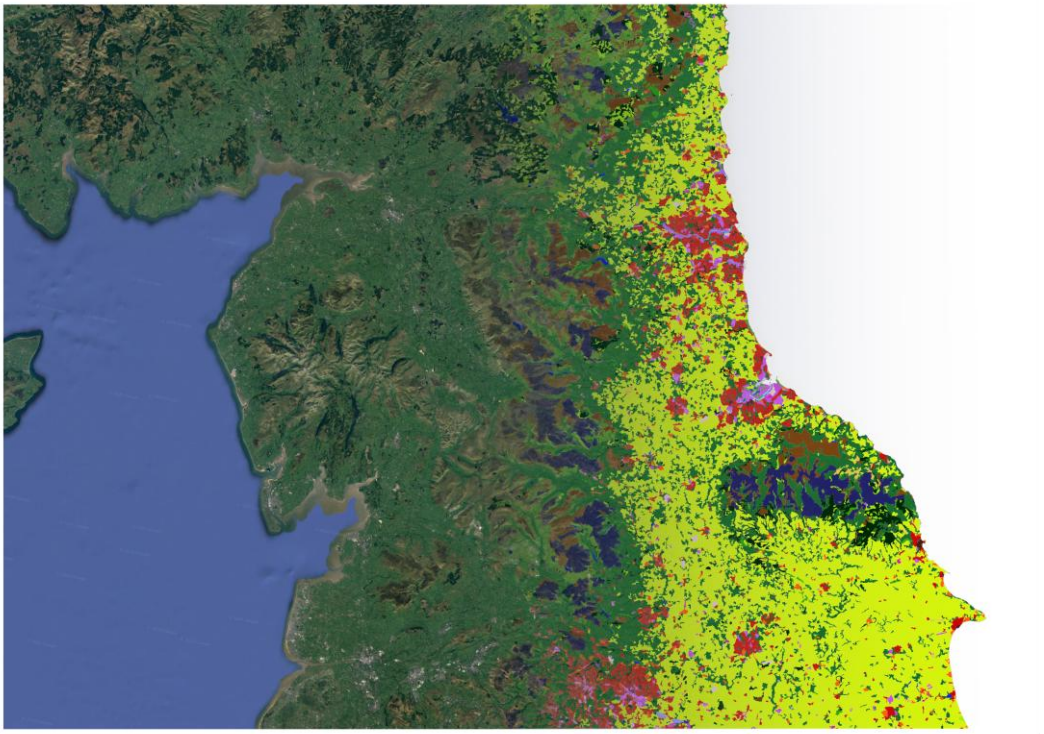
Land Use in the United Kingdom: Regional Analysis



Highfield Biological Consulting
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SUMMARY

The European CORINE 2018 land use dataset was examined and analysed to produce a series of maps of the UK and its constituent countries and regions. The data indicates a landscape that, although varied across the country, is dominated by agricultural activity, particularly in southern England. Forested / woodland areas are sparse across England, Northern Ireland and Wales with only Scotland having appreciable contiguous areas of tree cover. Here, the woodland is dominated by coniferous plantations and the only part of the UK with significant areas of deciduous broadleaved trees is the South East region on England.

Urbanisation was examined and seen to reach levels of around 15% in the South East of England, falling to less than 2% in Scotland. Overall, around 90% of the UK outside Scotland is covered by just three aggregated land use classifications: agriculture, forestry/woodland and the built environment (urban, industrial, transport etc). As such, there is very little environment that can be considered remotely natural[1] outside of Scotland, a fact that places in stark relief the challenges the UK faces with respect to improving the state of the country's declining wildlife and meeting environmental /climate change goals.

[1] Here the term "natural" is used to describe environments that have low levels of direct human interference. There are few, if any, truly natural environments remaining in the UK.

Contents

1. INTRODUCTION

The landscape of the UK we see today has chiefly been shaped by the activities of man. Following the last ice age, which ended around 11,700 years ago, the tundra that emerged as the ice receded became dominated by trees that, as the climate varied, changed in species composition and richness [1, 2]. Humans rapidly re-settled what would become the British Isles (the Doggerland land bridge connected Britain to continental Europe until around 8000 years BCE) and have progressively altered the landscape ever since. The process accelerated following the migration of Neolithic farmers to Britain approximately 6000 years ago [3]. The expansive post-glacial forest cover that once stretched over much of the islands was gradually removed from the landscape and by around 2500 years ago at least half of Britain's forests had been replaced by cultivated or grazed land [1].

Arthropogenic modification of the British landscape was nearly complete by the late 18th century as the enclosure of open land, a process that had been ongoing since the 13th century, intensified and finally fenced-in much of the remaining open common land [4, 5]. Agriculture progressively became more science-based and mechanised so that by the middle of the 20th century farmed land was being used ever more intensively and less and less quarter was given to other species associated with the agri-environment. This increasing intensification of the UK's agricultural landscape continued throughout the late 20th century up to the present day.

The agricultural landscape effectively serves to sequester the radiant energy of the sun for the purposes of man. This diversion of energy, by necessity, deprives other species of the resources they require and, as a consequence, the UK's landscape has become one that has become ever more hostile to wildlife. Now, in the third decade of the 21st Century, it is becoming increasingly apparent that the use of land has to be examined and addressed in order that future generations enjoy an environment that provides anything other than a barren, ecologically moribund and essentially wildlife-free country. Of course, such changes have to be made in tandem with improvements in a series of other areas (e.g. farming practices, pesticide use etc,) but the fact remains that the application that humans put a given area of land to has the single most marked impact on the quality of the environment within that area, the services it provides and the species that occur there.

It is also important to understand how land use and land use change act as contributors and/or mitigators of climate change. Many natural and semi-natural landscapes act as sinks for carbon dioxide and, hence, reduce net outputs of the gas. The repurposing of land (land use change; LUC), alternatively, can result in the release of greenhouse gasses (GHGs), including carbon dioxide (CO_2 and methane (CH_4), contributing to the emissions of a given state or region. Therefore, it is important that land is managed in the future in such a way that GHG emissions are minimised and sinks for GHG gasses are preserved and/or created.

It is with the importance of land use in mind that a recent report published by the UK's Committee on Climate Change [6] set out plans detailing how land use could and should be changed over the next thirty years to meet the nation's climate change objectives. The ultimate objective described by this report is to achieve a net carbon neutral status that balances all emissions of GHGs with that removed by the activity of sinks for the gases. This extensive report outlines goals which can only be fully appreciated when one examines the current land use situation, and it is important to understand that absolute values of UK lands types are not necessarily particularly useful metrics. As such, here the UK has been broken down into its constituent countries, England, Northern Ireland,

Scotland and Wales and each examined in isolation. In addition to this, England has been divided into its regions. This approach gives a much better, though still far from perfect, picture of land use in the UK and demonstrates the misleading picture that can painted when the UK is examined as a single unit.

2. METHODS

The UK was addressed on a regional basis as shown in Figure 1 in order to ascertain the degree that certain land uses have become concentrated in certain parts of the country. As a result, the UK was divided into its component countries and England sub-divided into its recognised regions (formerly known as government office regions).

The data presented here was produced using QGIS 3.10. The land use dataset that was analysed was obtained from the Copernicus Land Use Service website (CORINE 2018) [7]. These data comprises the entire EU as well as a number of non-member states. Shapefiles used for extracting data for various UK countries/regions were obtained from the Ordnance Survey. The extracted data for each region or country were summed to produce the totals for England and the UK, respectively.

The full methodology is described in Appendix 1.

Tabulated land classes and CORINE identification codes are tabulated in Appendix 2.

The entire 2018 dataset contains a number of errors that were not fully resolved at the time of writing. As a result, only a few references are made to land use outside the UK. The issues with the full dataset are described in Appendix 3 as are some minor discrepancies with an earlier report on land use across the UK.

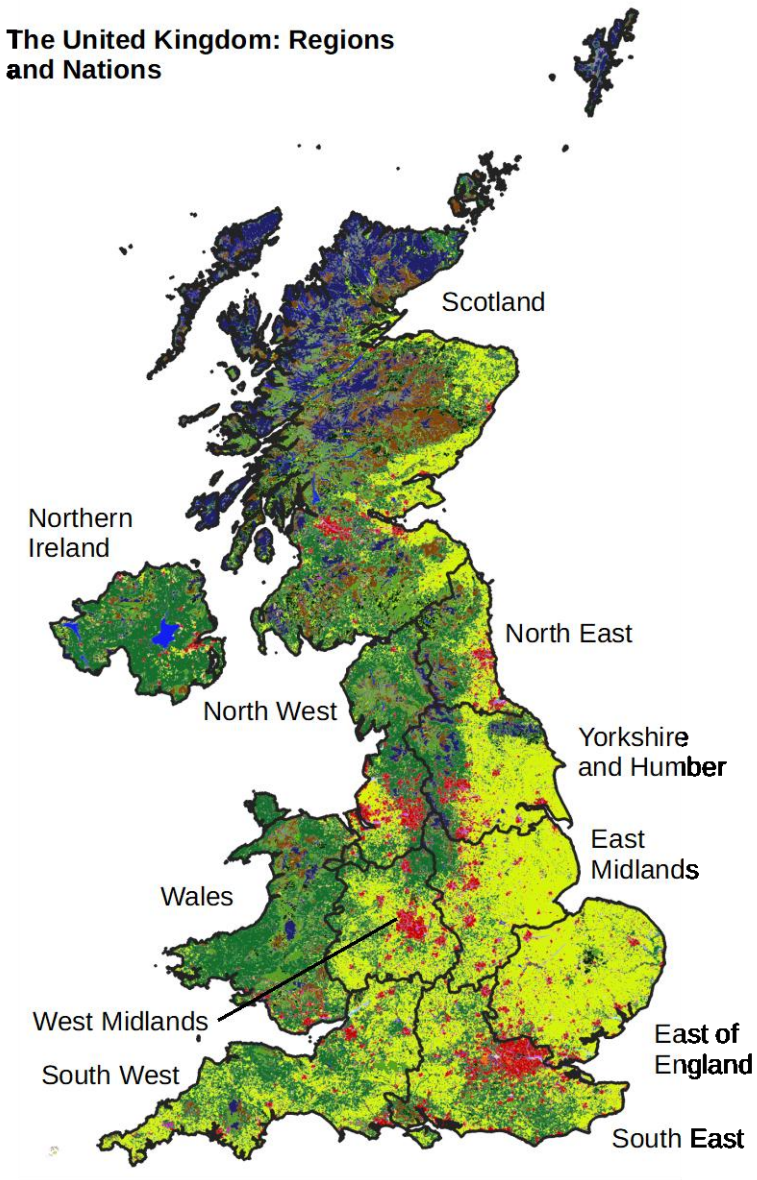


Figure 1. The nations and regions of the UK addressed by the present report.

3. RESULTS

The following series of maps cover the regions of the United Kingdom sequentially, starting with the UK as a whole followed by the constituent countries and then the regions of England. Any method for sub-dividing the UK has limitations, but the approach used here does indicate how some land use types are concentrated in certain areas. The maps included with each figure have been scaled to the page.

3.1 Overview

The complete land cover map of the UK is shown in Figure 2 and indicates that the nation as a whole is dominated by just two land types: pastures and arable (>55%). When England is examined in isolation (Fig. 3), the picture becomes even more biased towards these two land types, particularly arable, with over 70% of the land given over these two uses. Northern Ireland (Fig. 4) is similarly dominated by agriculture although the primary use is as pasture (*ca*. 63 %) with arable being a relatively minor category.

Scotland (Fig. 5) provides a complex land use picture that, of the nations of the UK, has the least emphasis on agricultural uses and, instead, is dominated by peat bogs and heathland that are consistent with the large areas of upland found in the country. Forestry is also much more prevalent in Scotland than it is elsewhere. Wales (Fig. 6), however, has a landscape largely dominated by pasture.

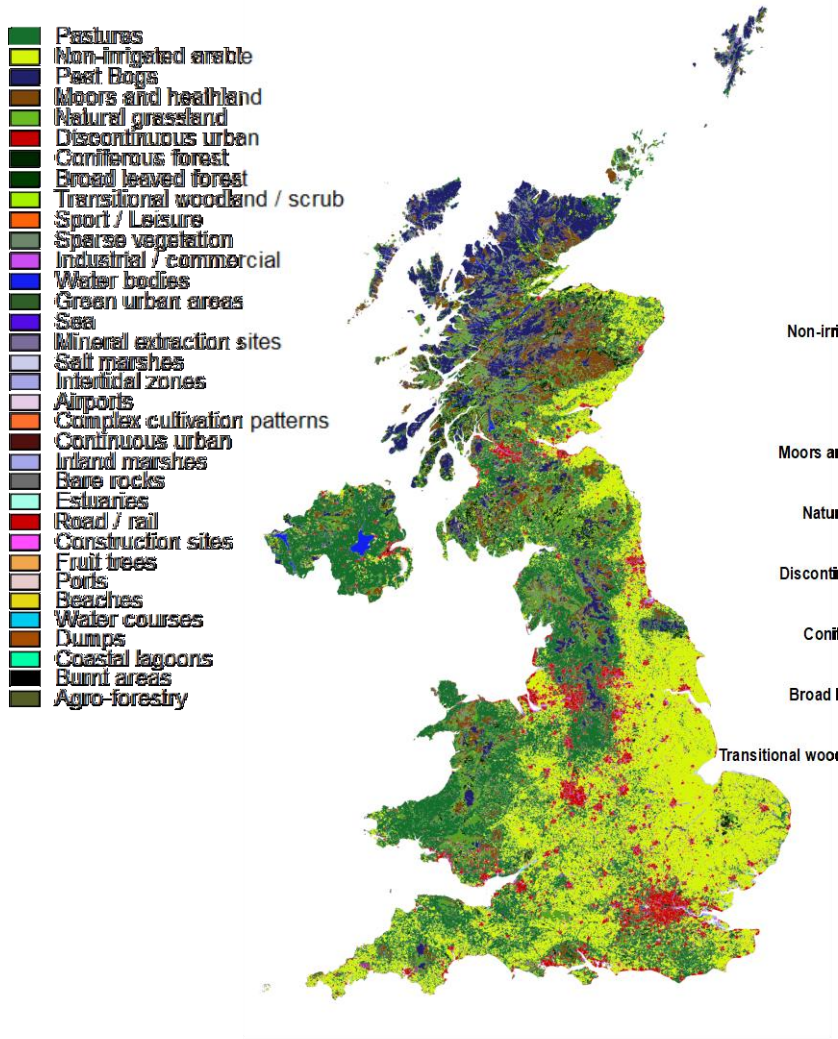
The English regions yield quite distinct land use pictures. For example, the North West (Fig. 7) is dominated by pasture, in a similar fashion to Northern Ireland and Wales and, despite including one of the most sparsely populated counties of England (Cumbria), has the second highest discontinuous urban coverage of *ca.* 10%, almost exclusively concentrated in the southern half of the region. Similarly, in the North East (Fig. 8) pastures also comprise the largest single use although there is also a comparable area of arable farming. The North East has, in terms of coverage in England, a relatively large area of coniferous forest, at 5.6%.

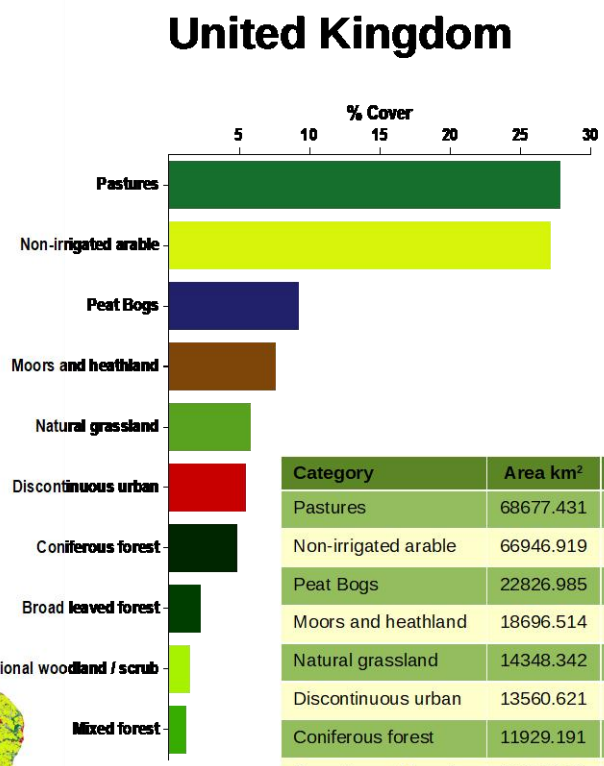
The Yorkshire and Humberside region (Fig. 9) shows a transition moving south to a much greater proportion of arable land (>45%) although large areas of pasture at the margins of the Pennines to the west are still present. The Leeds-Bradford, Sheffield and Hull conurbations give this region a comparatively high urban coverage (7.3%). The change to an arable landscape moving further south increases in the East Midlands (Fig. 10), where >63% of the area is given over to this use, When combined with pastures, 80% of the land is given over to just two agricultural uses. The large conurbations of Leicester, Nottingham and Derby contribute to discontinuous urban cover in this region reaching almost 7%.

The East of England (Fig. 11) is the region most dominated by arable farming within the entire UK, at approaching 69%. When added to pastures and discontinuous urban, over 87% of the land area is given over to just three land classes and, as such, this part of the country is one of the least diverse in the entire UK. By contrast, the South East of England – the region including Greater London – is comparatively diverse. Most obviously, whilst this region has the greatest discontinuous urban cover it also has proportionately the largest areas of broad leaved forests across the entire UK (6.3%).

Despite the urbanisation of this region (Fig. 12), over 65% is still given over to what can be considered exclusively agricultural activities.

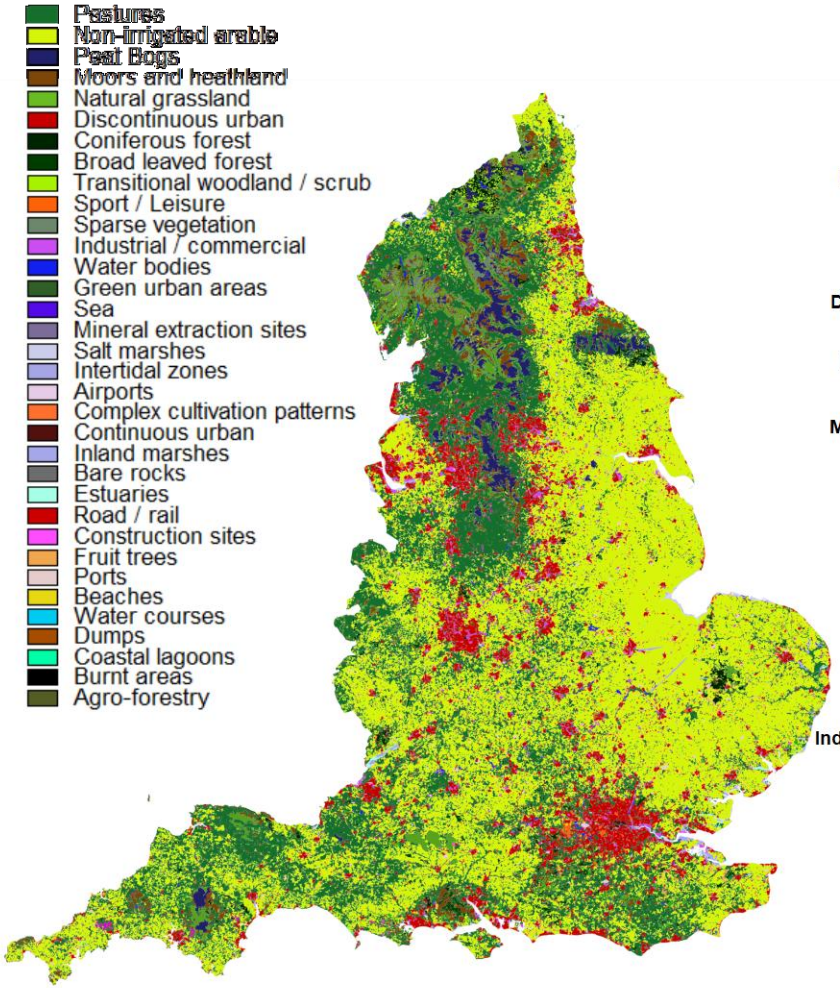
The South West (Fig. 12) presents quite a fragmented picture dominated by arable and pastures that make up >77% of the land area. Although often perceived as a largely rural part of the UK, this region still has a discontinuous urban cover of 5.3%. This region ranks second in England (and the UK as a whole) with respect to broad leaved tree cover at just over 3.5%. The West Midlands is primarily of note for having the UK's third highest discontinuous urban cover at around 9% (Birmingham, West Bromwich and Coventry etc.) and, in common with most other parts of Britain, the region is dominated by arable farming and pastures.

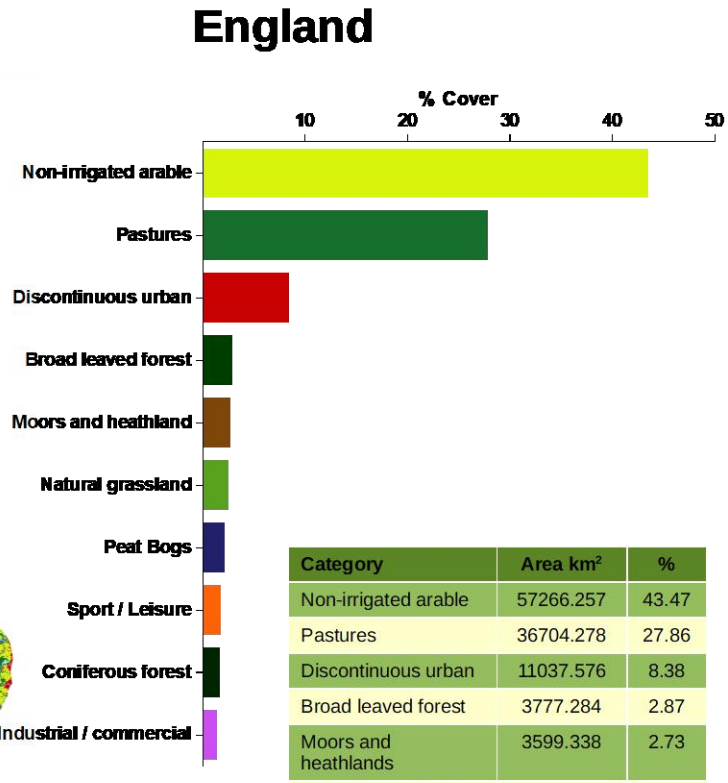




Category	Area km²	%
Pastures	68677.431	27.89
Non-irrigated arable	66946.919	27.19
Peat Bogs	22826.985	9.27
Moors and heathland	18696.514	7.59
Natural grassland	14348.342	5.83
Discontinuous urban	13560.621	5.51
Coniferous forest	11929.191	4.85
Broad leaved forest	5554.946	2.26
Transitional woodland / scrub	3816.244	1.55
Mixed forest	3003.635	1.22
Other	16848.77	6.84
Total Area	**246209.60**	

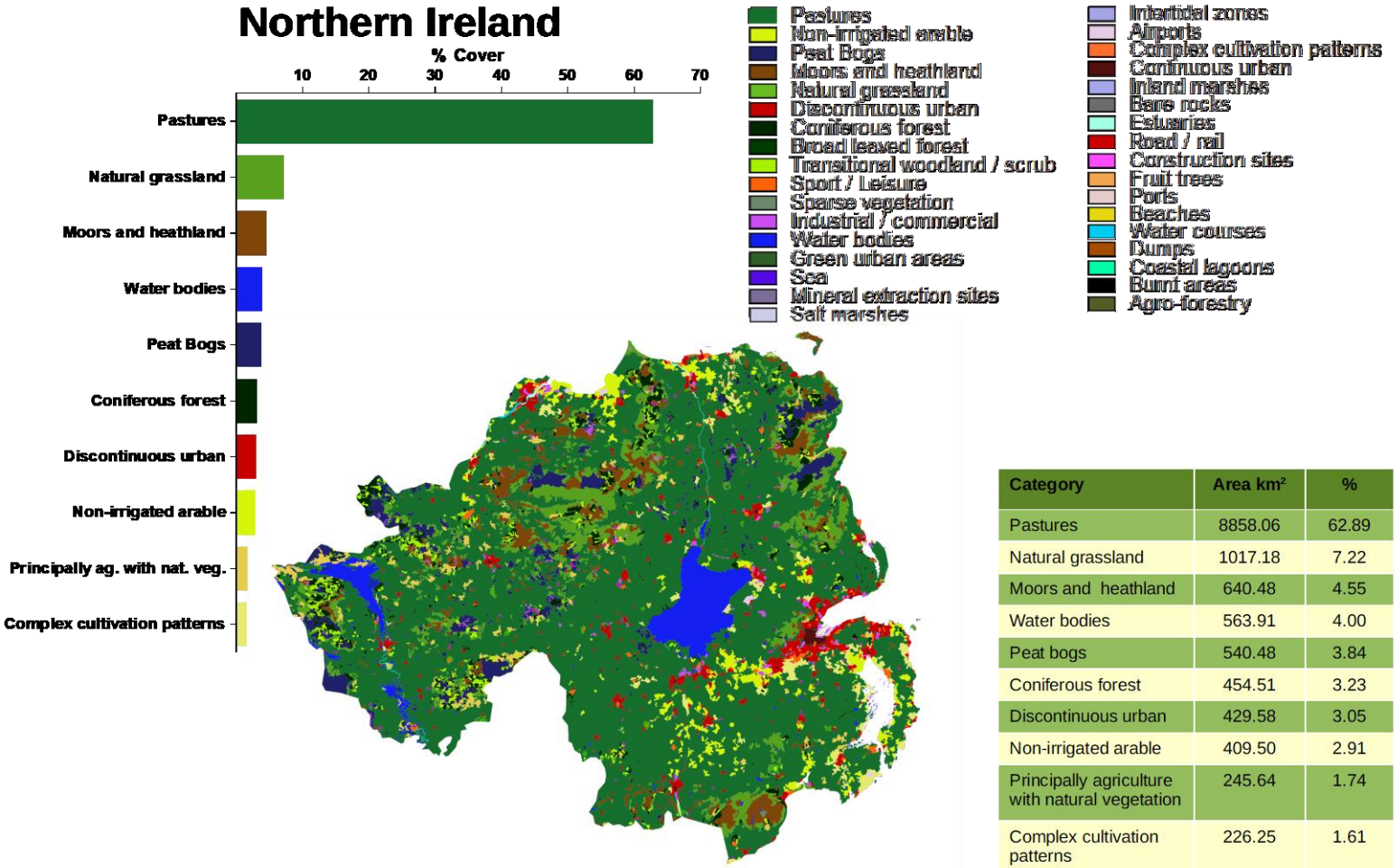
Figure 2. Land use in the UK.





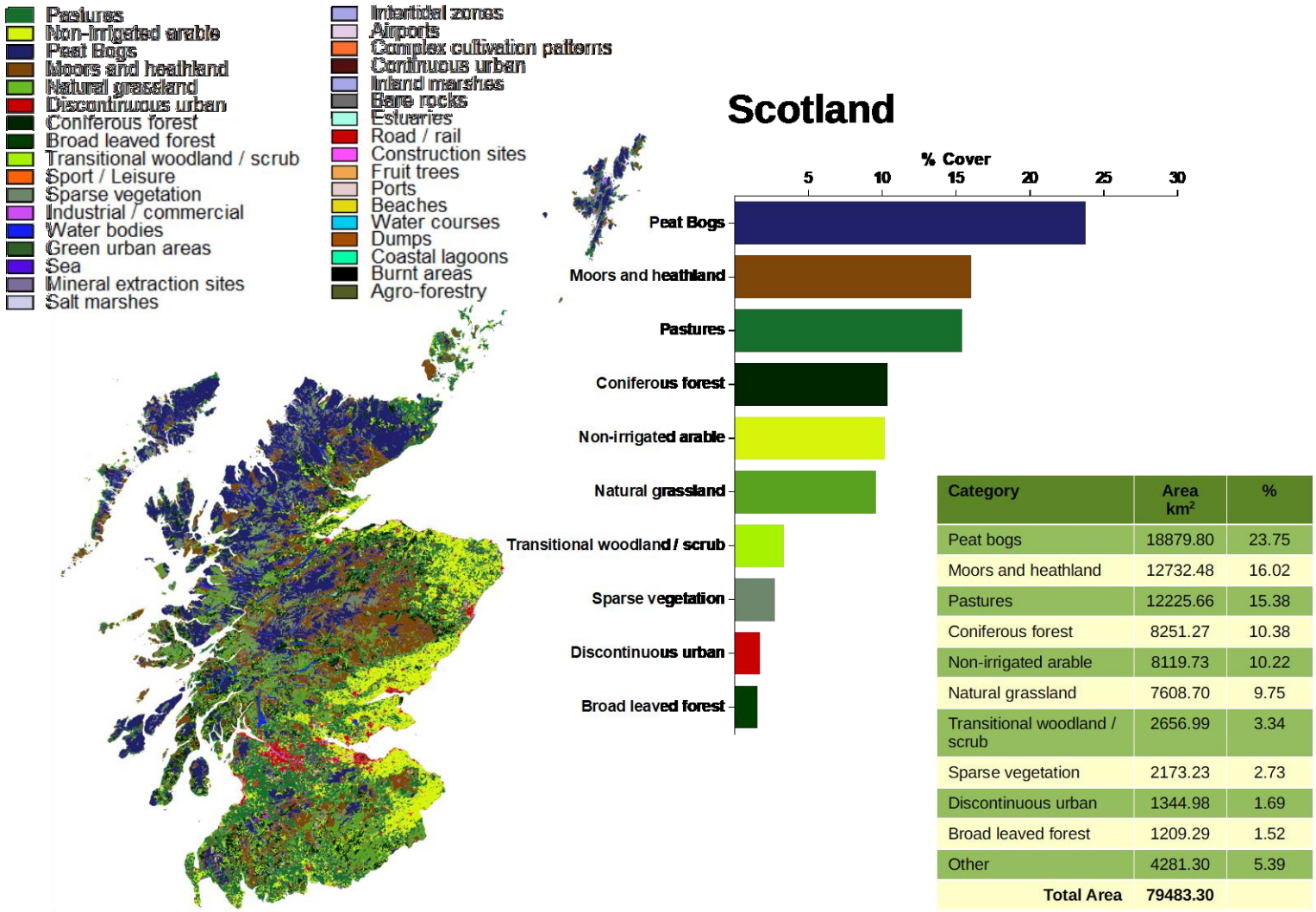
Category	Area km²	%
Non-irrigated arable	57266.257	43.47
Pastures	36704.278	27.86
Discontinuous urban	11037.576	8.38
Broad leaved forest	3777.284	2.87
Moors and heathlands	3599.338	2.73
Natural grassland	3274.362	2.49
Peat bogs	2811.273	2.13
Sport / leisure	2333.794	1.77
Coniferous forest	2158.484	1.64
Industrial / commercial	1850.089	1.40
Other	6928.44	5.26
Total Area	**131741.17**	

Figure 3. Land use in England.



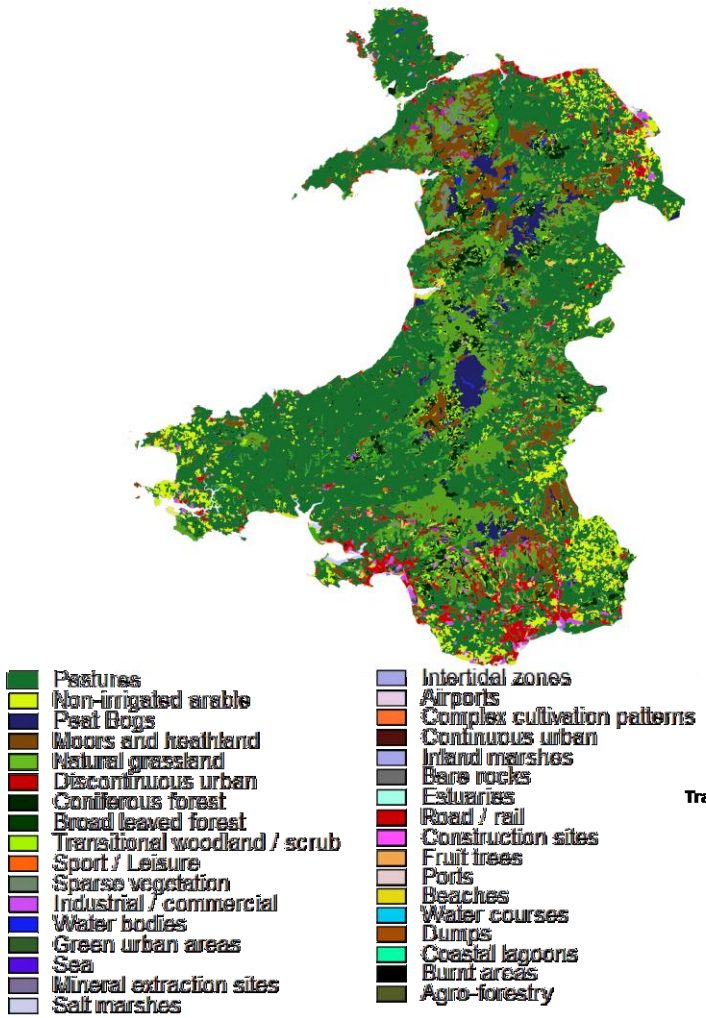
Category	Area km²	%
Pastures	8858.06	62.89
Natural grassland	1017.18	7.22
Moors and heathland	640.48	4.55
Water bodies	563.91	4.00
Peat bogs	540.48	3.84
Coniferous forest	454.51	3.23
Discontinuous urban	429.58	3.05
Non-irrigated arable	409.50	2.91
Principally agriculture with natural vegetation	245.64	1.74
Complex cultivation patterns	226.25	1.61
Other	698.77	4.96
Total Area	**14084.36**	

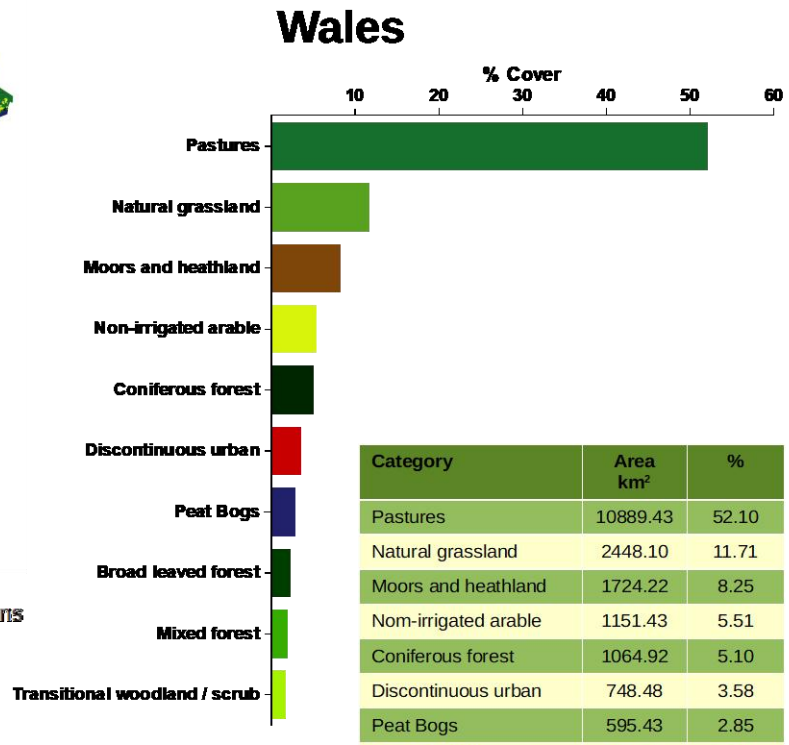
Figure 4. Land use in Northern Ireland.



Category	Area km²	%
Peat bogs	18879.80	23.75
Moors and heathland	12732.48	16.02
Pastures	12225.66	15.38
Coniferous forest	8251.27	10.38
Non-irrigated arable	8119.73	10.22
Natural grassland	7608.70	9.75
Transitional woodland / scrub	2656.99	3.34
Sparse vegetation	2173.23	2.73
Discontinuous urban	1344.98	1.69
Broad leaved forest	1209.29	1.52
Other	4281.30	5.39
Total Area	**79483.30**	

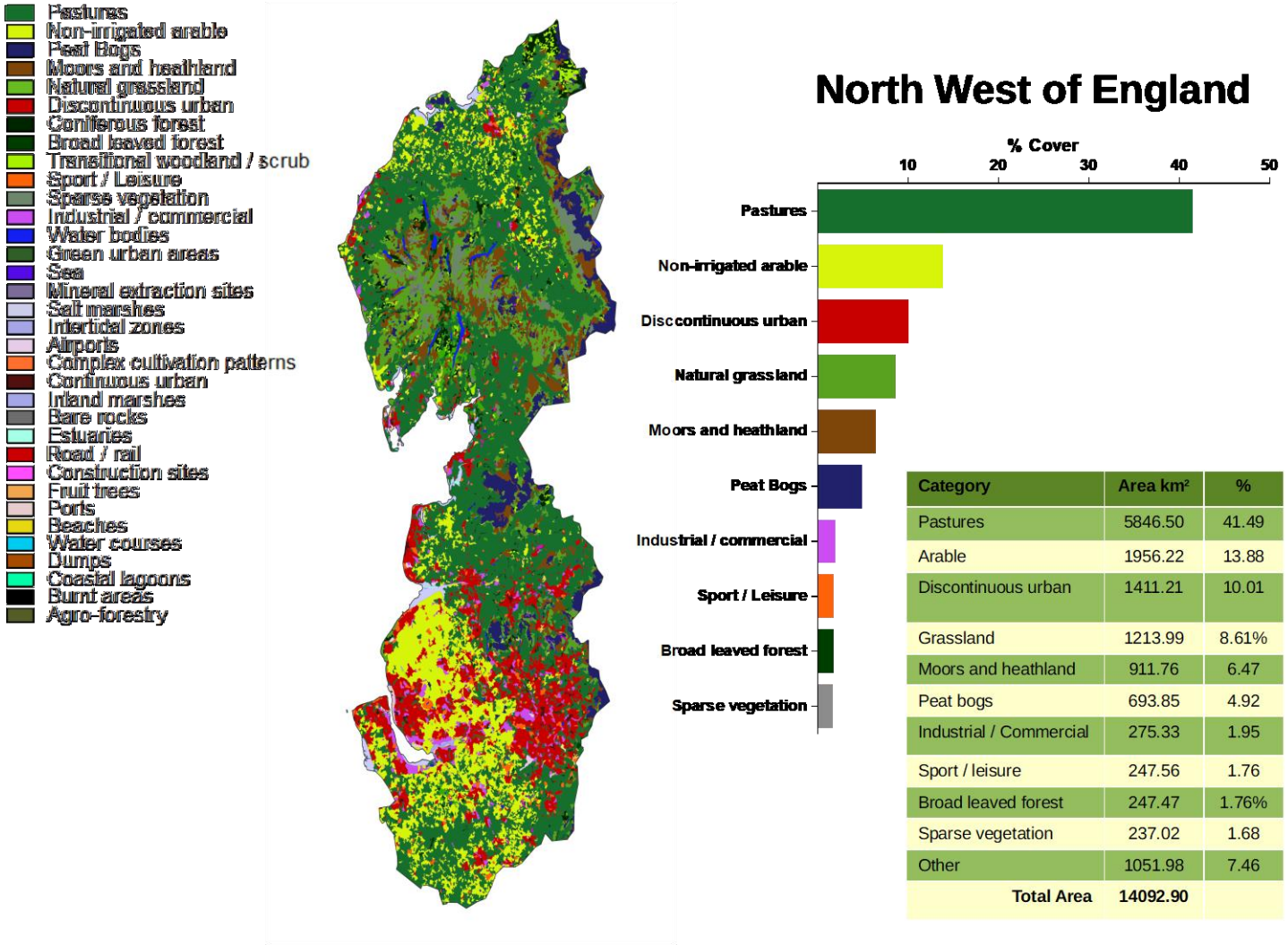
Figure 5. Land use in Scotland.





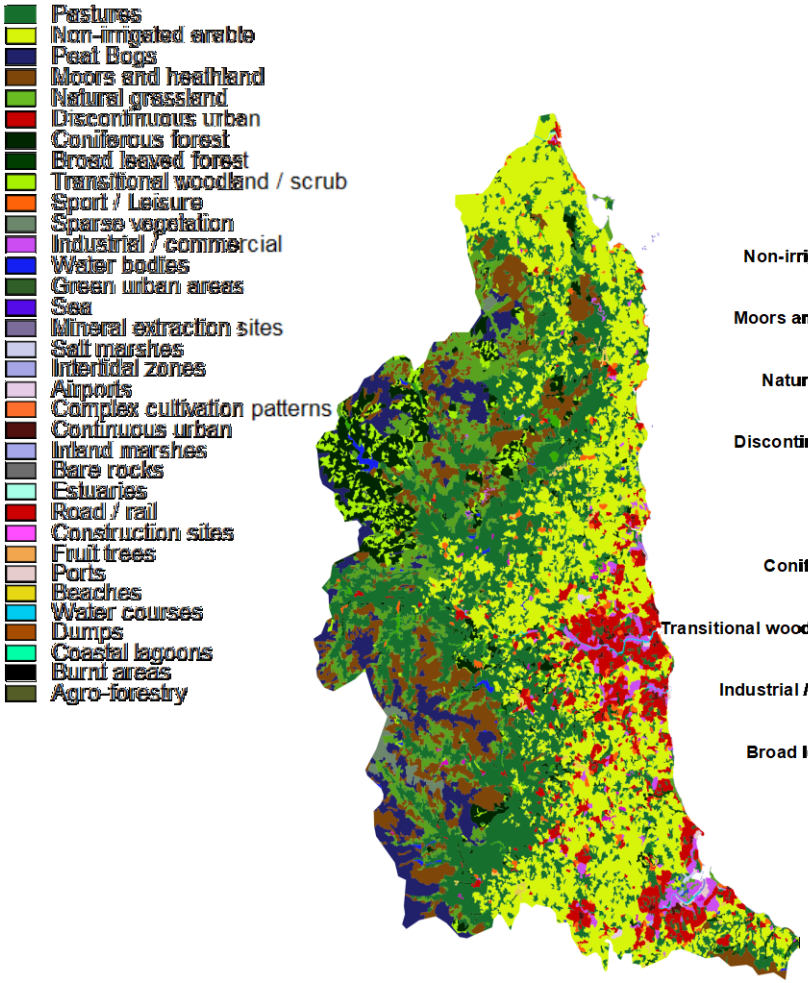
Category	Area km²	%
Pastures	10889.43	52.10
Natural grassland	2448.10	11.71
Moors and heathland	1724.22	8.25
Nom-irrigated arable	1151.43	5.51
Coniferous forest	1064.92	5.10
Discontinuous urban	748.48	3.58
Peat Bogs	595.43	2.85
Broad leaved forest	491.72	2.35
Mixed forest	415.57	1.99
Transitional woodland / scrub	363.70	1.74
Other	1007.78	4.82
Total Area	**20900.76**	

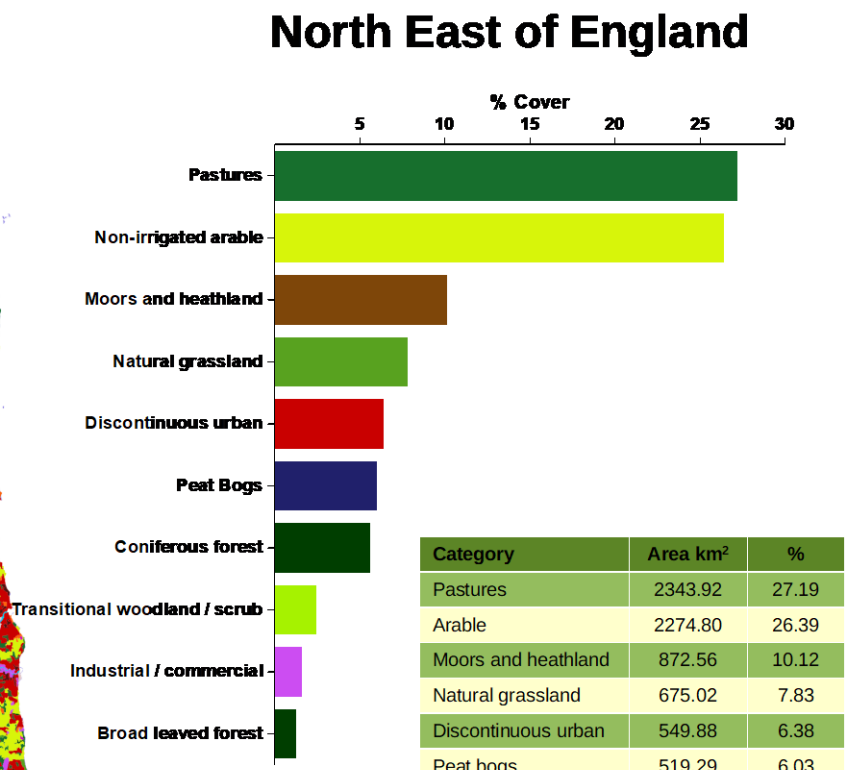
Figure 6. Land use in Wales.



Category	Area km²	%
Pastures	5846.50	41.49
Arable	1956.22	13.88
Discontinuous urban	1411.21	10.01
Grassland	1213.99	8.61%
Moors and heathland	911.76	6.47
Peat bogs	693.85	4.92
Industrial / Commercial	275.33	1.95
Sport / leisure	247.56	1.76
Broad leaved forest	247.47	1.76%
Sparse vegetation	237.02	1.68
Other	1051.98	7.46
Total Area	**14092.90**	

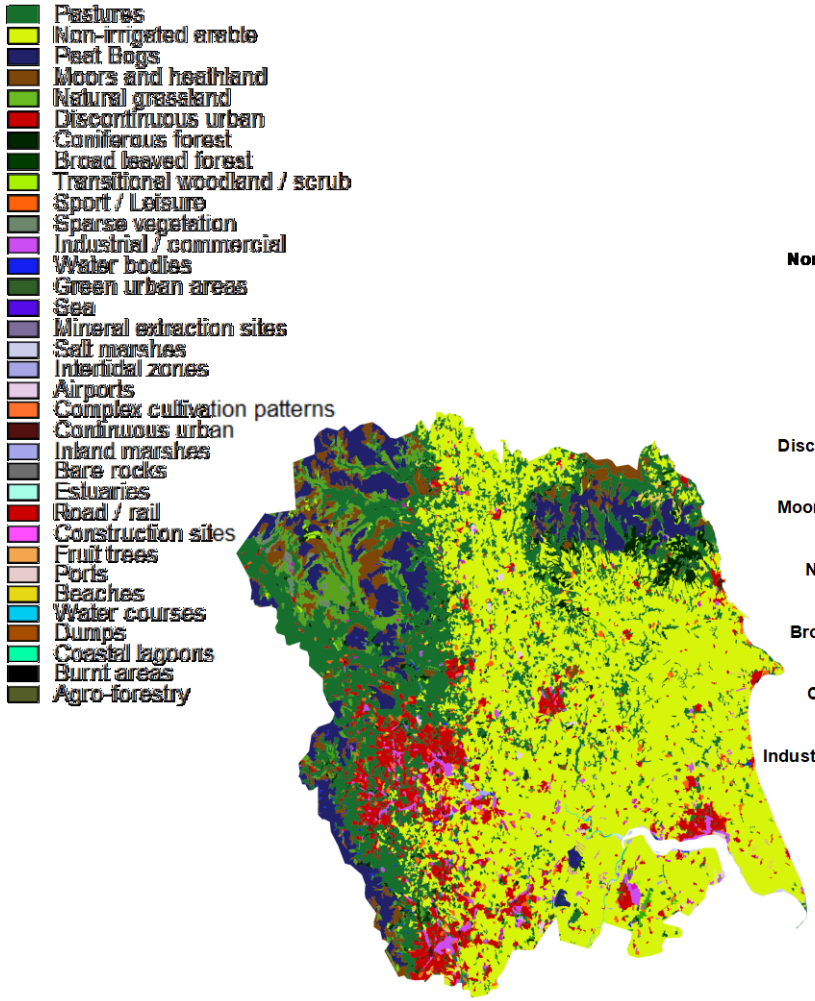
Figure 7. Land use in the North West of England.

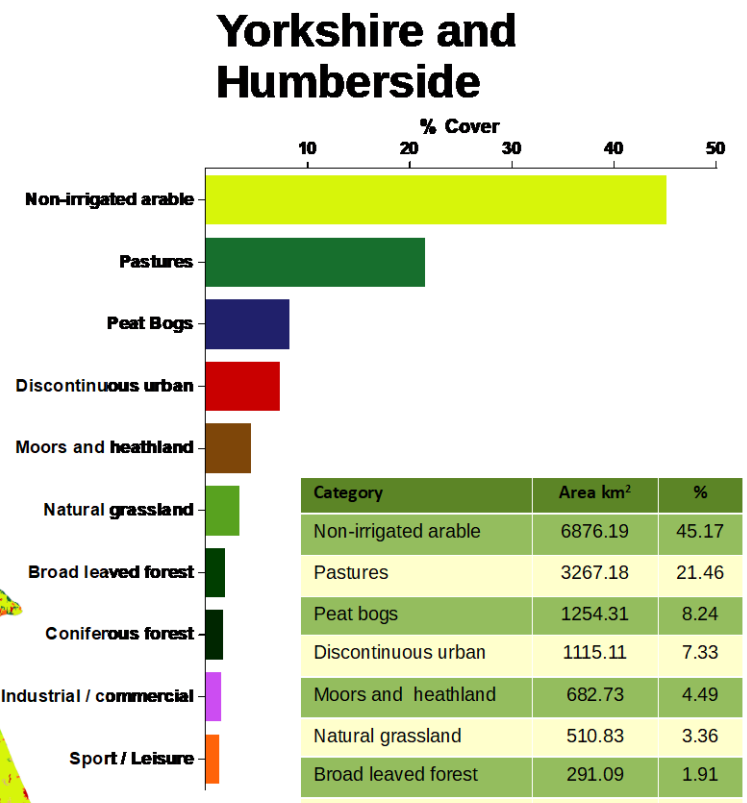




Category	Area km²	%
Pastures	2343.92	27.19
Arable	2274.80	26.39
Moors and heathland	872.56	10.12
Natural grassland	675.02	7.83
Discontinuous urban	549.88	6.38
Peat bogs	519.29	6.03
Coniferous forest	482.25	5.60
Transitional woodland / scrub	211.75	2.46
Industrial / commercial	136.55	1.58
Broad leaved forest	110.38	1.28
Other	442.78	5.14
Total Area	**8619.18**	

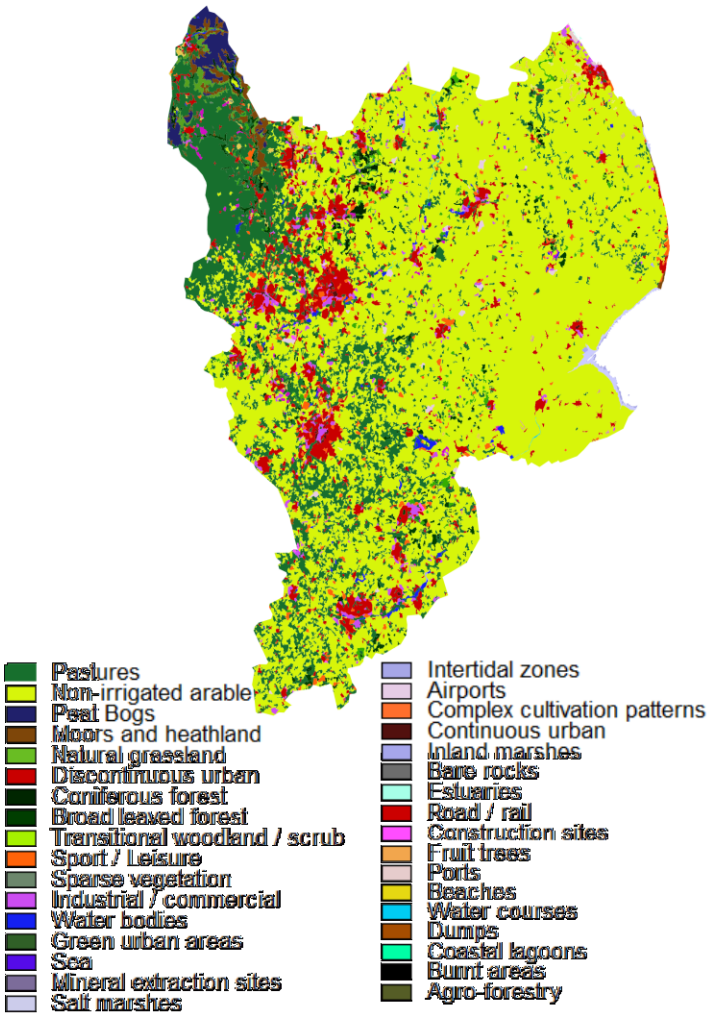
Figure 8. Land use in the North East of England.

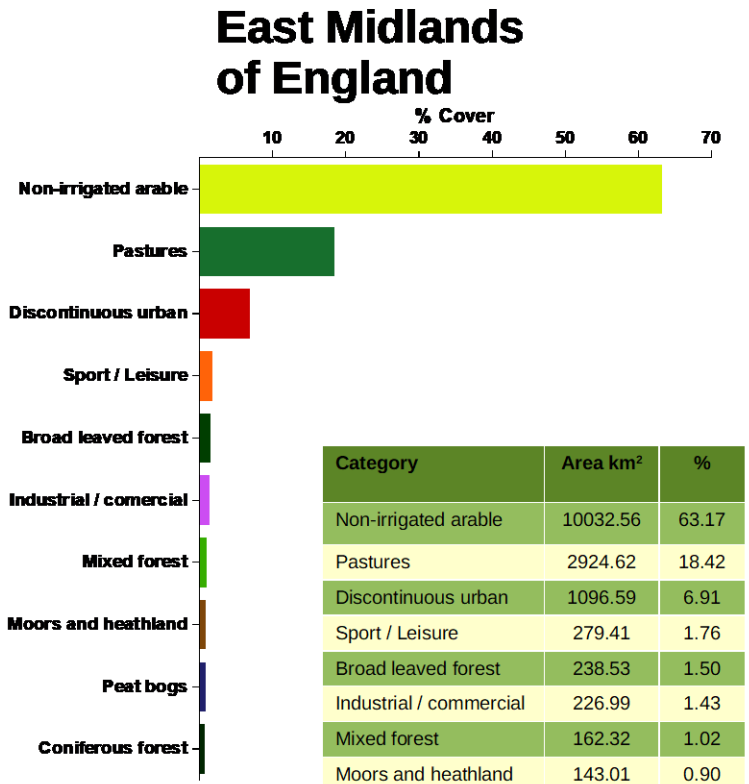




Category	Area km²	%
Non-irrigated arable	6876.19	45.17
Pastures	3267.18	21.46
Peat bogs	1254.31	8.24
Discontinuous urban	1115.11	7.33
Moors and heathland	682.73	4.49
Natural grassland	510.83	3.36
Broad leaved forest	291.09	1.91
Coniferous forest	268.34	1.76
Industrial / commercial	233.29	1.53
Sport / leisure	205.30	1.35
Other	517.96	3.40
Total Area	**15222.33**	

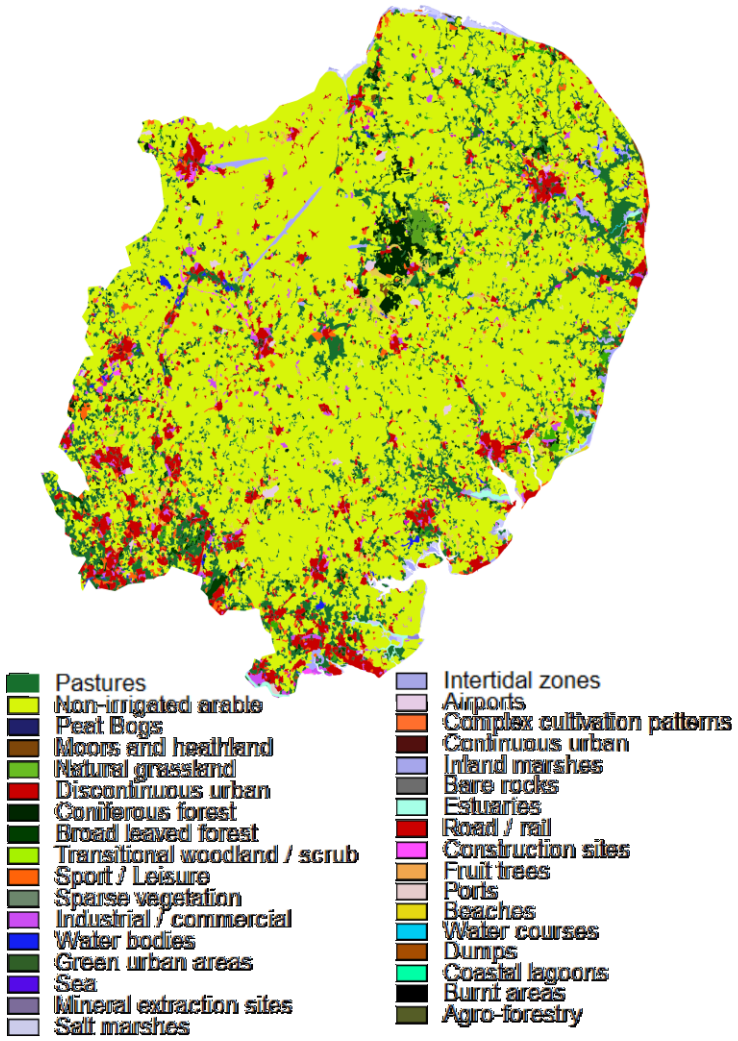
Figure 9. Land use in Yorkshire and Humberside.

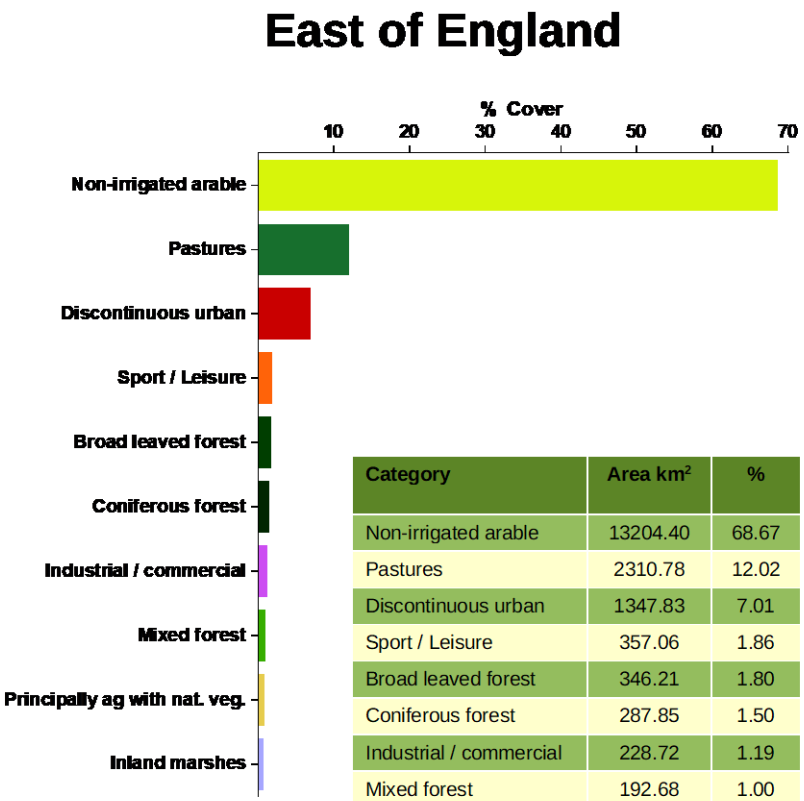




Category	Area km²	%
Non-irrigated arable	10032.56	63.17
Pastures	2924.62	18.42
Discontinuous urban	1096.59	6.91
Sport / Leisure	279.41	1.76
Broad leaved forest	238.53	1.50
Industrial / commercial	226.99	1.43
Mixed forest	162.32	1.02
Moors and heathland	143.01	0.90
Peat bogs	141.84	0.89
Coniferous forest	113.95	0.72
Other	520.93	3.28
Total	**15880.75**	

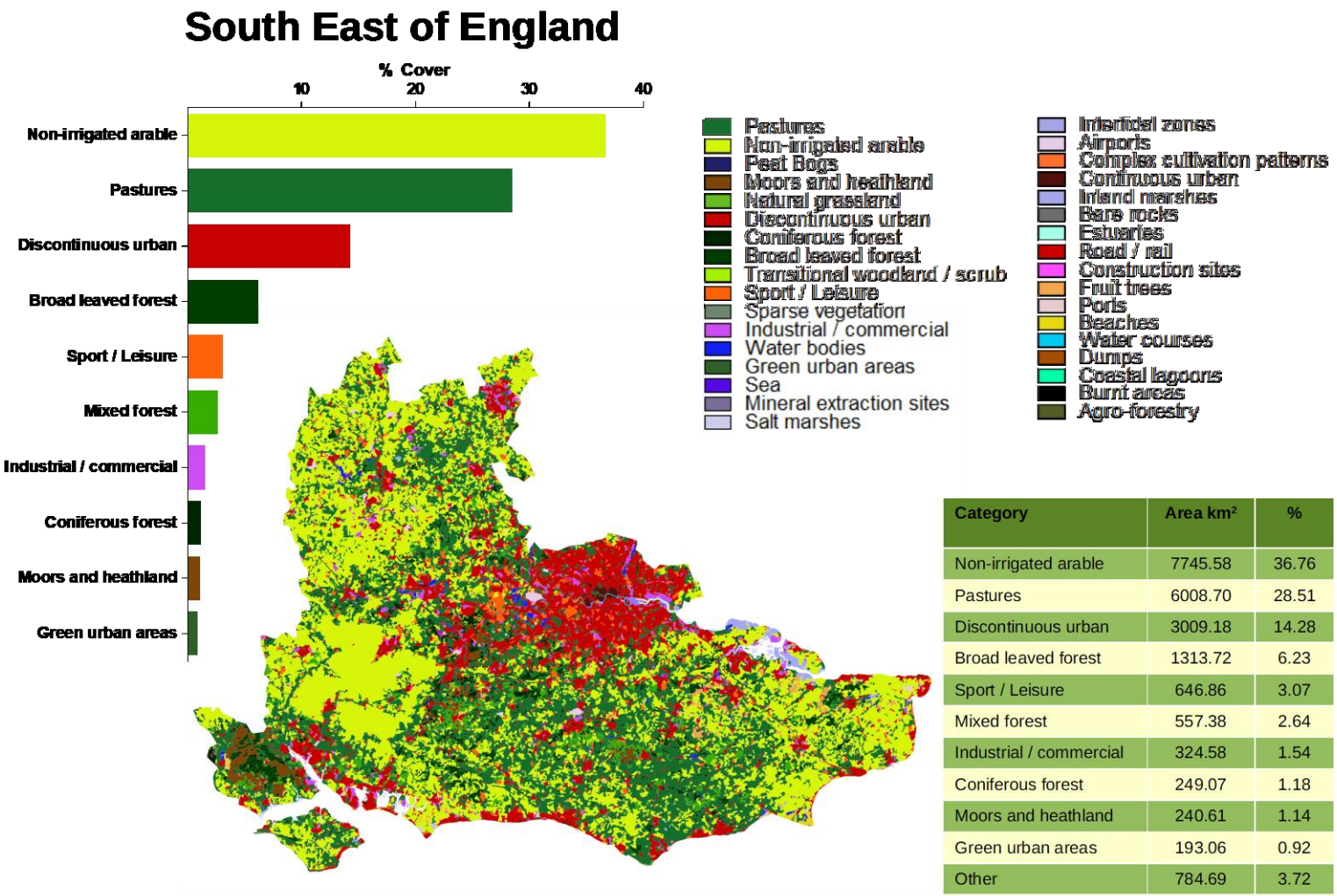
Figure 10 Land use in the East Midlands of England.





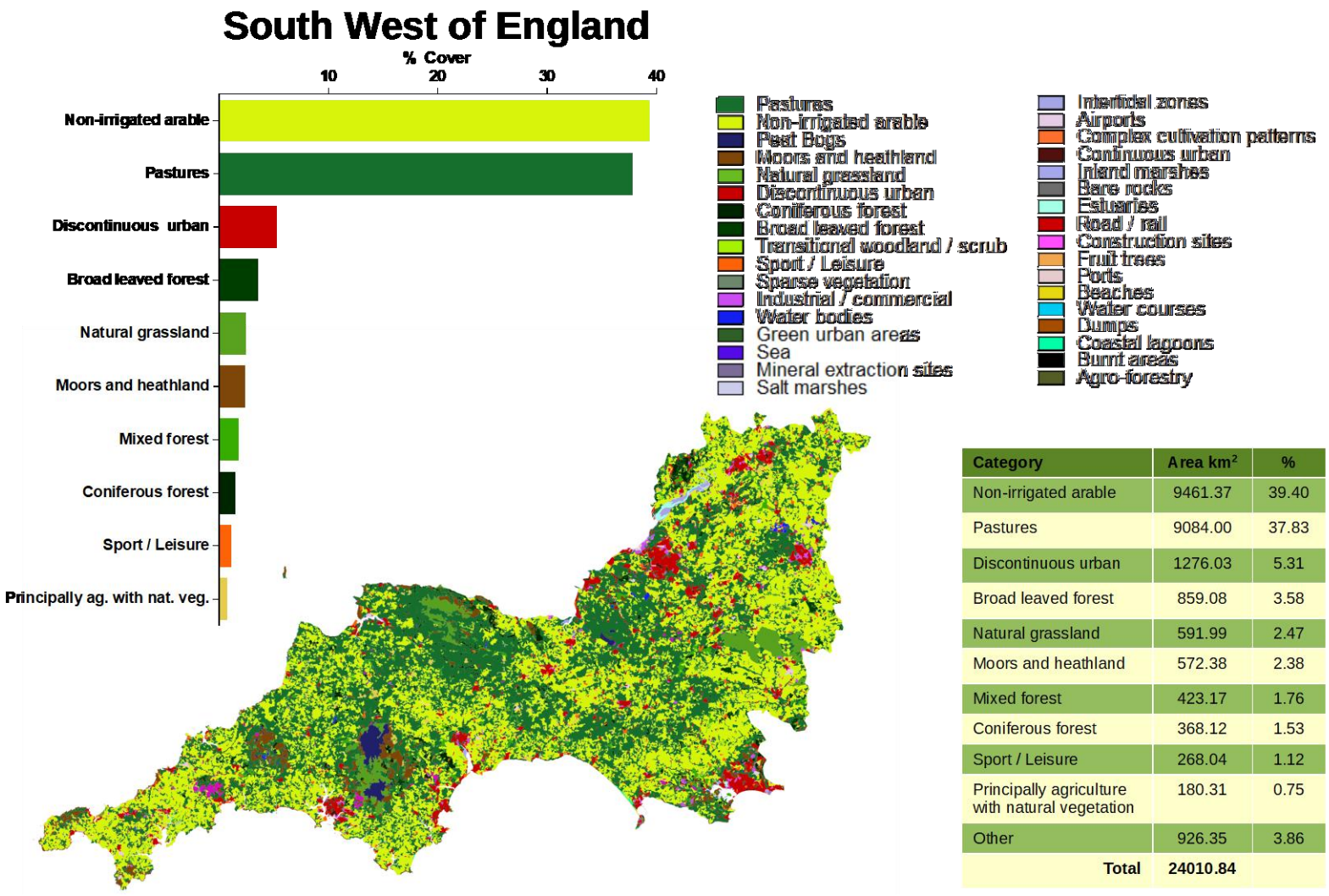
Category	Area km²	%
Non-irrigated arable	13204.40	68.67
Pastures	2310.78	12.02
Discontinuous urban	1347.83	7.01
Sport / Leisure	357.06	1.86
Broad leaved forest	346.21	1.80
Coniferous forest	287.85	1.50
Industrial / commercial	228.72	1.19
Mixed forest	192.68	1.00
Principally agriculture with natural vegetation	167.91	0.87
Coniferous forest	144.01	0.75
Other	640.56	3.33
Total	**19228.02**	

Figure 11. Land use in the East of England.



Category	Area km²	%
Non-irrigated arable	7745.58	36.76
Pastures	6008.70	28.51
Discontinuous urban	3009.18	14.28
Broad leaved forest	1313.72	6.23
Sport / Leisure	646.86	3.07
Mixed forest	557.38	2.64
Industrial / commercial	324.58	1.54
Coniferous forest	249.07	1.18
Moors and heathland	240.61	1.14
Green urban areas	193.06	0.92
Other	784.69	3.72
Total	**21074.40**	

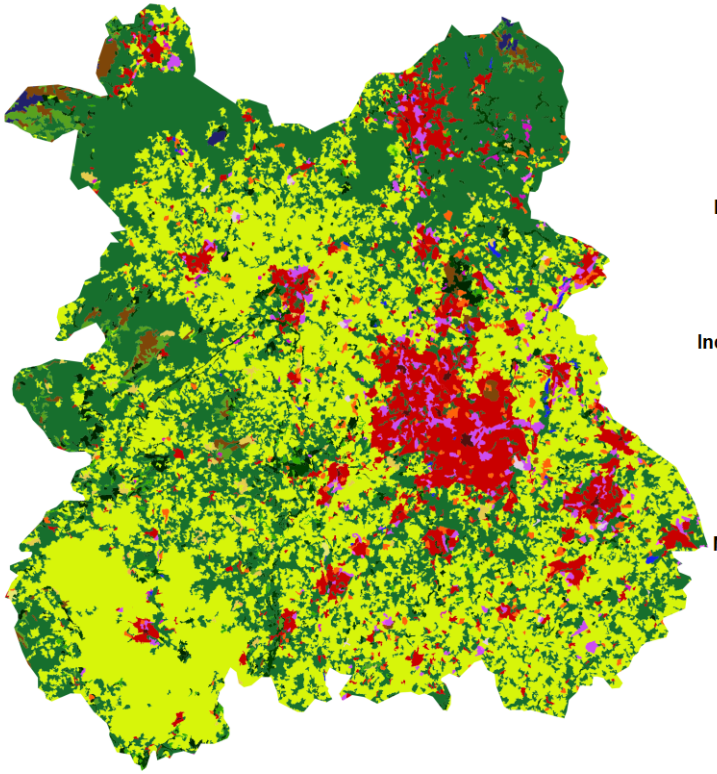
Figure 12. Land use in the South East of England.

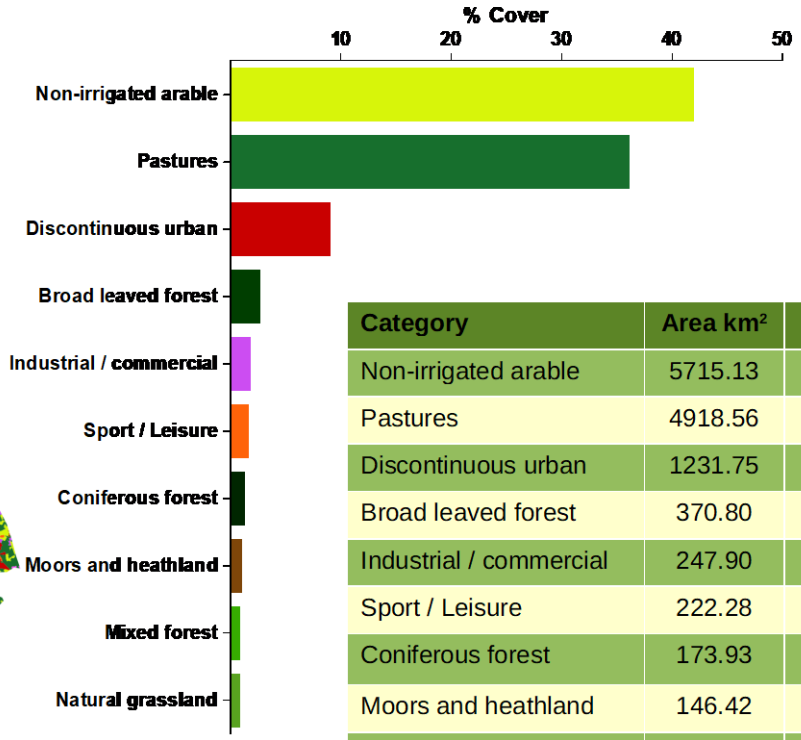


Category	Area km²	%
Non-irrigated arable	9461.37	39.40
Pastures	9084.00	37.83
Discontinuous urban	1276.03	5.31
Broad leaved forest	859.08	3.58
Natural grassland	591.99	2.47
Moors and heathland	572.38	2.38
Mixed forest	423.17	1.76
Coniferous forest	368.12	1.53
Sport / Leisure	268.04	1.12
Principally agriculture with natural vegetation	180.31	0.75
Other	926.35	3.86
Total	**24010.84**	

Figure 13. Land use in the South West of England.

West Midlands of England





Category	Area km²	%
Non-irrigated arable	5715.13	41.98
Pastures	4918.56	36.13
Discontinuous urban	1231.75	9.05
Broad leaved forest	370.80	2.72
Industrial / commercial	247.90	1.82
Sport / Leisure	222.28	1.63
Coniferous forest	173.93	1.28
Moors and heathland	146.42	1.08
Mixed forest	126.66	0.93
Natural grassland	119.93	0.88
Other	340.37	2.5
Total	**13613.72**	

Figure 14. Land use in the West midlands of England.

3.2 Intensity of land use by region

3.2.1 Agriculture

Agriculture dominates the landscape of Britain, as is shown in the four maps below (Figs 15A-D). The maps show agriculture in four different ways:

A. Land exclusively used by agriculture plus land potentially used by agriculture: Land classes 211[2] (arable) and 231 (pastures) + 222 (fruit trees), 242 (complex cultivation patterns), 243 (principally agriculture with natural vegetation), 321 (natural grasslands) and 322 (moors/heathland).
B. Exclusively agriculture: Land classes 211 (arable) and 231 (pastures).
C. Arable only (211).
D. Pastures only (231).

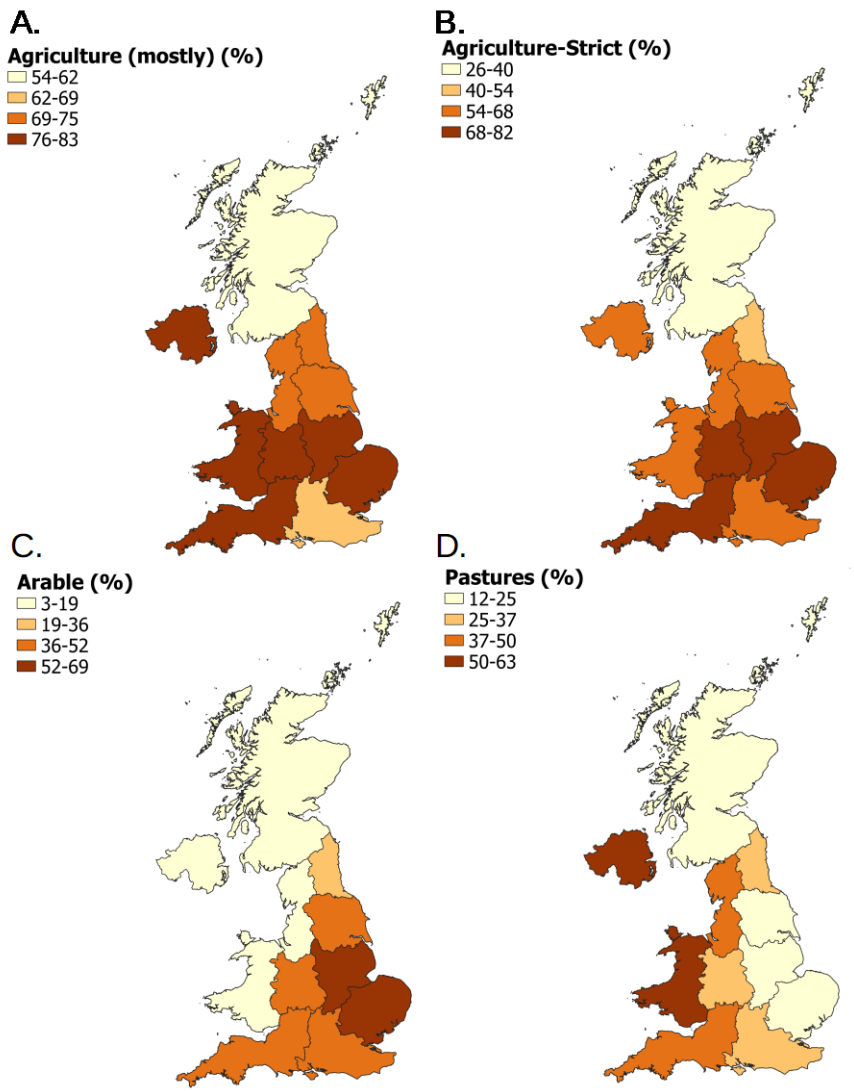


Figure 15. The intensity of agriculture across the UK.

[2] The numbers here refer to the code assigned to each land use class in the CORINE dataset. See full details in Appendix 2.

With the exception of Scotland, the UK has an agricultural intensity that exceeds 60% (broad definition), or 40% (strictly defined), of land use for all regions. Agricultural land use is dominated by arable farming across the southern and eastern parts of England and pastures in most of the north and west of the UK. In the East of England and East Midlands, where agriculture at its most intense, arable farming occupies well over 50% of the land.

3.2.2 Forestry

Much if the UK is characterized by a very low coverage of woodland and forests. When all woodland classes are aggregated, this is becomes highly apparent with much of England, and all of Northern Ireland, having less than 6% cover. Scotland has the highest level of tree cover at just over 16%.

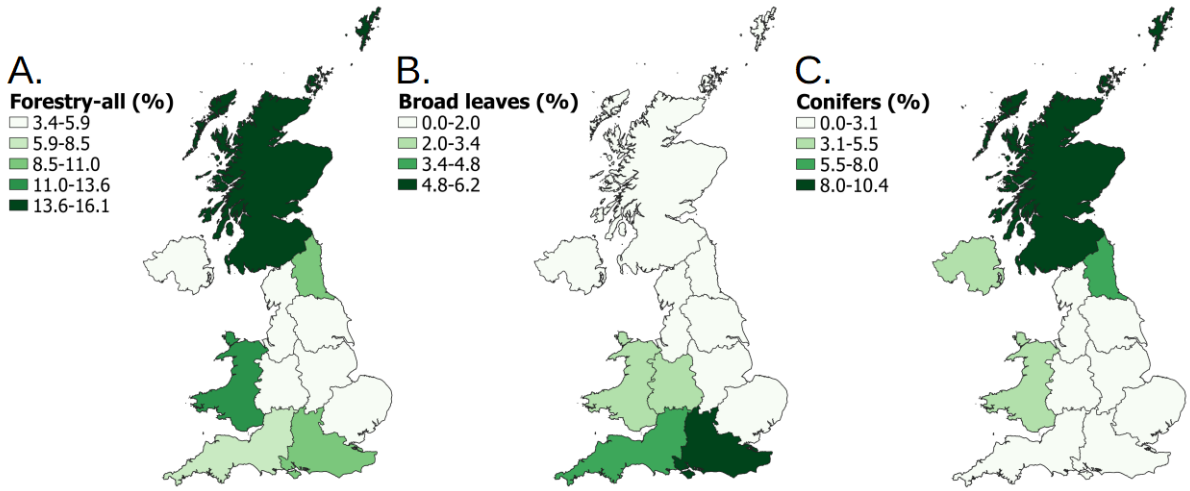


Figure 15. The prevalence of forestry/woodland across the regions of the UK.

It is interesting to note that the highest coverage of broadleaved woodland occurs in the South East of England, a region that also has the greatest urban cover. It is also notable that outside Wales and the south /western areas of England the cover of broadleaved trees is less than 2% in all other regions.

Conifer plantations are the dominant forestry type in Scotland and, to a lesser extent, Wales and Northern Ireland. The only area with significant areas of conifers (>5%) in England is the North East, with all other regions having less than 3.1% , a fact that probably reflects the disparity in the planting of trees for economic purposes between Scotland and the rest of the UK over the last fifty years or so.

3.2.3 Urban Areas

The CORINE 2018 data classifies urban areas as either continuous or discontinuous and has a number of other categories that relate to built environments, such as roads, ports/airports and industrial sites. It is therefore worth examining the situation from both the point of view of strict urban classification and the broader built environment.

A. Urban strict: 111 (continuous urban) and 112 (discontinuous urban).

B. Urban extended: (continuous urban) and 112 (discontinuous urban) + 122 (road/rail, 123 (ports), 124 (airports) and 133 (construction sites).

As can be seen, the maps produced by aggregation of the two urban categories (Fig 16A) and that for urban, industrial and transport areas combined produce the exact same distribution pattern. South East England has an urban coverage of 14.8% that increases to 15.5% when other built-upon categories are included in the value. At the opposite end of the spectrum, Scotland's built-up areas extend to only 1.7%, increasing to 1.8% when other areas are included.

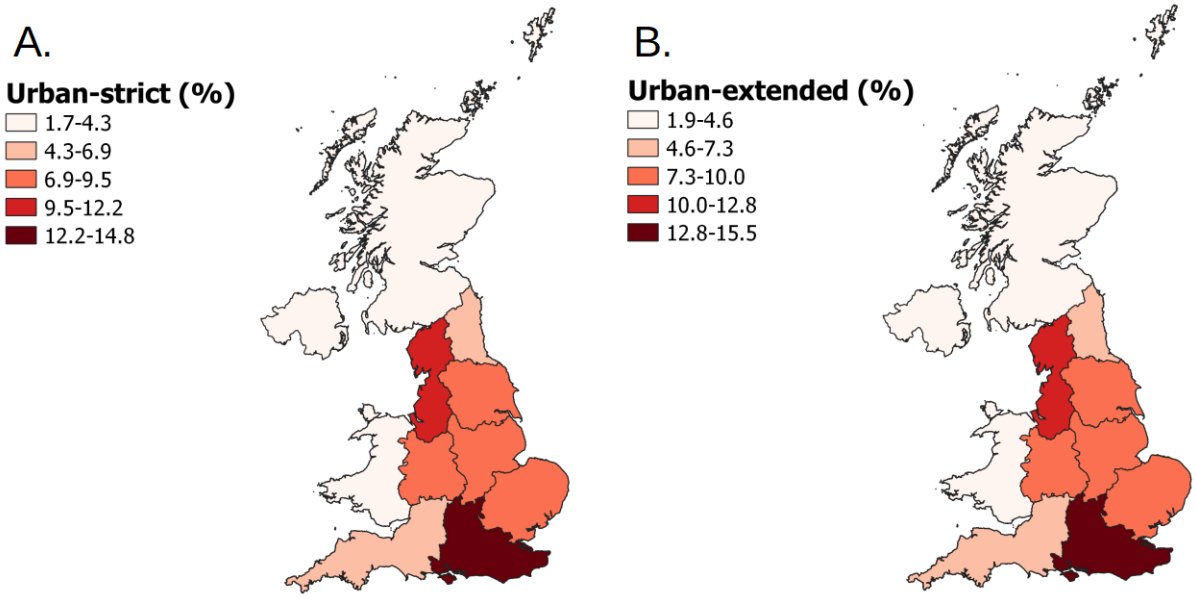


Figure 17. Regional urban land cover across the UK.

After the South East, the North West of England is the most heavily urbanised with much of the east of the country only marginally less built upon. The data presented here show how the generally low values for the built environment for the UK as a whole mask quite marked differences across the various regions.

3.2.4 Other land types

The current report has focused primarily upon three broad types of land use: agriculture, forestry and the built (urban/industrial) environment. The reason for this is made clear in Figure 18 (below), which shows that these three types of use account for the vast proportion of land in most of the regions examined. Figure 18A shows the data for forestry (all types) along with the percentages for strictly interpreted agricultural (arable and pastures) and urban categories (continuous and discontinuous urban). This shows that in England, 90% or more coverage is achieved in four of the regions covered, whilst in the remaining four the values are between 70% and 80%. Northern Ireland and Wales also return values that exceed 70% for the totals of these categories

Figure 18B shows what is possibly a more accurate representation of agriculture, forestry and built environments. Here, agriculture now includes a variety of land classes that are potentially under agricultural use (as described above) such natural grasslands, complex cultivation patterns and heathland whilst the urban category has been expanded to include industrial and transport infrastructure, amongst others.

It is likely that this aggregation of several related categories for the agricultural and urban (i.e. built environment) categories more accurately represents the degree that farming and the built up / paved-over areas occupy UK land. In this second iteration of the data all English regions approach or surpass 90% coverage, as do Northern Ireland and Wales.

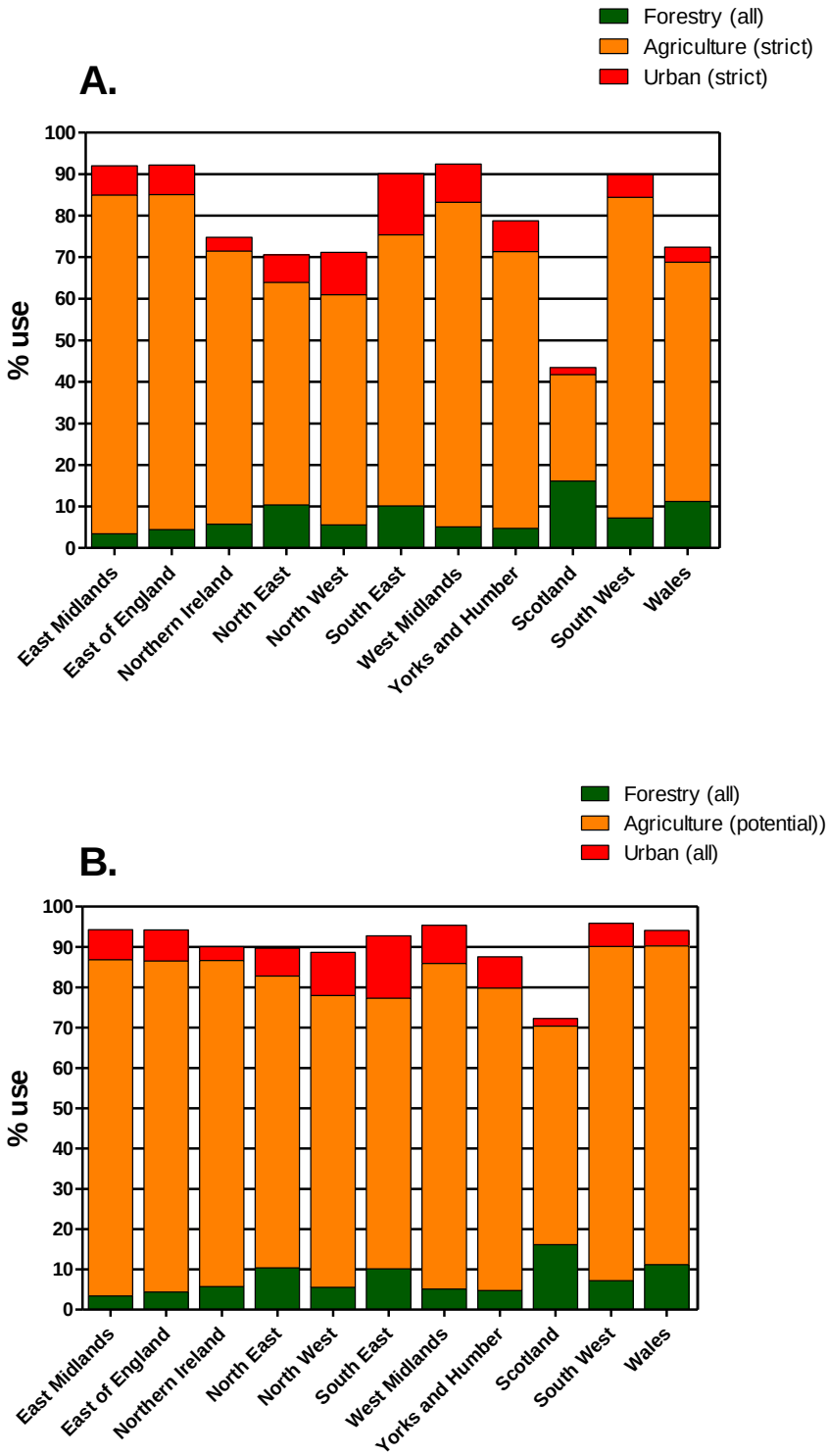


Figure 18. Agricultural, forestry and urban land use in the UK.

Only in Scotland does the picture change to any great extent. Here, a little over 43% of the land is put to the above applications when the strictly categorized data is used. However, if the definition of what constitutes agricultural land is broadened as described above to include heathland and moors, areas that are often grazed by sheep, and some other minor potentially agricultural areas (e.g. natural grasslands) the picture changes markedly, pushing the value up to >70%. The majority of the remaining area is peat bog (23.6%).

This final analysis serves to emphasise the fact that the UK's landscape is dominated by human activity and in many areas of the nation less than 10% is put to uses that are not agricultural, forestry or urban/built upon in nature. As such, across large tracts of the country there is very little space remaining that could be classified as being exclusively given over to nature.

4. DISCUSSION

The data presented here indicates that land use varies quite markedly across the countries that make up the UK and within the regions of England. There is, however, an overarching tendency towards three major types of land use regardless of the part of the UK: agriculture, forestry and urban / built environment. Land given over to uses outside the three main aggregated classes is typically less than 10% over most of the UK, Scotland being the exception. These land uses; agriculture, forestry and urban, are often associated with intensive human management. They are managed primarily to achieve an anthropocentric goal of food production, timber production or habitation and industry. Their dominance of the landscape has substantial implications for biodiversity as well as having broader environmental implications.

The CORINE dataset provides detailed data for over 30 different land uses classes applicable to the UK and, in some instances, aggregating related classes helps build a more meaningful picture of the current state of the UK. Notably, the aggregated value for the built environment classes (urban, roads, rail, industrial sites etc.) is much greater in England, at 10.3%, than, for example, Scotland where the value is just 2.6%. This value is dominated by discontinuous urban areas that cover a full 8.4% of England, as opposed to 3.1%, 3.6% and 1.7% in Northern Ireland, Wales and Scotland, respectively. Those that suggest [8] urbanisation is not particularly extensive or problematic in the UK often fail to emphasise the fact that the built environment is very much concentrated in England and that some of this urbanisation is eroding the quality of the environment over parts of Britain. Importantly, it is likely that the regions of the UK already containing significant urban areas are the localities that will see the largest increases over the coming years.

Agriculture dominates the land area of England to a remarkable extent. Arable farming and pastures alone account for over 71% of the land area whereas this value is just 25.6% in Scotland. Certain areas of land, such as those classed as sparsely vegetated or peat bog, are frequently grazed and, as such, the land used for agriculture cannot be precisely determined from only examining the CORINE data. It is, therefore, likely that even the extended aggregated agriculture value, that does not include these two classes, is an underestimate of agriculture's dominance in the UK landscape. It is clear, however, that across the UK as a whole the land exploited for agricultural purposes falls between 70% and 80% of the entire area. This value largely falls within the generally accepted value for the UK [9] and those produced by Rae using the 2012 CORINE dataset.

Notably, the area of woodland / forest cover calculated here using the CORINE data (10%) is lower than that that published by the UK's Forestry commission (13%) [6]. The reason for this is probably due to small areas of woodland being misidentified by the CORINE methodology. The UK Forestry Commission classifies woodland as any given area with 20% canopy cover or the potential to reach that figure [10]. The disparity between the CORINE and Forestry Commission datasets is, therefore, probably due to the absence of small and/or highly discontinuous woodland in the former's data. If this is indeed the case, it would suggest that a significant proportion of land accounted for in the UK woodland inventory exists as very small parcels of land, often isolated from other wooded areas and possibly of limited ecological value. Moreover, recently planted areas of woodland, whilst likely to be included in the Forestry Commission data, are not visible to the CORINE methodology. Again, as with other land classes, England's value, at 6.2%, is markedly different to Scotland and Wales, which have 16.1% and 11% woodland cover, respectively. As such, the CORINE data indicates, somewhat depressingly, that England has a greater area of continuous and discontinuous urban areas (8.6%) than it does land covered by trees to any meaningful extent. When broad leaved trees are examined, the cover outside the South East and South West of England is very low, a fact that serves to illustrate how the agriculturally-dominated landscape of the UK has a very low tolerance of the presence of trees. The low levels of UK forest cover, particularly in England, can be contrasted with France, for example, where a cover of *ca.*27% was calculated from the 2018 dataset.

The numerous land use classes outside the agricultural, forestry and urban/built environment categories generally constitute less than 10% of the land of any part of the UK outside of Scotland. Of these other classes, the most prevalent is categorised as sports and leisure in the CORINE dataset. Examination of parts of the north of England and south of Scotland (data not shown), where this land use type is relatively sparse and easily examined, revealed that these areas predominantly belong to just three types: parkland (stately home gardens/parks etc.), holiday parks (camping, caravan sites etc.) and golf courses.

The Committee for Climate Change's report (2020) [6] indicates that the UK should aim for a woodland cover at least 17%. The data presented here, although likely underestimating tree cover, illustrates the magnitude of this aspiration that requires the planting of 30,000 hectares of trees annually (300 km^2), a total area in excess of that of the county of North Yorkshire, by 2050. England, most obviously, has very few large contiguous areas of forestry, as Figure 3 shows, with only distinct areas of coverage visible in the South Lakes, Northumberland, North Yorkshire, the west of Suffolk and Norfolk, and areas of the South East. Much of England, particularly the eastern half, is essentially devoid of significant areas of tree cover.

Although there are undoubtedly ecologically high value environments within agricultural areas (e.g. hay meadows), woodland / forest (e.g. ancient woodlands) and the urban / built environment (gardens, green spaces, parks) it is a sobering fact that much of the UK's more natural environments persist within a fraction of the 15% (10% in England) of land lying outside of the three major aggregated use classes. It is likely that some of these areas, such as natural grasslands, are unlikely to be natural to any degree and, in some cases, are probably utilized to some degree by agriculture. In the same vein, although peat bog is considered as a distinct category, at least some of this area in the UK (9.3%) is grazed by sheep as these areas often occur within zones of heathland / moor. Salt marshes (0.17%) probably constitute the UK's most extensive areas of natural or near–natural environment, followed by intertidal zones (0.14%) and inland marshes (0.13%). Therefore, however

one chooses to measure it, natural environments cover only a very small proportion of Britain's land mass. It is, therefore, not surprising that at least 20% of the UK's mammals are listed as declining to some degree [12], as are many birds [13] and insect species [14]. Such declines can only be addressed by a coherent plan to alter the way some of the land is used across Britain.

In summary, the UK - particularly England - is essentially an agricultural landscape with much of the remainder made up of forestry / woodland or built-up areas, transportation infrastructure and industrial zones. It is clear that moves to achieve the goal of a more biodiverse landscape that contributes to climate change mitigation goals are presented with considerable challenges. To implement changes that have any meaningful and positive impact on the UK landscape will, inevitably, require marked changes in the extent and types of agriculture undertaken in some parts of the country. This report complements a prior report that covered some aspects of land use at the UK level [15]. A following iteration of this report will examine how land use has changes since 2000, the year that the CORINE data first covered the UK. A fourth report is in preparation dealing with land use across the whole of Europe (EU and UK).

5. ACKNOWLEDGEMENTS

Work such as this is made possible due to the freely available CORINE data provided via the Copernicus portal of the European Union [2] and copyright statements associated with the data are available from their website. This data is used here for strictly non-profit purposes and this report can be disseminated freely without the permission of the author.

6. DISCLAIMER

This is the first iteration of this report and, although the data presented here is believed to be accurate, computational manipulations conducted within the GIS environment may have introduced some sources of error and, as a result, please contact the Author if inaccuracies are apparent. Interested parties are urged to download and examine the data for themselves should they seek to verify any of the data presented here. The QGIS program that was used to visualize and manipulate the data is freely available from https://www.qgis.org/en/site/.

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APPENDIX 1. METHODOLOGY

The 2018 CORINE land use data was downloaded from the Copernicus Land Monitoring Service website (https://land.copernicus.eu/pan-european/corine-land-cover) as a GeoPackage (CLC 2018). The GeoPackage was opened in QGIS 3.10.1 and subjected to the FIX GEOMETRIES (*vector*

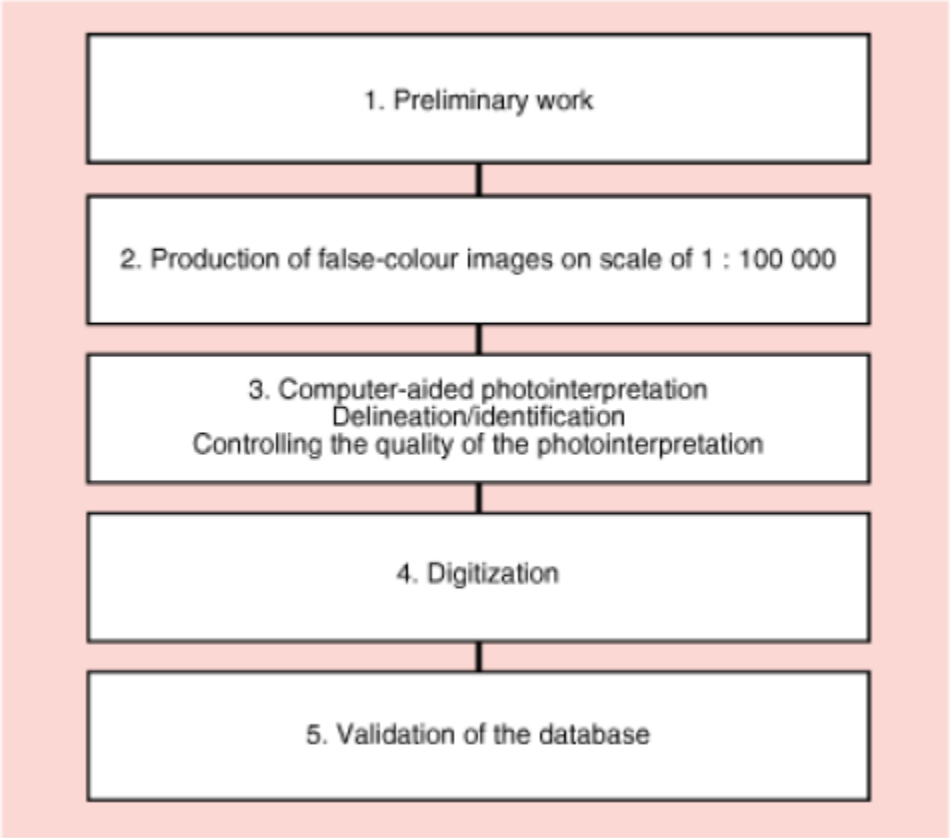
geometry>fix geometries) procedure. The United Kingdom was separated from the full European land use map via the CLIP vector function (*vector>geoprocessing tools>clip*) using the gadm36_GBR_0.shp shapefile (available from the Ordnance Survey). This clip removed most of the area classed as sea; areas that for the purposes of this report are irrelevant and need to be discarded to produce an accurate percentage cover value for any land type. This clipped UK land area was reprojected into the LAEA Europe / EPSG:3035 coordinate reference system (CRS) of the CORINE data before use. Clips of the constituent nations of the UK were made from shapefiles of England, Northern Ireland, Wales and Scotland that were, in turn, produced by creating individual shapefiles from the gadm_GBR_1.shp OS shapefile. As before, these were reprojected into the LAEA Europe / EPSG: 3035 CRS before being used for clipping purposes. A similar process was used to isolate the English regions.

Areas of the polygons contained within the clips of the UK and constituent countries were calculated using the $Area function of the QGIS field calculator (accessed via the attributes table menu) which returns a m^2 value for each polygon[3]. Calculations were implemented at the maximum precision setting (10). The values for each polygon were exported to a comma separated value (*.csv) file and imported into LibreOffice Calc for further manipulation. Calculation of the areas for each polygon type (i.e. aggregated value for each land use category) were made using pivot tables and expressed as km^2.

Graphs of data (used for the figure legends) were constructed in GraphPad Prism 5 and composite figures produced in GIMP 2.10 with additional annotation undertaken in LibreOffice Impress.

The CORINE data was initially produced from aerial photography using the approach outlined in the graphic below, the details of which can be found at the Copernicus website].

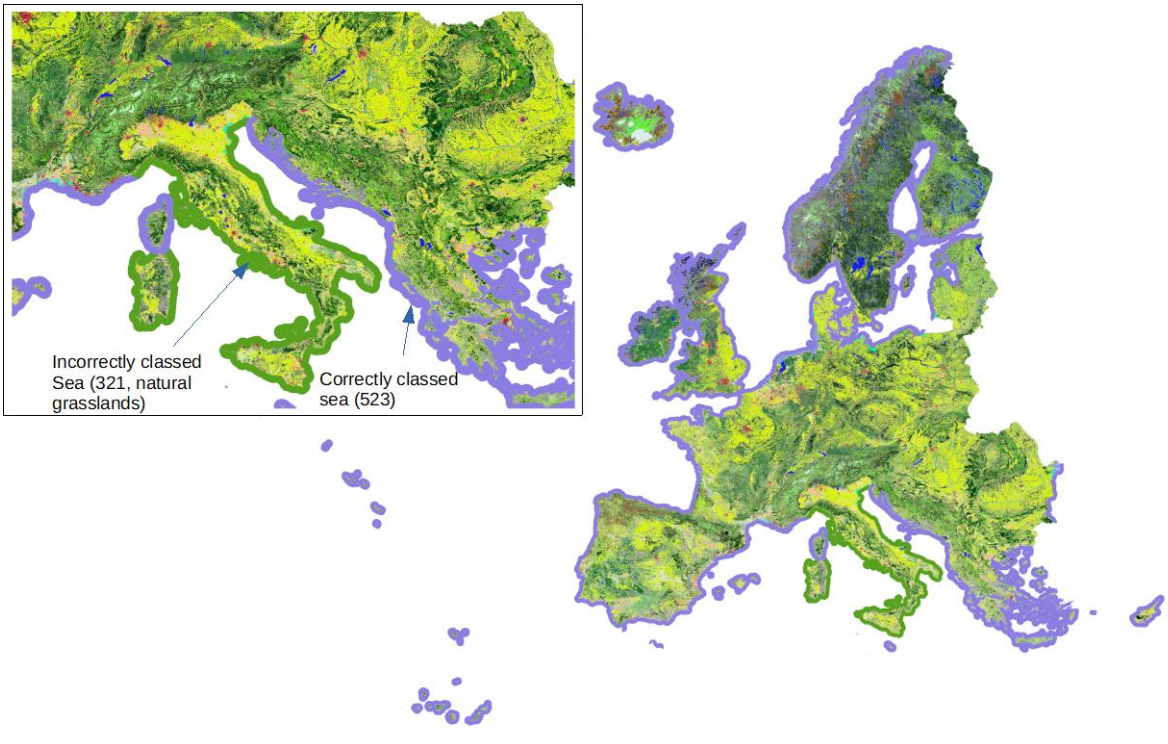
[3] Note that areas are contained within the geopackage provided by CORINE in hectares. However, these areas were recalculated after the geometry fix and reprojection of the data.


1. Preliminary work
2. Production of false-colour images on scale of 1 : 100 000
3. Computer-aided photointerpretation
Delineation/identification
Controlling the quality of the photointerpretation
4. Digitization
5. Validation of the database

APPENDIX 2. CORINE 2018 land classifications

CLC Code	Description
111	Continuous urban
112	Discontinuous urban
121	Industrial / commercial
122	Road / rail
123	Ports
124	Airports
131	Mineral extraction sites
132	Dumps
133	Construction sites
141	Green urban areas
142	Sport / Leisure
211	Non-irrigated arable
222	Fruit trees
231	Pastures
242	Complex cultivation patterns
243	Principally agriculture with natural vegetation
244	Agro-forestry
311	Broad leaved forest
312	Coniferous forest
313	Mixed forest
321	Natural grassland
322	Moors and heathland
324	Transitional woodland / scrub
331	Beaches
332	Bare rocks
333	Sparse vegetation
411	Inland marshes
412	Peat Bogs
421	Salt marshes
423	Intertidal zones
511	Water courses
512	Water bodies
521	Coastal lagoons
522	Estuaries
523	Sea

APPENDIX 3. The CORINE 2018 full dataset – Data accuracy



The full CORINE 2018 data set showing the two major data accuracy issues.

The full CORINE 2018 data set produces the above map from which values for the areas of each land class can be extracted. However, the data contains a number of problematic areas that prevent providing wholly accurate values for Europe. In particular, the data includes a category for sea, an area that extends outwards from the coastline, adding many thousands of km^2 to the areas of maritime countries, making percentage calculations of the areas of land used by a given category lower than they actually are. Secondly, some parts of the area categorized as sea have been miscategorised around Italy and Sardinia (see green band around the coast of these features in the inset).

These issues are all resolvable but do mean that the dataset is not immediately reliable and requires manipulation to give meaningful results for all land classes across all countries. As such, no references are made here to land use across Europe as a whole and this issue will be addressed in a following report.

The earlier, more general, report on land use produced by the present author [14] was based on an earlier iteration of the data and some small discrepancies between that report and the current work are apparent with respect to the total areas of the UK and its constituent nations / regions. These discrepancies do not, however, impact on the proportion of land given over to any particular land type to any meaningful degree.