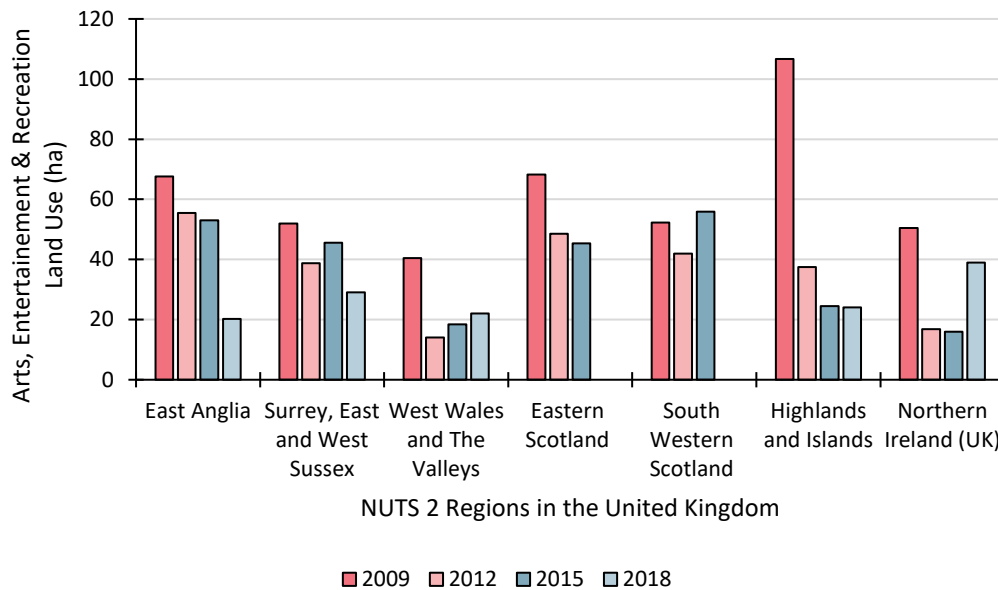


Figure 10.2: Land use for the arts, entertainment and recreation sectors in NUTS 2 regions of the United Kingdom (Source: Eurostat, 2021). Displayed in thousands of hectares.

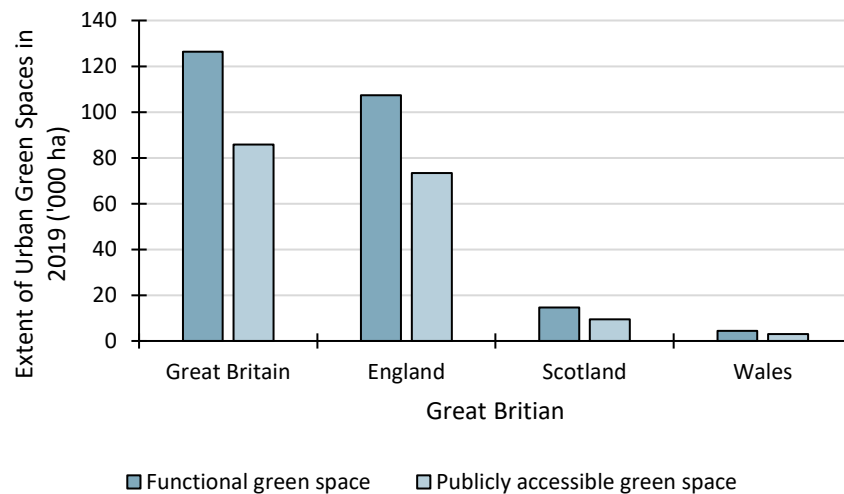


Figure 10.3: Extent of Urban Green Spaces in Great Britain in 2019 (Source: Office for National Statistics, 2019).

More specifically, with regards to recreation and functional green spaces in the UK, there are 9,276 public parks or gardens which cover an area of up to 44,040ha, 15,899 playing fields covering 28,430ha and 7,602 other types of sports facilities covering 15,030ha (Figure 10.4; Office for National Statistics, 2019). In addition, England has the highest number of registered golf courses in all of Europe, with over 2,200 golf courses according to England Golf (2022), which is representative of an area of over 125,000ha. However, according to the Office of National Statistics (2019), the number of golf courses and area covered in 2019 is much less with 1,790 golf courses representing an area of 16,690ha (Figure 10.4; Office for National Statistics, 2019). Again a discrepancy between the two

sources regarding the number of and the land area used for golf courses in Great Britain further indicates there is a knowledge gap and a lack of consistent reliable data evident in the recreation sector.

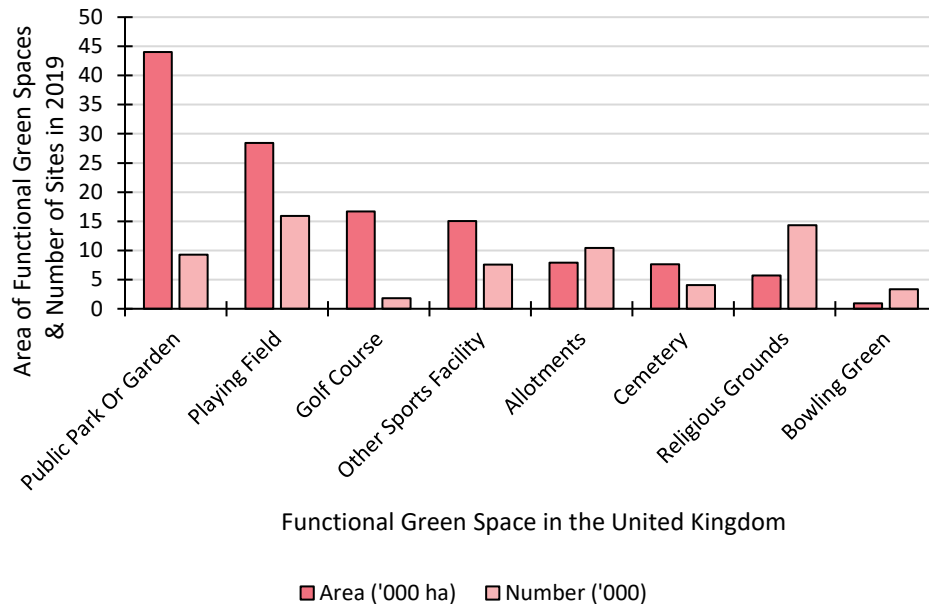


Figure 10.4: Extent of functional green space ('000 hectares) by type of function and the number of sites ('000) in Great Britain in 2019 (Source: Office for National Statistics, 2019).

According to the National Society of Allotment and Leisure Gardens in 2011, 330,000 combined allotment plots were recorded in England and Wales, (GOV.UK, 2011). In Addition, the 2019 data recorded by the Office for National Statistics suggest that there are 10,435 allotments in Great Britain which cover 7,920ha (Figure 10.4; Office for National Statistics, 2019) with an estimated number of 316,998 allotment plots currently within Great Britain's urban areas (Office for National Statistics, 2019). Here it is evident that estimated values for the number of allotment plots are similar for the two sources. Furthermore, there were 9,275 public parks or gardens covering 44,040ha and 15,899 playing fields covering 28,430ha (Office for National Statistics, 2019).

In summary, the British are very focused on open green spaces for their inhabitants, specifically functional green space and publically accessible green space, however, the distribution of land area varies across the UK. The area of land used for the arts, entertainment and recreation sector in the UK has decreased by 35% between 2009 and 2018, however in 2019, there were playing fields, religious grounds and 10,435 allotments and in 2022 there were 2200 golf courses recorded. Considering the large areas of land used in the recreation and private sectors in the UK, it can be concluded that there is great potential for use of RDFs in this sector.

## 11 Discussion and Conclusion

The price of fertilisers is increasing across NWE due to a combination of factors including the China export ban, but most predominantly due to the Russia-Ukraine war. Russia is a major exporter of fertilisers to Europe, but due to sanctions imposed by Europe, the price of fertiliser has soared and the supply is being diminished. According to the European Commission (2022), the price of mineral fertiliser products for EU farmers has increased by 149% between September 2021 and September 2022. These fertiliser shortages in Europe can affect yields resulting in less food being produced, which in turn can affect food security. Not only does the lack of availability of mineral fertilisers and the increasing prices affect the agriculture sector, but it can have a knock-on effect in the horticulture and private/recreation sectors also. The recreation sector in Europe accounts for less than 6% of the total area used for nature recreation, leisure and sport in 2018 (Eurostat, 2018). Although the land use for this sector is small compared to that in agriculture in Europe, there is a potential gap in the private/ recreation sector for the use of mineral fertiliser alternatives, such as RDFs.

The recreation and private sectors in NWE in terms of land use account for the following:

- The recreation sector in Belgium is thriving, with land used for recreational areas and other spaces increasing by 23% between 2011 and 2021 (Statbel, 2021). The land used for the arts, entertainment and recreational sector varied over time at a NUTS 2 level, however in Prov. Antwerpen increased by 8% between 2015 and 2018 to 6,800ha (Eurostat, 2021).
- France has the third highest number of golf courses in Europe according to Statista (2022a), with over 574 official golf courses. There are up to 480 gardens and parks in Paris alone with the Bois de Boulogne Park in the West of Paris, now occupying 873ha of land (Britannica, 2022a). Although the land used for the arts, entertainment and recreation sectors in France up to 2018 was decreasing, at a NUTS 2 level land use in Provence-Alpes-Côte d'Azur increased to 49,000ha between 2015 and 2018 (Eurostat, 2021).
- According to the European Golf Association (2021), there are up to 1,050 golf courses in Germany, and 1.4m organised allotment gardens, covering an area of nearly 47,000ha (Drescher, 2009). Nordrhein-Westfalen in Germany has the largest area of land used for sport/leisure and recreation, and public green space with 87,859ha and 57,573ha available respectively in 2021 (Destatis, 2022).
- In terms of the recreation sector in Ireland, there are up to 2500 allotments and community gardens that are provided by local authorities (Wicklow, County Council) that range anywhere from 50 square metres up to 250 square metres in size across Ireland, in addition to 478 golf courses (European Golf Association, 2021).

- In Luxembourg, there are 212 recreational spaces for playgrounds (Luxembourg city tourist office, 2023) and various sports pitches and allotments.
- The Netherlands, in 2017, had 36,000ha of sports grounds, 33,000ha of parks and public gardens and 24,000ha of holiday recreation areas that excluded hotels (CBS, 2022). The city of Amsterdam alone manages 26 sports parks and over 100 smaller sports facilities (CBS, 2022). The land used for sports grounds increased between 2008 and 2017, from 34,000ha to 36,000ha (CBS, 2022). Furthermore, there are 78,240,000 allotments recorded in the Netherlands in 2009, with 5,995 of them located in Amsterdam Bole et al., 2009).
- In the United Kingdom, London is one of Europe's greenest European capitals with 33% of London's public green space (World Cities Culture Forum, 2022). Furthermore, there is up to 212,249ha of green space in Great Britain which is divided into functional and publically accessible green spaces (Fields in Trust, 2021). The UK also have 9,276 public parks or gardens, covering an area of up to 44,040ha, 15,899 playing fields covering 28,430ha and 7,602 other types of sports facilities covering 15,030ha (Office for National Statistics, 2019).

In conclusion, there is a growing demand for mineral fertiliser alternatives across NWE in the agricultural and horticulture sectors, particularly, more recently due to the Russia-Ukraine war, the China export ban and the logistical delays associated with Covid-19. The private/ recreational sector, although much smaller than the agriculture and horticulture sectors has potential for the use of RDFs and more so in the coming years with fertiliser price increases and a lack of availability. For example, on a small scale, private and allotment gardeners are becoming more aware of the importance of using mineral fertiliser alternatives such as peat-free composts and soil improvers. On a larger scale, golf course and sports ground owners are also moving away from conventional mineral fertilisers and are starting to explore more sustainable and natural alternatives.

Although land use data is available for the arts, entertainment and recreational sector, specific data on the private/recreation sector alone across NWE is not recorded across Europe. In addition up to date, recent information is lacking on fertiliser use on sports grounds, allotments or in private gardens. To assess the demand for RDFs in this sector, it was important to know how much fertiliser is used in the recreation/ private sector and what type of fertilisers are they using. From a sustainability perspective, the environmental impact of fertiliser use in this sector is also unknown. This information was not available for any of the target countries explored in this study. In addition, the land use data in many instances were only available up to 2018, resulting in a four-year knowledge gap. Due to this lack of current information, it has proven difficult to predict what will happen in the private/ recreation sector in the future concerning the use of fertilisers, impacting our ability to forecast future trends and inputs. In addition, attaining current relevant information on the private/ recreation sector across NWE can contribute to our security of fertiliser supply knowledge.

Taking into consideration the considerable amount of land in many countries available for use in the recreational and private sectors, there is great potential for the use of RDFs. In particular for use in private or city-owned allotments, private gardens, sports pitches, playgrounds and golf courses that were highlighted through this research. The reliance of NWE on mineral fertilisers would be reduced if the acceptance, availability and use of RDFs in the private/ recreation sector increased. The use of these sustainable and locally sourced fertilisers would contribute to closing the nutrient cycle loop and the circular economy across NWE.

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