INTEGRATION OF GEOSPATIAL INFORMATION IN SUSTAINABLE DEVELOPMENT INDICATORS

João Diogo David Dias Costa

Internship Report submitted in partial fulfilment of the requirements for the degree of Mestre em Ciência e Sistemas de Informação Geográfica (Master in Geographical Information Systems and Science)

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Internship Report supervised by

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Direção-Geral do Território

February 2019

DECLARAÇÃO DE ORIGINALIDADE

Declaro que o trabalho contido neste documento é da minha autoria e não de outra pessoa. Toda a assistência recebida de outras pessoas está devidamente assinalada e é efetuada referência a todas as fontes utilizadas (publicadas ou não).

O trabalho não foi anteriormente submetido ou avaliado na NOVA Information Management School ou em qualquer outra instituição.

Lisboa, 13 Agosto 2018

Assinatura

João David

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DECLARATION OF ORIGINALITY

I declare that the content of this document is my own and not from somebody else. All assistance received from other people is acknowledged and all sources (published or not published) are referenced.

This work has not been previously submitted for evaluation at NOVA Information Management School or any other institution.

Lisbon, 13 Agosto 2018

Signature

João David

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INTEGRATION OF GEOSPATIAL INFORMATION IN SUSTAINABLE DEVELOPMENT INDICATORS

Abstract

This report aims to introduce, discuss, detail and describe the internship I have accomplished at Directorate-General for Territory (DGT), the Portuguese national mapping and cadastre agency. As a geographic information systems intern, the nature of my work was focused into the United Nations Sustainable Development Goals (SDG) indicators with a geospatial component. My main duty was to hold the functionality of aspects regarding SDG matters that could emerge to DGT in an operational perspective. I have researched about the indicators metadata and the benefits that the integration of geospatial information delivers to measure and monitor the progress towards sustainable development. In a practical working context, two SDG indicators in articulation with Statistics Portugal were produced and calculated: 11.3.1 – ratio of land consumption rate to population growth rate; 15.4.2 – mountain green cover index. The principal outcomes of this internship were appealing for my academic path: the production of a manuscript entitled "R*atio of Land Consumption Rate to Population Growth Rate—Analysis of Different Formulations Applied to Mainland Portugal*" published at ISPRS International Journal of Geo-Information, and, a presentation delivered in the first United Nations World Geospatial Information Congress held in China. Therefore, I have considerably improved my GIS capabilities, learning and applying geospatial methodologies such as the dasymetric mapping technique. Additionally, as part of the internship workflow, I followed and collaborated with UN-GGIM: Europe Work Group on Data Integration subgroup 2 activities.

INTEGRAÇÃO DE INFORMAÇÃO GEOESPACIAL EM INDICADORES DE DESENVOLVIMENTO SUSTENTÁVEL

Resumo

O presente relatório tem como objetivo central introduzir, discutir, detalhar, e descrever o período de estágio realizado na Direção-Geral do Território (DGT). Como estagiário de sistemas de informação geográfica (SIG), a natureza do meu trabalho focou-se nos Objetivos de Desenvolvimento Sustentável (ODS) das Nações Unidas. A minha principal responsabilidade foi exatamente garantir o funcionamento da pasta ODS de acordo com as tarefas e trabalhos operacionais em que a DGT ter-se-ia de envolver e desenvolver. Assim, investiguei sobre os metadados dos indicadores ODS e tudo aquilo que eles representam para sua correta aplicação. Do mesmo modo, investiguei sobre a necessidade e os benefícios provenientes da integração de informação geográfica nesses mesmos indicadores, com o intuito de medir e monitorizar o progresso rumo a um desenvolvimento desejavelmente sustentável. Numa perspetiva de operacionalização, dois indicadores ODS foram calculados e produzidos numa articulação com o Instituto Nacional de Estatística: 11.3.1 – Rácio entre a taxa de consumo do solo e a taxa de crescimento da população; 15.4.2 – Coberto vegetal nas regiões de montanha. Os resultados deste estágio foram proveitosos tendo em conta o meu percurso académico: a produção do artigo "*Ratio of Land Consumption Rate to Population Growth Rate—Analysis of Different Formulations Applied to Mainland Portugal*" recentemente publicado na revista *ISPRS International Journal of Geo-Information* assim como uma apresentação dos resultados do trabalho de estágio no congresso das Nações Unidas, *United Nations World Geospatial Information Congress*, decorrido na China. Concluindo, melhorei substancialmente as minhas capacidades em SIG com a aprendizagem levada a cabo na DGT, e com aplicação de metodologias como a técnica do mapeamento dasimétrico. Ainda no âmbito do meu estágio, acompanhei e colaborei com o grupo de trabalho UN-GGIM: Europe Work Group on Data Integration subgroup 2 activities.

KEYWORDS

Sustainable Development Goals

Indicators

Geographic Information Systems

Land Cover Land Use

Dasymetric mapping

PALAVRAS-CHAVE

Objetivos de Desenvolvimento Sustentável

Indicadores

Sistemas de Informação Geográfica

Ocupação e uso do solo

Mapeamento dasimétrico

ACRONYMS

APA - Portuguese Environmental Agency

ARSET - Applied Remote Sensing Training

CAOP - Official Administrative Portuguese Map

CEOS - Committee on Earth Observations Satellites

CLC - Corine Land Cover

DEM – Digital Elevation Model

DESA - Department of Economic and Social Affairs

DGT - Directorate-General for Territory (Direção-Geral do Território)

DSOT - Territorial Planning Services Department (Direção de Serviços de Ordenamento do Território)

EFGS - European Forum for Geography and Statistics

EGNSS - European Global Navigation Satellite System

EO - Earth Observation

EPA - United States Environmental Protection Agency

ESA – European Space Agency

EU - European Union

FAO - Food and Agriculture Organization

GEO - Group for Earth Observations

GGIM – Global Geospatial Information Management

GIS – Geographic Information Systems

IAEG-SDGs - Inter-Agency and Expert Group on Sustainable Development Goal Indicators

ICNF – Nature and Forests Conservation Institute

IDM - Intelligent Dasymetric Mapping

INE – Statistics Portugal (Instituto Nacional de Estatística)

IPCC - Intergovernmental Panel on Climate Change

JRC - Joint Research Centre

LCLU – Land Cover Land Use

MAUP - Modifiable Areal Unit Problem

MCU - Minimum Cartographic Unity

MDG - Millennium Development Goals

MoU - Memorandum of Understanding

MS - Member States

NASA – National Aeronautics and Space Administration

NGO - Non-Governmental Organizations

NMCA - National Mapping and Cadastre Agency

NSDI - National Spatial Data Infrastructure

PNPOT - National Programme of Territorial Planning Policies

REOT - Territory Planning State Report

RTAE - Relative Total Absolute Error

SDG – Sustainable Development Goals

TAE - Total Absolute Error

UN – United Nations

UNOOSA – United Nations Office for Outer Space Affairs

UNSC - United Nations Statistical Commission

LUE - Land Use Efficiency

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1. INTRODUCTION

1.1 Scope

This report aims to describe and to present the work done in the internship accomplished at Directorate-General for Territory (Direção-Geral do Território, in Portuguese), also referred as DGT. DGT is the national mapping and cadastre agency (NMCA) of Portugal, gathering unique competences related with geographic information production and deliverables at national level. The internship opportunity appeared while the Sustainable Development Goals (SDG) gradually started to be introduced in the institution, mainly due to a cooperation agreement signed with Statistics Portugal (INE), addressing to further explore the potential of geospatial information in the SDG indicators and their integration with statistic data. As at the time there was no one dedicated to the SDG´s in an everyday basis working tasks, the job was proposed and delivered to me. Thus, and for some period, I was the focal point for operational work in DGT about SDG thematic, specifically regarding to SDG indicators, which was in fact the nature of my work as a geographic information systems (GIS) intern. This led me to keep straight cooperation with INE, and consequently, with United Nations-Global Geospatial Information Management (UN-GGIM): Europe, Work Group on Data Integration, subgroup 2. All the work was internally coordinated and supervised in a first moment by DGT sub-director professor Mário Caetano, and, posteriorly, jointly by the researcher Rita Nicolau, and by Cristina Garret, the directress of the territorial planning services department (DSOT). Despite being allocated in the geographic information division, during all over the internship period, I worked closely with DSOT.

1.2 Structure

The report is structured to initiate with a contextual introduction about the goals intended to be achieved. As a student of the Master degree program in Geographic Information Systems and Science, which is part of the UNIGIS consortium (an international universities network offering specialization diplomas and master's degree in geographic information systems and science), I will share research activities carried out during this academic course in parallel with the realization of this internship.

On the following section, after briefly describing DGT´s functions and introduce the dataset that I mostly used for my GIS approach, the activities and the lines of work conducted are reported. Afterwards, it is mentioned other side work developed at the institution. This chapter is particularly distinctive from the fact that explains what I have executed and with whom I had contact. Subsequently, it´s explained the context of the Agenda 2030 and the SDG indicators, transitioning to the geographic information status and importance by identifying potential geo-indicators and spotting international initiatives in terms of what have been compassed. This component took the first weeks of the internship period, where I had been study about SDG implementation and the core importance of geospatial information. Thenceforth, we step into the most practical output production that I have done for DGT, which can be split into three major elaborations further explained in detail in their sections: a) the analysed DGT indicators systems and their relationship with SDG geospatial indicators; b) the production of core information to integrate some of the SDG indicators; c) the implementation of SDG indicators 11.3.1 - Ratio of land consumption rate to population growth rate and 15.4.2. - Mountain green cover index. In fact, the principal focusses were emphasized over the SDG indicator 11.3.1 and in its all background work aligned with two different methodological approaches. An internal perspective and an external request. The report is then concluded along with a personal reflection of the overall internship period.

With the production of this report, it is foreseen to present the outcomes and achievements during the internship, but also to narrate the history of my period at DGT in a direct relation with the work I have produced. In other words, on this report it must be underline what I have done, how have I done, what I have found at my arrival, with whom I have connected and contacted and how was that association, what I have produced and achieved, and finally, what I have left for DGT. Methodologies, analysis, results, discussion and conclusions, are aligned and described in each dedicated chapter.

Hence, after the introductory chapter, the report can be unfolded into three major sections. First, a full narrative of the internship. This can be read as the report at its core, bringing a detailed description of my time at the mapping agency (2. The internship at DGT). The second part can be labelled as the state of art. A most theorical approach to the internship theme, even if at some point it is already anticipated an output from my work (3 Sustainable Development Goals). Finally, the third component demonstrates the most relevant output production from my internship (4 Analysing DGT indicators systems containing geospatial information, 5 Production of core information to integrate SDG indicators, 6 Implementing SDG indicators).

1.3 Goals and tasks

The set of goals were induced, updated, or added while the work had been developed. The starting goal was to study about how geographic information could be used as base information to be integrated with statistical information to produce SDG indicators and spatial analysis. As so, this goal would be unfolded onto other primal sub-goals, such as the importance to understand the relation between SDG specific indicators and geographic information, which lead me to investigate and identify what later would be called “geospatial indicators”. Once identified and listed, the intention was to compare and understand the potential relationship that they could carry when cross-matched with other indicators stablished in internal indicators system. Likewise, one of my main goals and tasks was to respond to solicitations associated with the sort of geospatial indicators and their applications, while testing methodologies to produce and calculate some indicators. An ultimate goal and motivation was to foster and promote the development of an article to be submitted in a reference journal.

Designated has the representative person in DGT for SDG indicators, I needed to assure the effective function of this subject not only internally, but also in a direct cooperation with Statistic Portugal, namely, with representatives of their Unit for Coordination of Territorial Statistics. Besides, was essential to be updated about the activities carried out by UN-GGIM: Europe Work Group on Data Integration subgroup 2, precisely leaded by Francisco Vala from Statistics Portugal.

My personal goals for this internship were the following: raise competences and routines in GIS analysis; adopt GIS workflows; meet and contact with individuals having a strong presence in the GIS field; learn with experts; grow up as a GIS professional; learn new methods and applications; obtain valuable work experience. All of those, considering a practical and demanding reality. Summing up, hereby are listed the internship goals and tasks:

- Hold and be responsible for DGT SDG working tasks
- Identify SDG geospatial indicators from the UN, EU and internal DGT indicators systems
- Comparing UN and EU SDG geo-indicators with other geo-indicators from DGT indicators systems
- Understanding and define which of those geo-indicators could benefit from DGT data input for production
- Integrate geographic information with statistical data to produce spatial analysis
- Cooperate with Statistics Portugal
- Collaborate and follow UN-GGIM: Europe Work Group on Data Integration subgroup 2 activities
- Discuss and testing methodologies to apply on SDG indicators

- Calculate SDG indicators
- Study, investigate, produce and calculate the SDG indicator 11.3.1 – Ratio of land consumption rate to population grow rate
- Production of a scientific paper to be submitted in a reference journal

1.4 Research activities during the master degree

The period at DGT was in fact influential to raise my capabilities in terms of GIS skills and experience in a real-world scenario. Nevertheless, during my master programme I had been working in other lines of research, which I will be sharing next.

My first work entitled "*Application of spatial regression to investigate current patterns of crime in the north of Portugal*"[1] was presented as a poster in the AGILE 2017 conference hold in The Netherlands. For the 25th Portuguese Association for Regional Development (APDR) 2018 congress I have researched about "*Modelling carbon capture for continental Portugal based on land cover changes*"[2]. Recently, the manuscript "*Modelling youth pregnancy in continental Portugal by geographically weighted regression*" was accepted to publication in the Geospatial Health journal (Annex 1).

Concretely from the work developed in DGT, three references need to be highlighted. First, a presentation for the National Science Summit 2018 expounding a methodologic approach for the indicator 11.3.1 – Ratio of land

[1]Accessible through https://agileonline.org/index.php/conference/proceedings/proceedings-2017
[2]Accessible through: http://apdr.pt/data/documents/PROCEEDINGS_APDRCongress2018.pdf

consumption rate to population grow rate[3]. Rita Nicolau delivered the presentation; I had a major contribution for the cartography, making all the maps. Next, a remarkable milestone for my (yet, short) academic and scientific path: being a presenter/panellist in the parallel session measuring and monitoring the SDG[4], at the first United Nations World Geospatial Information Congress. Finally, the manuscript produced in the internship context: "*Ratio of Land Consumption Rate to Population Growth Rate—Analysis of Different Formulations Applied to Mainland Portugal*"[5] published in the ISPRS International Journal of Geo-Information (2019).

2. THE INTERNSHIP AT DGT

2.1 DGT – The national mapping and cadastre agency

The Directorate-General for Territory, founded in 2012, it´s a public national institute, being a central service integrated in the Ministry of Environment of the Portuguese Government. Their headquarters are settled in the Portuguese capital, Lisbon. Their mission, as a mapping agency, is to create and maintain spatial databases, and to produce national cartographic reference products (DGT, 2018). Therefore, their competences in terms of geographic information and spatial planning are unique and fundamental. DGT is administratively organized into service departments: territorial planning services department (DSOT); Cadastral information services department (DSIC); planning, institutional relations, communication and support planning department

[3]Accessible through: http://www.encontrociencia.pt/files/2018/1400_298_SE_3_Maria_Rita_Nicolau-_Joao_David-_Mario_Caetano.pdf
[4]Accessible through: http://ggim.un.org/unwgic/presentations/1.3-Joao_Costa_David.pdf
[5]Accessible through: https://www.mdpi.com/2220-9964/8/1/10/html

(DSPRI); geodesy, cartographic and geographic information services department (DSGCIG). During my internship, I was allocated in the geographic information division, even if most of the time I worked jointly for DSOT.

DGT owns an open data policy. The official administrative Portuguese map (CAOP) is published annually. Yet, one of the most significant geographic information products is the Portuguese Land Cover and Land Use (LCLU) map, COS, available for the years of 1995, 2007, 2010 and 2015. COS was the geospatial product that I mostly used for the work conducted during the internship. It is based on a vector data model and corresponds to polygonal maps that represent homogenous land use/cover units (Direção-Geral do Território, 2018). The reference mapping unit is 1 hectare, with a defined distance between lines equal or higher than 20 meters and a percentage equal or higher than 75% of a given LCLU thematic class (idem). COS thematic classification is based on a hierarchical system of 5 level LCLU classes. At the more detailed level, COS 2007 and COS 2010 have 225 classes. COS 1995 has 89 classes and COS 2015 has a nomenclature with 48 classes. The nomenclature is compatible with the European LCLU map, Corine Land Cover (CLC), which has 44 classes and a minimum unit of 25 hectares (Caetano e Marcelino, 2017). CLC is available for 1990, 2000, 2006 and 2012. COS is only produced for mainland Portugal, while CLC includes Azores and Madeira islands, archipelagos from the Portuguese Republic.

2.2 Lines of work and internship activities

The purpose for my internship at DGT were the United Nations Sustainable Development Goals and the nature of my work was to research about SDG indicators with a geospatial component, taking into consideration their further implementation and production.

When I was first introduced to this new project at DGT, tasks and lines of work were still to be defined. With time, they started to be composed. Yet, this needs to be understood as a normal process due the fact that SDG were, at the time, giving the introductory steps at the institution and I was indicated to hold the SDG “folder” considering an operational work-level. Evidently, in a high-level standard, Mário Caetano was leading and responsible for the SDG framework and consequently for my groundwork. During almost all my period in DGT, he was also the institutional contact point for the relations with Statistics Portugal regarding this thematic.

The particularly starting period generated extra motivation but also higher sense of responsibility. From the first meeting with DGT sub-director, I retained the main idea that my goal would be to integrate geographic information with statistical data to produce spatial analysis. And to do that, Mário Caetano shared some pathways. I got advised to start looking for initiatives and activities that merged geospatial information and sustainable indicators concepts. Some of those could be boosted by the Group for Earth Observations (GEO). Those findings delivered a first insight of the internship scope, and about what I could potentially be doing in the following months.

Even if not from the beginning, over my internship I worked along with the researcher Rita Nicolau. In a first moment, Rita showed me several GIS datasets and sources that I could use for the work that I would later produce on DGT, and shared essential bibliography as well other documents for my study purpose. Later, she reviewed my work for DSOT. It was common that Rita access the status of my work, as it was common that she would review, advice, or comment if necessary. Specially, because Rita led the investigation that we both prosecuted towards SDG indicator 11.3.1 - Ratio of land consumption rate to population grow rate, guiding and conducting the workflow. In addition, Mário Caetano and Cristina Garret followed closely my work. The same can be said about Statistics Portugal SDG working group, which expected the results from my internship work. Due to that factors, I needed to embrace additionally effort and carefulness to respect and honour DGT working standards.

SDG´s were introduced in DGT in the act of a memorandum of understanding (MoU) signed with INE, contemplating a medium-term strategy to promote a greater interoperability between spatial and statistical data to support statistical production and to promote spatial and statistical integration to produce new indicators (Nunes et al, 2015). Before my arrival, naturally few has been done. Working groups from both institutions met at INE´s headquarters once, where among other topics, SDG were a discussion point. It was the first direct contact that DGT had with SDG in terms of the institutional cooperation. INE presented and introduced UN SDG indicators, as well the Working Group on Data Integration from UN GGIM: EUROPE.

From that meeting, I found the most practical file regarding what later it would be my work. An excel matrix fulfilled with information relative to 6 indicators in which DGT was identified by INE to eventually come across with the source and/for production, or to deliver other type of input for those indicators. In summary, the matrix stated that for indicators 6.6.1: change in the extent of water-related ecosystems over time, and, 15.3.1: proportion of land that is degraded over total land area, other entities should be involved in order to discuss their relevance, methodology and criteria; the indicators 11.3.2: proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically, and, 11.a.1: proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city, were classified as non-applicable whereby DGT committed to draw an explanatory note to clarify that their monitoring did not seem relevant; lastly, indicators 11.3.1: ratio of land consumption rate to population growth rate, and, 15.4.2: mountain Green Cover Index, needed to be deeply analysed, evaluating if COS could be a suitable source for their production. That was all I found upon my arrival.

In a very first phase of the internship, my line of work was directed to deeply study and understand the Sustainable Development Goals and all what would be related with geographic information or geospatial analysis. That component was pure theorical, but essential. Hence, I had studied and learnt about the SDG indicators set and the importance of geospatial information to support monitoring and measure the sustainable progress. My methodology was stablished by reading documents and emails forward to DGT (from other national and international entities); discover and navigate through important web pages which provided useful and official information (e.g. ongoing initiatives and activities); watching webinar sessions (as a form of introduction to the theme), and, collecting and read documents available on the web (power point presentations, reports, articles, etc.). Two of the webinars I have attended were the IRLOGI Webinar - "UN GGIM Fundamental Geospatial Datasets and UN GGIM Committee of Experts Recent Meeting" by Clare Hadley (Ordnance Survey Great Britain) and Colin Bray (Ordnance Survey Ireland) and "Discovery Day 2017: Technology's contribution to improving tenure governance towards achieving the SDGs" organized by the Food and Agriculture Organisation of the United Nations, the European Union Joint Research Center, the World Bank and the United Nations Economic Commission for Europe.

By collecting those and other documents, I started to compose a solid desktop folder that even if its content goes beyond the scope of my work (because I collected a substantial number of documents ranging from several subjects integrated on SDG matters), it appeals to be much of interest for further applications and to bear additional information. The folder named "SDG" englobed other folders with all the materials and data that I have gathering during my internship period (Annex 2). That folder was later left to DGT. At that point, I acquired compact knowledge regarding geospatial information and indicators, as well about international initiatives and main stakeholders. Thereafter, I made my first internal presentation entitled "Geospatial Information in the context of SDG Indicators". That presentation had a positive impact and feedback from the attendees: Mário Cateano, Rita Nicolau and Cristina Garret. The structure was the following: a) the Sustainable Development Goals b) SDG Indicators c) SDG Indicators and geographic information d) International initiatives e) The Portuguese status f) DGT role g) Documentation. As a matter of fact, when I dealt with an important subject, I was offered to present it to my supervisors or/and to other personal who followed my work. Thus, two other main sessions were presented: one deliberating an external solicitation by the Food and Agriculture Organization (FAO) of the United Nations for the indicator 15.4.2 – Mountain green cover index, and other, when my tasks concerning the analysis between SDG geospatial indicators and DGT indicators system was completed. Notwithstanding, other smaller or individual sessions were made when necessary, such as presenting the indicator 11.3.1 in its first exploratory analysis. Those presentations were important not only for my supervisors' access and evaluation of my work, but also to share important information, as well to deliberate about actions to be taken, work guidelines to follow and strategies to implement.

Meanwhile, I received my first work task from Mário Caetano to analyse the document "*The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data - 11.3.1* **|** *Ratio of land consumption rate to population growth rate*" from UN-GGIM: Europe **|** Work Group on Data Integration **|** subgroup 2. DGT had gotten the request from INE. I was told to analyse the document and to express my suggestions and comments. One of those earlier suggestions was well accepted at the time: a potential disaggregation of the indicator by migratory status. In fact, this type of request (documentation reviewing and delivering contributions) was a common practice during the internship period. Therefore, analysing and reviewing draft versions and other important official institutional documents was an active part of my work at DGT, pointedly on the first months. This was done mostly within the scope of UN-GGIM: Europe Work Group on Data Integration. As already mention, Francisco Vala (INE) was the coordinator of the UN-GGIM: Europe Work Group on Data Integration subgroup 2 - The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data. I delivered my contributions, suggestions, feedback or comments to documents such as the "Draft policy paper on the integration of statistical and geospatial information", "UN-GGIM: Europe | Work Group on Data Integration | subgroup 1 Policy Paper on the Integration of Statistical and Geospatial Information Contributions Portugal", "The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data - Phase 3 | Analysis of Indicators", among others. Those contributions were mainly regarding indicators conceptualization and definitions. Those working tasks can be referred as "indicators metadata analysis". In that context, the most important documents that benefit from my work were: "The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data – discussion"[6] and "The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data - INDICATOR 11.3.1 | Ratio of land consumption rate to population growth rate"[7]. Moreover, I followed the activities of the subgroup 2 Territorial dimension of SDG indicators, as I was added to the group e-mailing list, thus, receiving the correspondence sent by its members which occurred regularly. This was important because it let me access the group´s communication and kept me updated on their activities. Accordingly, as DGT actively participate in that UN GGIM: Europe group and due to the institutional cooperation with INE, this work was relevant for the mapping agency, as it was discussed. At the time, I was DGT´s representative.

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[6]Accessible through: http://un-ggim-europe.org/sites/default/files/Discussion_SDG_11%203%201_Ratio%20of%20land%20consumption%20rate%20to%20population%20growth%20rate.pdf#overlay-context=content/wg-b-data-integration

[7]Accessible through: http://un-ggim-europe.org/sites/default/files/SDG_11.3.1_Ratio%20of%20land%20consumption%20rate%20to%20population%20growth%20rate.pdf#overlay-context=content/wg-b-data-integration

As it was previously mentioned, one of my goals and tasks was to guarantee a valuable working collaboration with Statistics Portugal considering DGT-INE cooperation agreement. Statistics Portugal SDG working team was composed by elements of their Unit for Coordination of Territorial Statistics: Cátia Nunes, Diana Almeida, Inês Fontes and Francisco Vala, the team leader. About a week after my first internal presentation, I have met with Cátia Nunes at INE headquarters, facing a first understanding of the working paths thereafter. It was also a convenient session to deliver some questions and resolve doubts. I was the only representative of DGT on that meeting. We had debated about tasks, indicators, guidelines, and targets to achieve. It was also an opportunity for INE dispose me into the SDG context regarding their framework. From an UN GGIM: Europe Group on Data Integration sub group B task to select 1-3 indicators (namely 11.2.1 and 15.1.1 from tier I; 11.3.1 classified as tier II; 11.7.1. belonging to tier III), I was informed that in due time, INE and UN-GGIM: Europe sub group would request to DGT- consequently, to me- to deeply study the indicator 11.3.1, advancing for its corresponding analysis, application, calculation and production. Additionally, I strengthened DGT´s position to straightly cooperate with INE and UN-GGIM on SDG issues, assuring a fundamental active participation.

I was motivated to develop ideas, to help build something useful, to work on demand in all “geospatial” aspects that could arise from that. However, it was a less positive aspect to notice that the national progress towards SDG implementation was far from what I have expected. From a governmental side, there was nothing relevant to instate about SDG indicators monitoring (that is, in the scope of the indicators mainly). The spectrum of SDG monitoring would be improved if moving onwards to create an SDG platform to disseminate the information onto a geoportal. As it would be worthwhile to create a national indicator set list adapted to the Portuguese reality. “More could be done”, it was the reflexion. The lack of agility from a top-down hierarchy leaves other institutions resting their potential to address and leverage SDG monitoring and progress. The motivation is there but needs to be promoted. Yet, INE is an essential institution and plays a vital role to coordinate other institutions and to disseminate (statistical) information, guarantying that SDG indicators are implemented. All those insights are supported from the documentation consulted (saved on the SDG desktop folder), from all national and international contacts that I had with SDG key actors, and from all that I have learnt and experience in this internship.

After that first meeting with INE, I have been in another internal meeting with Mário Caetano and Cristina Garret, both designing a work plan basis (Table 1). The outcomes from the plan will be later shared on the report. A couple of weeks after, I finally had concluded the internship working plan description, a generical document, yet, presenting 9 work phases: a) study UN SDG b) Explore SDG indicators c) Identify and get to know the international initiatives dedicated to geospatial information and SDG indicators d) understand the national strategic framework e) Highlight DGT role towards SDG indicators in a direct articulation with INE f) Identify and list indicators that potentially benefit from the integration of geospatial information partially, or, integrally g) Harmonize and compare the identifies SDG indicators with DGT indicators system h) Suggest geospatial indicators to be applied, calculate and produced i) application of those indicators: testing, choose the best methodology, calculation and output. At the time of that document, I already had finalized tasks until point f).

TASK	DESCRIPTION	OUTPUTS	GUIDANCE
1	Identification of SDG indicators that can benefit from geographic information produced by DGT	List of SDG indicators with geographic information source from DGT	Mário Caetano
2	Mapping indicators associated with territory planning and urban development from the point of view of synergy and integration	1) List common indicators present in more than one indicator system 2) Harmonization proposal for similar indicators presented in more than one indicator system 3) List the remaining indicators	Cristina Garret

3	Development and methodological application for the indicators identified in 2. 1) and 2. 2)	1) Comparation of the methodological application using raster and vectorial data type, selecting and evaluating the criteria from the best option 2) Application of the methodological approach selected and calculation of the indicators identified in 2.1 and 2.2)	Mário Caetano Cristina Garret

Table 1 – The first working plan basis. Source: author

After finalizing, presenting and delivered to DSOT the work "Analysing DGT indicators systems containing geospatial information", detailed in the chapter 4 of this report, I started to work on the indicator 15.4.2. Mountain green cover index, which will be further explored in section 6.3.

A first milestone reunion with DGT and INE SDG working teams happen at DGT headquarters in the middle time of my internship period. The attendees from DGT, apart from me, were high-level representants: Mário Caetano, Cristina Garret and Ana Seixas, DGT sub-director. From INE´s side, all members of their SDG working team. That meeting impulse the kick-off facing indicator 11.3.1 work conjuncture. I had an active participation, presenting some slides about the work I committed until then. It was afterwards my task to produce and deliver to INE a methodological systematization document for that indicator, suggesting proposals for the indicator's operationalization taking into account different calculations options and methods. In fact, the work developed at DGT regarding this indicator had two primary lines: a solid articulated collaboration with INE/UN GGIM in order to respond to requests and demands foreseen in their guidelines; a coextensive research investigation lead by Rita Nicolau – where I was the research assistant-, assuming to test and apply other methodologies different from the one´s previously requested. Those work paths would be later accessed on the main chapter "Implementing SDG indicators". From that meeting, DGT acknowledged that the best data source to use for the national production of the indicator 15.4.2: Mountain green cover index was

COS. This was supported by the conclusions from my work towards the indicator. Additionally, an institutional shift also resulted from the meeting. Since most of the information from UN GGIM: Europe reached just to me within DGT, Mário Caetano was from that moment on the contact person that would follow the group´s activities from an institutional point. Nevertheless, I kept a direct contact with Cátia Nunes and Diana Almeida in relation to more practical issues about SDG indicator 11.3.1.

Whence, the focus of my work was integrally dedicated to all events from indicator 11.3.1, even if one or another time I was called to some spare work (explained in the next section). Accordingly, together with Rita Nicolau we were in charge for those activities on the following months. From a side, testing methodologies and applications to produce the indicator following the investigation line settled at DGT by Rita. From other side, working towards INE´s intentions and methodological suggestion to calculate the indicator at a national level for reporting. Both diverged among them. From the investigation line followed by DGT internally, we started to produce an article to submit for a special issue "Geo-Information and the Sustainable Development Goals (SDGs)" announced by the ISPRS International Journal of Geo-Information. An in-depth approach will be presented in the dedicated section to depict what has been done.

About one month and half before the terminus of my internship, the second reunion with INE took place again at DGT. This time, Francisco Vala, Cátia Nunes and Diana Almeida were accompanied by Bartholomeus Schoenmakers, who had been working along GEOSTAT 3[8] project. Bartholomeus was impressed and interest in the work we were developing, which caused a good feedback. From DGT side, it is worth to empathise the presence of Nuno David from DSOT. He was recently introduced to the SDG context. It was anew environment for him. Thus, I started to regular contact and meeting with Nuno, introducing him the theme, delivering all my knowledge, experience, and, in a most practical way, the entirely SDG folder, including my work. Soon I would leave, but SDG framework needed to be maintained in the best way. And Nuno assured that with my support. It was therefore a transition time. At the same moment, Mário Caetano took the decision to transfer all of SDG/UN-GGIM: Europe working sphere to DSOT.

In that same reunion, I have introduced developments regarding both lines of work conducted on the indicator 11.3.1 From that, it was agreed a deadline to disclose the indicator´s production. INE added the intention to report the indicator using another operational approach (namely, land use efficiency), considering a disaggregation to the municipality level. Also, it was necessary to make an ultimate official statement to decided which LCLU class from COS would be included to gauge the soil consumption variable. DGT was imperative in that resolution. To response to all of those issues, DGT agreed to outcome with an institutional document to deliver to Statistics Portugal.

The subsequent DGT-INE meeting was the very last one that I attended. DGT referred the importance of the core aspect from the major work that I have faced concerning the indicators harmonization (chapter 4). The monitoring of DGT´s main instruments regarding territory planning policies provided the opportunity

[8] A statistical geospatial framework for sustainable development

to aligned indicators from different sources into a single line, avoiding repetitions and double efforts. The reunion highlighted two main points within the scope of the last working tasks developed. First, the presentation and discussion of the institutional document previously referred in the last reunion. The report, “Analysis and methodologic development to establish simplified versions of the SDG indicator 11.3. 1”, showcased the results of the indicator´s production taking into consideration the investigation line developed at DGT accordingly to INE´s methodological request. For that report, I contributed with the calculations for the indicator as well preparing and producing all the maps. Secondly, it was discussed and justified the selection of land use classes that could represent soil consumption concept placed on the indicator definition, considering DGT´s expertise and experience on the field. DSOT had an important position on that decision. From that moment, INE demonstrated higher interest in the other investigation line which I was developing with Rita Nicolau, as an alternatively approach for the indicator production. Yet, the official national report would come out from the document “Analysis and methodologic development to establish simplified versions of the SDG indicator 11.3. 1”. This was indeed the final point of my period at DGT. My work was (almost) completed. The manuscript essential GIS core work was developed. The calculations of the indicators 11.3.1 and 15.4.2 have been done (later, with COS 2015 released I have updated this last indicator with the new dataset). The SDG folder transition to Nuno David was finalized. I can say that the cooperation that I had with DGT was successfully accomplished.

In summary, the internship can be divided in three phases already discussed on this section. In the first phase, I have studied about the SDG indicators and geospatial information, delivered the internal presentation, had the meeting with INE, and worked independently for the work request proposed by DSOT. The second phase started by the time of the first DGT-INE SDG meeting. That phased included the production of the indicator 15.4.2, the intensive research about the dasymetric mapping technique and about the indicator 11.3.1, and, consequently, the production of core information to produce SDG indicators. The very last phase comprises the last meetings with INE, the transition of the

SDG to DSOT and to Nuno David, and lastly, the production and calculation of the indicator 11.3.1, both in the external and internal development lines.

2.3 Other side work developed in DGT

During my internship, even if I was centred upon the aspect of geographic information and SDG indicators, I had the liability to develop additional side work, supporting other tasks or simply giving back up and contributions. Those side works were mainly short.

The first of those began with a request from DGT sub-director to study and analyse the document "Statistical Grids for Norway" (Strand and Bloch, 2009), which potentially could be related with what I would do next with SDG indicators, specifically for spatial data analysis and visualization. From that, I have created a small power point presentation and the feedback was excellent. This matter stayed on stan-by, as other priorities arise. Yet, I was told to later present the work in the internal INSPIRE working group.

The next solicitation from professor Mário Caetano, was to access DGT´s contribution for the SDG indicator 6.6.1: Change in the extent of water-related ecosystems over time. UN Environment Freshwater Team asked for reporting baseline data that they have generated utilized earth observations, as they notice lack of published data for that indicator at a national level. That call was made to INE, which shared with the partner institutions to evaluate the situation. After considering the indicator, I notice that it was part of a priority goal for the Portuguese government (Goal 6), and we have pronounced that the only contribute that DGT could add, was in terms of the spatial delimitation of the Portuguese coast.

DGT received a requested from the Urban Agenda SUL Bologna "team" regarding Action Area 5: Indicators of land take, to do a stocktaking of indicators that are already used by member states (MS) and European Union (EU) regions for measuring (gross/net) and take, soil sealing. The point was to have an overview of the different definitions and methods for measuring land take and to identify additional indicators able to effectively measure the side effects produced by land take. To response to that, it was necessary to fill an attached received form. Naturally, Marta Magalhães from DSOT, looked form my contributions to that request. As so, I filled the form as intended (Annex 3).

In one task articulated with DSOT, I have worked conjointly with Rita Fachadas, another intern student at DGT. Cristina Garret asked us a technical note that should reflect an analysis for the SDG´s indicators 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically and 11.a.1: Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city. From my part, I have pictured their status regarding UN and EU developments, as well identifying the definition of the referred indicators by some nations. Afterwards, we both composed the technical note, including the explanation, analysis and perspective about those indicators and their suitability for an application at a national level considering the Portuguese reality, proceeding with a methodological proposal for other two proxy indicators to be implemented: “level of citizens confidence in their residential municipality and “performance of municipalities in planning and land management issues”. This work was later used as an explanatory note from DGT to INE regarding the institutional cooperation and the SDG interconnection. Additionally, Cristina Garret asked me to review and complement the work done by Rita Fachadas in terms of matching the SDG indicators and their potential association with action measures of the action plan from the National Programme of Territorial Planning Policies (PNPOT).

In the meantime, I was convoked for an internal work session dedicated to Territory Planning State Report (REOT), a theme receiving high importance at the time in DGT. The goal was to understand how REOT indicators could related to SDG indicators, in order to avoid duplications.

3 SUSTAINABLE DEVELOPMENT GOALS

3.1 SDG and the 2030 Agenda

The 2030 Agenda for Sustainable Development adopted by the United Nations General Assembly on 25 September 2015 aims to transform our world, stating an action plan for people, planet, prosperity, peace and partnership (United Nations A/RES/70/1, 2015). This universal and holistic approach acts in the social, economic and environmental fronts, calling for a deep transition in the way that humanity looks and works for development, emphasising well-being and sustainability for all nations (OECD, n.d.). The new agenda is the natural replacement of the 8 Millennium Development Goals (MDG), a resolution adopted in 2000 which was focused to reduce extreme poverty, yet, mainly targeting the developing countries (United Nations A/56/326, 2001). Many lessons were learnt from the MDG (UNDP, 2016). Not surprisingly, MDG taught that for monitoring and measuring progress, data is an indispensable element, otherwise, the lack of quality data and analysis offer a serious limitation (United Nations, 2015; World Bank Group and UNDP, n.d.). One of the most important aspects from the MDG-SDG transition, is the acknowledgement that geospatial data can support monitoring in many aspects of development (United Nations, 2015).

At the core of the 2030 Agenda are placed the Sustainable Development Goals. The SDG were born in 2012 at the United Nations Conference on Sustainable Development in Rio de Janeiro, Brazil (United Nations A/RES/66/288, 2012). They are a set of 17 fundamental goals encompassing 169 targets that need to be achieved to guarantee a better planet for all. Those goals are not only highlighting the need for climate action, the need to eradicated poverty, or the gender equality need. The Sustainable Development Goals (Figure 1) commend a broad and integrated perspective of the priority needs concerning the 5 P´s of the sustainable development (people, planet, prosperity, peace and partnership).

Figure 1 – The 17 Sustainable Development Goals. Source: United Nations

The support for implementing the 2030 Agenda is guaranteed by concrete actions and policies declared on the Addis Ababa Action Agenda of the Third International Conference on Financing for Development (United Nations A/RES/69/313, 2015). Yet, the success of the SDG implementation relies on the active involvement by all stakeholders, from the governments, civil society, private sector, academia, non-governmental organizations (NGO) and citizens. One of the strongest statements that clearly differ from MDG, is the recognition that "no one will be left behind", meaning that the goals and targets must be achieved in all the countries, for all the people, and for all the society segments (United Nations A/RES/70/1, 2015). Nonetheless, the SDG´s are not legally mandatory.

3.2 Indicators

To follow, monitor, measure, evaluate and track the progress over sustainable development goals and their targets, a set of 232 indicators have been constructed. They are called UN SDG indicators and assume a global approach. Each indicator is articulated within a certain target from a certain goal (Figure 2). The indicators were classified into three tiers (Figure 3) based on their level of methodological development and data availability for their development at the global level (Nicolau et al, 2019). Tier I means that they have an established and acceptable methodology and that data is already available at a global level; Tier II represents indicators embody an established and acceptable methodology, yet, data is not regularly produced or available; Tier III indicators do not carry an international agreed methodology (UN-Habitat, 2018). To ensure that no one is left behind, quality, accessible, timely, reliable and disaggregated data is needed (United Nations A/RES/70/1, 2015).

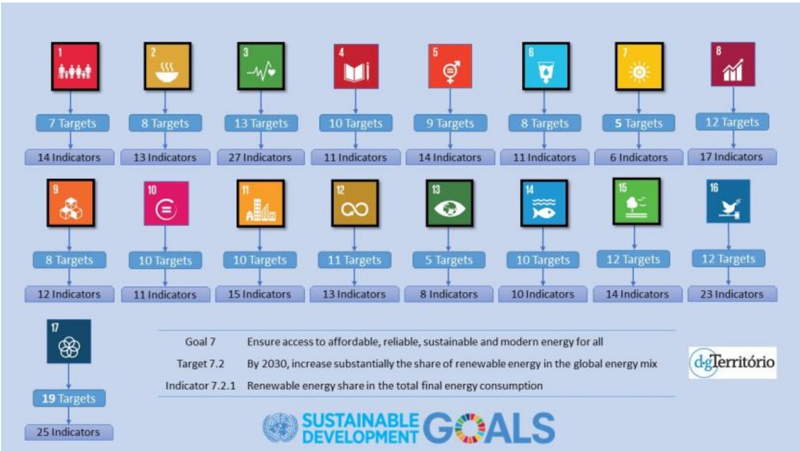

Figure 2 – SDG targets and indicators and a showcase from Goal 7. Source: author

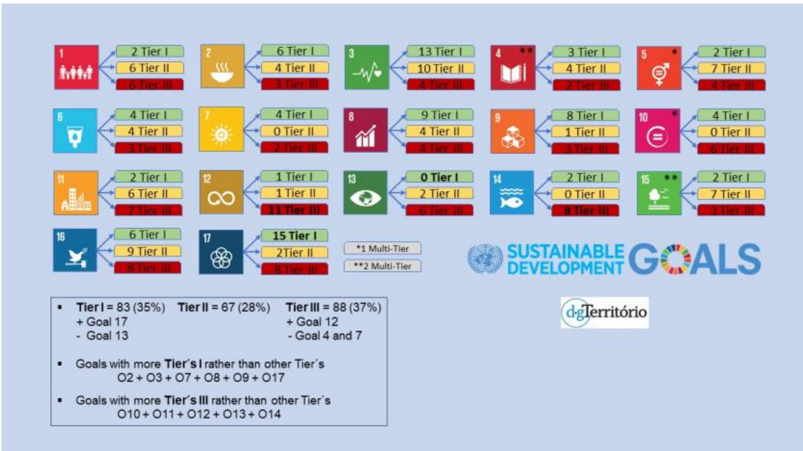

Figure 3 – SDG indicators tier classification (by 10/17) Source: author

SDG indicators should be disaggregated by income, sex, age, race, ethnicity, migratory status, disability and geographic location (United Nations A/RES/71/313, 2017). For effective global monitoring, The sustainable development solutions network itemized ten principles for the indicators: 1.Limited in number and globally harmonized; 2.Simple, single-variable indicators, with straightforward policy implications; 3.Allow for high frequency monitoring; 4.Consensus based, in line with international standards and system-based information; 5.Constructed from well-established data sources; 6.Disaggregated; 7.Universal; 8.Mainly outcome-focused; 9.Science-based and forward-looking; 10.A proxy for broader issues or conditions (UN-SDSN, 2015). The indicators have two main intentions: first, as a management tool, they will allow nations to monitor progress towards sustainable development and help to develop and implement strategies for achieving the SDG; second, they will serve as a report card by measuring the progress to achieve their target and to provide accountability of governments to their citizens (UN-SDSN, 2014).

The UN statistical commission (UNSC), a division of the department of economic and social affairs (DESA), had the task to determining the UN SDG global indicator framework. In 2015, the UNSC formed the Inter-Agency and expert group on sustainable development goal indicators (IAEG-SDGs) to develop and implement the indicator´s global framework, which later were adopted by the General Assembly on July 2017, within the resolution A/RES/71/313 (United Nations A/RES/71/313, 2017) Before, the IAEG-SDG already had proposed the global indicator framework, which was submitted to the 47th session of the UN statistical commission in March 2016 (European Space Agency, 2018).

Each indicator embodies a custodian agency- an UN body or an international organization- responsible, among other things, for their coordination and report, and to support nations with methodologies and data for monitoring the indicators (idem). At a regional level, EU developed an SDG indicator set list aligned with the UN global indicator list, with 100 indicators relevant to the region, allowing SDG being monitor in the context of a long-term EU policies (Eurostat, 2018). They are called EU SDG indicators. Those are fundamental for the EU´s sustainable development strategy to embrace 2030 Agenda to

Europe (European Commission, 2016). Yet, it is important to understand that each nation has a vital role to prepare their own priority and suitable indicators set list fitting the national context. Countries should not be limited to report or wait for custodian agencies report their data. They need to go beyond, taking ownership and establishing national frameworks, and constructed their own SDG national indicators set, considering UN Sustainable Development Goals (United Nations A/RES/70/1, 2015; UNOOSA, 2018b). As noted by IAEG-SDG, the indicators proposed are intended for global reviews (Eggers, 2016). After all, national monitoring is the most important level, and countries can define the nature of the indicators to response to their needs (UN-SDSN, 2015).

3.3 SDG and Geographic Information

3.3.1 Geospatial Indicators

The UN resolution Transforming our world: the 2030 Agenda for Sustainable Development have a particularly engaging declaration for the geospatial community: “We will promote transparent and accountable calling-up of appropriate publica-private cooperation to exploit the contribution to be made by a wide range of data, including earth observation (EO) and geospatial information, while ensuring national ownership in supporting and tracking progress” (United Nations A/RES/70/1, 2015). Earth observations and geospatial information, will, therefore, extend capabilities to produce those indicators. The need for geographic location and disaggregation is out there. As I could understood after studying the UN SDG indicators and their background, some of them are only possible to be produced with the integration of this data sources. Their integration into SDG monitoring is crucial to capture the sustainability and reinforce SDG global framework, principally due to their continuant spatial and temporal resolution (GEO, 2017). SDG´s are then positively impacted by the benefits from the use of satellite applications; e.g. when combined with statistical data, EO data and analysis can enabling to monitor changes over a period of time (UNOOSA, 2018a; Digital Globe, 2016).

Three key advantages of satellite EO data for SDG are: (1) satellite EO data makes the prospect of a Global Indicator Framework for the SDGs viable; (2) the potential to allow more timely statistical output; (3) improved accuracy in reporting by ensuring that data are more spatially-explicit (European Space Agency, 2018). As EO data and information can support the achievement of at least 12 SDG goals, programmes like the Copernicus[9] have an opportunity to demonstrate and showcase the contribution of their features to help achieving the Sustainable Development Goals (Roeland, 2017). Earth observations and geospatial information can significantly reduce the costs of monitoring and make SDG reporting feasible when just limited resources are available (GEO, 2017).

Geospatial information aggregated with statistical information can be essential to produce certain indicators, such as the 11.3.1 – Ratio of land consumption rate to population growth rate. Within that necessity, the Global Statistical Geospatial Framework (Figure 4) assures a high-level framework expressed by 5 broad principles that are considered essential for integrating geospatial and statistical information (UN EG-ISGI, 2018). Geospatial information it is important because provide the content and context for understanding natural and human systems (Jarzabek, 2015). It is essential obtaining geospatial data about people, built and natural environments (Hadley, 2018). Hence, a minimum list of global fundamental geospatial data themes was created to be implemented within the scope of SDG (United Nations E/C.20/2018/7/Add.1, 2018). Themes are a high-level categorisation of subject matter which can be further broken down into sub-themes (Hadley, 2018). The minimum list was extended to an

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[9] European Union's Earth Observation Programme. It offers information services based on satellite Earth Observation and in situ (non-space) data.

elaborated set of national fundamental data themes (Figure 5) to contribute as data inputs to the goals and targets by means of the global indicator framework, considering a same-time challenge and opportunity for the national geospatial information agencies (Scott and Rajabifard, 2017,). Not less important, is to consider that geospatial information can contribute to the indicators and their metadata in the following: a) as a direct indicator in itself; b) to support and augment statistical; c.to improve the production process of statistical data; d) to validate national statistical data inputs; e) to communicate and visualize the geographic dimensions and context of the indicators where appropriate; f) to provide granularity and disaggregation of the indicators where appropriate (Iliffe, 2018). Hence, the efficient use and integration of geospatial information and EO, sometimes combined with other data types such as demographic or statistic data, empower nations to create spatial and cartographic visualizations, evaluate impacts, monitor changes over time, create realistic models and improve decisions and policy-making (European Space Agency, 2018).

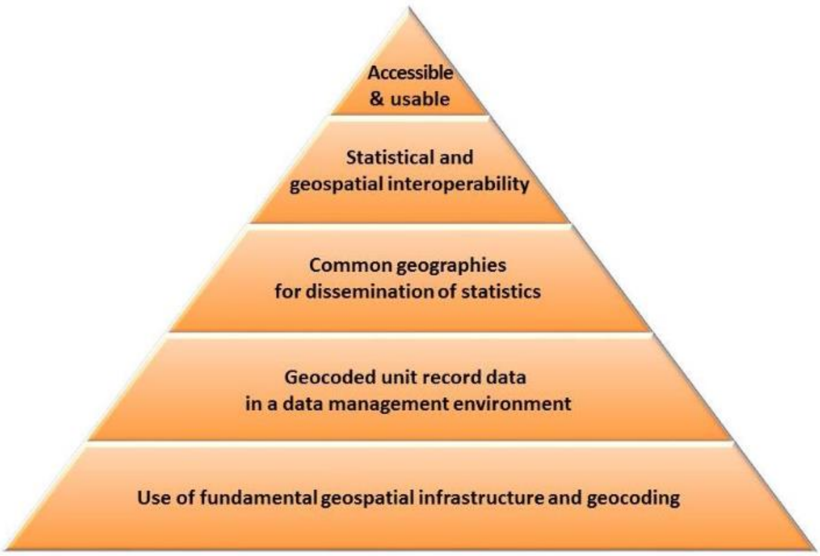

Figure 4 - Global Statistical Geospatial Framework Source: UN-GGIM

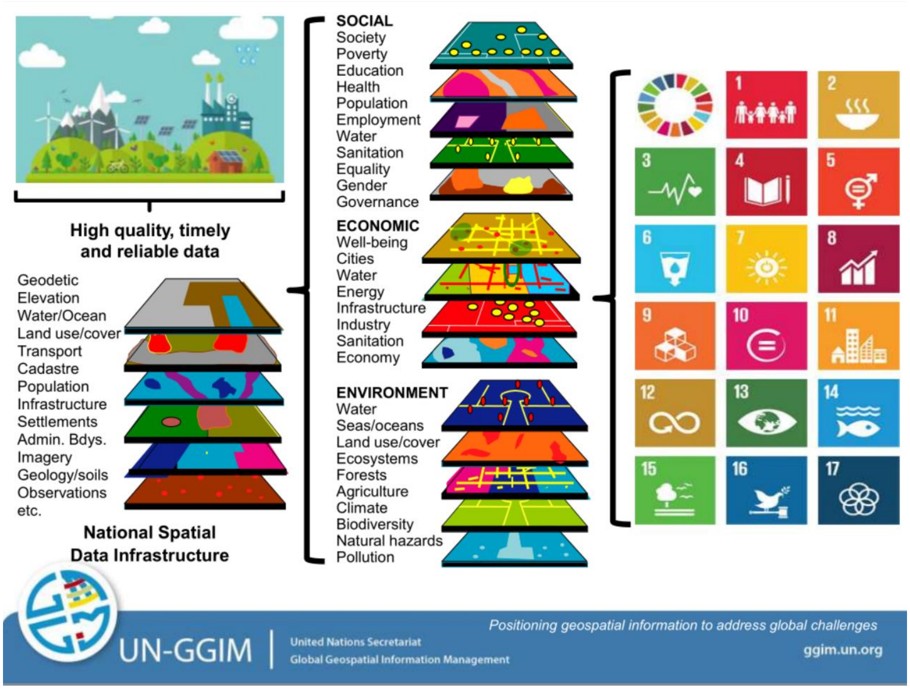

Figure 5 - Global fundamental geospatial data themes Source: UN-GGIM

In the scope of my work, following my methodology and purpose, from all the documents I have analysed, I started to compose an Excel file with a list of all indicators that were identified by institutions or initiatives, in where geospatial information can contribute for SDG indicators on the previously mentioned aspects (Annex 4). I named “SDG geo-indicators” (or geospatial indicators). This was from where I started to work for the task 1 presented in Table 1. First, I understood which indicators could benefit from geospatial information even if in a very small extend, since several entities already had identified those, for posteriorly list SDG indicators with geographic information source from DGT. Besides the number and name of the SDG indicator, that document have dedicated columns to understand the geographic information contribution to each indicator, to know which is the source that identified that indicator as gathering or benefiting from geospatial features or integration, some observations made by whom identified the indicator or in the scope of my work, and finally, accessing if INE had at the time data in their system regarding each indicator. The list is extensive with 61 indicators. I decided to include all the indicators that those sources identified has a “geospatial indicator”, even if in the minimum sense of the geospatial concept (e.g. cartographic representation or location-based patterns), due to two reasons: first, I acknowledged their competence and vision to identify the indicator as benefiting from geographic information or production, even if at a first glance, one could not agree with certain indicators on the list; secondly, including all SDG indicators identified from all those competent initiatives and institution, instead of continuing with my personal input filtering that information using my own criteria, would afterwards benefit DSOT because more indicators would be crossmatch with other indicator systems. That does not mean that I agree with all the indicators at that list. In which extend indicator 2.3.1, 12.a.1 or 17.6.1, for instance, can own that relation? Yet, after shared the issue with my Rita Nicolau, justifying my reasons to add those even if I would not agree with that list at a glance, we have decided to maintain and add all those indicators as clarified. After my first geo-indicators list, I note in a first insight that 5 indicators could benefit from geographic information and spatial analysis from DGT. Those are 11.2.1 - proportion of population that has convenient access to public transport, by sex, age and persons with disabilities; 11.3.1 - ratio of land consumption rate to population growth rate; 11.7.1 - average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities; 15.1.1 - forest area as a proportion of total land area; and 15.4.2 - mountain green cover Index. From those, I would deeply work on two of them.

3.3.2 International Initiatives

As a mean to address alternative data source and methodologies, the geospatial-statistical integration, as well the use of geospatial information and EO to produce certain indicators, the IAEG-SDG has a specific working group on geospatial information which aims to "ensure from a statistical and geographic location perspective that one of the key principles of the 2030 Agenda, to leave no one behind, is reflected in the Global indicator framework" (UN-Habitat, 2018). The group has six main tasks, such as considering how geospatial information can contribute to the indicators and metadata; reviewing the agreed indicators and metadata with a geographic location lens; or identifying existing geospatial data gaps, methodological and measurements issues (IAEG-SDG, 2016).

UN-GGIM, formally stablished in 2011, aims to address planetary challenges concerning the use of geospatial information, including in the Agenda 2030, providing guidelines and best practices, setting directions for the production and use of geospatial information within national and global policy frameworks, and building and strengthening geospatial information capacity of countries (Scott and Rajabifard, 2015; European Space Agency, 2018). They are very active, being a most fundamental initiative to the efficiency and effective use of geospatial information to support achieving SDG. They have regional committees, such as the UN-GGIM: Europe. Born in 2014, their work is to "ensure that the national mapping and cadastral authorities and national statistical institutes in the European UN Member States, the European Institutions and associated bodies work together to contribute to the more effective management and availability of geospatial information in Europe, and its integration with other information, based on user needs and requirements" (UN-GGIM: Europe, 2019). UN-GGIM: Europe has four working groups. During my internship, I have collaborated and follow activities from working group B: data integration.

As already mentioned, a notable important sector for SDG monitoring is EO. The group on earth observations (GEO) and the committee on earth observations satellites (CEOS) along with space agencies are working with scientists, academia, governments and with the private sector in developing partnerships for implementing UN SDG (GEO, 2017). GEO´s Earth Observations in Service of the 2030 Agenda for Sustainable Development Initiative 18 aims to promote the potential of EO, supporting efforts to promote to integrate EO and geospatial information in national development and monitoring frameworks (GEO, n.d.). Their vision states that "countries, stakeholders, and the global community desire additional Earth observations and geospatial information to continue progress on improved social, economic, and environmental sustainability" and their purpose is straightforwardly to "organize and realize the potential of Earth observations and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the Sustainable Development Goals" (idem). CEOS ad hoc team on Sustainable Development Goals (AHT-SDG) drive activities in support of the SDG through GEO and other pathways (CEOS, 2018). CEOS´s handbook "Satellite earth observation in support of the sustainable development goals" it is a robust special edition document to understand dive deeper on the subject (European Space Agency, 2018). It is divided in three parts: the role of EO data in support to the SDG; stakeholders' perspectives on EO for the SDGs; examples of EO contribution to SDG Targets and Indicators. ESA, the European space agency, is supporting the full realisation of EO in the UN 2030 Agenda, focusing on the global indicator framework, encouraging national statistics office and UN statistical division to integrate EO in their practices, to inform development policies and to ensure accountability (Coulson, 2018). ESA has already developed a wide range of programmes concerning sustainable development and 2030 Agenda. (ESA, 2018). The EU earth observation and monitoring programme, Copernicus, concretely contributes to monitor SDG indicators from goals 2,3,6,7,11,13,14 and 15, through six operational services (Copernicus, 2018). Some of its member states are already developing activities and promoting Copernicus use for SDG (European Commission, 2017). The North American National Aeronautics and Space Administration (NASA) is mainly contributing in a more practical procedure delivering a free of charge applied remote sensing training (ARSET), targeting everyone who intends to understand how to access and apply EO to meet and support monitoring SDG (ARSET, 2018). The UN office for outer space affairs (UNOOSA) carry their vision to bring the benefits of space to humankind, producing synergies joining together Copernicus and European Global Navigation Satellite System applications (EGNSS) (UNOOSA 2018a, 2018b). Other major geospatial institutions and companies, such as ESRI, are committed and working towards SDG within international initiatives. Finally, combined geospatial and statistical initiatives such as the European forum for geography and statistics (EFGS) or the GEOSTAT projects[10] by Eurostat, leverage and promote that integration.

3.3.3 The Portuguese Status

As it was already emphasized, the monitoring, implementation and evaluation of the developments for achieving SDG needs to be carry out by each country, involving not only governments but also other key actors.

In Portugal, the Ministry of Foreign Affairs together with the Ministry of Planning and Infrastructure, has the role to general coordinate the SDG (Statistics Portugal, 2017). Enlighten by the national report on the implementation of the 2030 Agenda for sustainable development, SDG 4 quality education, SDG 5 gender equality, SDG 9 industry, innovation and infrastructure, SDG 10 reducing inequalities, SDG 13 climate action, and, SDG 14 protecting Marine Life, are part of the strategical priority of the nation (Ministry of Foreign Affairs, 2017).

Statistics Portugal, in the level of statistical production and analysis, has a preponderant role to monitor and measure what is being done to achieve SDG. They are the agency that coordinates the SDG indicators process in articulation with other national and international entities. INE has a dedicated SGD multidisciplinary working group dedicated to the Agenda 2030 implementation,

[10] GEOSTAT 1: Creating a population grid for Europe (2010-2014);
GEOSTAT 2: A point-based foundation for statistics (2015-2016)
GEOSTAT 3: The ESS Statistical Geospatial Framework (2017-2018)

in the statistical point of view. That was the group which whom I have worked in a direct articulation when I was intern at DGT. Among others, the group aims to survey the information available at INE and in other institutions, to coordinate and contact with other entities that potentially could produce necessary information for indicators, and, to identify lack of information (Statistics Portugal, 2017). As a practical result, a data platform with UN SDG global indicators with data for Portugal is available through their website[11]. At a national level, official statistics available (41%) do not cover all those indicators; much of them are not available or they are under study, and a quarter is out of scope (Statistics Portugal, 2018).

DGT is one of the entities which INE is articulating with. DGT has an active fundamental participation in the SDG indicators process. Evidently, DGT has a main role in terms of LCLU and urban matters regarding sustainable development. In my first presentation, I mentioned that DGT should extract all the potential and value of geographic information to SDG indicators, working into their methodology, ponder data types and sources, to produce what I sometimes call geospatial indicators. From the background of that vision, I also recognised that promoting the use of remote sensing products, mainly, from the Copernicus programme, could be one way that DGT, and consequently, me as an intern, would be facing the SDG indicators subject internally. Yet, the role of DGT braces into exploring their geographic products as data sources to produce information to the indicators. Thereupon, the next step is to produce spatial analysis. As depicted, DGT collaborates with INE in a direct way. Moreover, it suggested to support the coordination of the indicators process

[11] Available through**:** https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_perfsdg

with other entities, like the Portuguese environmental agency (APA) and the nature and forests conservation institute (ICNF). Beyond that, the mapping agency is present in the SDG international activities, such as the UN GGIM.

4. ANALYSING DGT INDICATORS SYSTEMS CONTAINING GEOSPATIAL INFORMATION

This work task was requested by DSOT and took me several weeks to finalize. It was an optional demand, not included in a first glance on my internship activities. I have positively accepted it in order to add value to my internship workflow and to learn more about the analysed systems. In fact, DSOT had high expectations with the outcomes of this work and they were grateful for such involvement. That is unambiguous because the objective was articulated with their main intentions to harmonize and reduce efforts in the indicators production, avoiding repetitions. Specifically, because the aim was to articulate all those documents/indicators system, with focus to the internal programmes REOT and PNPOT. Due to this work acceptance, I have postponed the indicator 11.3.1 workplan, whereof at the time of that request, I already knew that would be the indicator from which I would explicitly work in a wide approach. The first step was to access and identifying indicators with a geographic/geospatial component. The six analysed indicators systems were the UN SDG indicators (my work on them was already addressed on this report), EU SDG, PNPOT, REOT, PT2020 – a system to monitor and evaluate the implementation of Portugal 2020 cooperation agreement between Portugal and the European Commission-, and the last, ISO 37120 2017 a Portuguese Standard for sustainable development of communities - indicators for city services and quality of life. After my completion, all the work was reviewed by Rita Nicolau, and, posteriorly, its final version was presented and delivered to DSOT.

A stepwise procedure was implemented (Annex 5). Initially, for each system, it was necessary to identify indicators containing a geospatial component, following the same logic that I applied before with UN SDG. An indicator could be also added to my list if it would benefit from DGT data sources input (e.g. COS, CAOP). For that, I have studied from side to side each system. First, I recorded all indicators present in each indicator´s system into an Excel file, even if with geospatial absence (Annex 6). Then, individually, I searched for any kind of relation with an UN SDG indicator. Utilizing Microsoft Access software to compile information and to create databases, I selected just the geo-indicators from the Excel file, which were then cross matched with UN SDG indicators considering their direct or indirect relation. Some additional comments could be noted in a dedicated column if needed. Each listed indicator from an analysed system could be related with one or more UN SDG indicators. That was "analysis 1: DGT indicators systems VS UN SDG". In summary, an Excel file with all the indicators from the 5 systems, regardless their geospatial component, and five Access files each representing a single analysed indicator system, containing just the geospatial indicators crossed match with UN SDG indicators.

Onto EU SDG, 21 indicators were found to have any kind of relation with the SDG geo-indicators, from which 7 have a direct relationship (Annex 7). For PNOPT I hadn´t found a direct relationship with any SDG indicator (Annex 8). Yet 11 indicators have another type of relation. REOT is a specific case. At the time of this analysis, the document was not yet fully developed. I had just a couple of pages explicating five territorial thematic domains which later would be covered with indicators. Hence, I tried to look to the UN SDG geo-indicators list and fit them in each correspondent domain, if suitable (Annex 9). A batch of 32 indicators could be included in those domains. PT2020 had just a couple of indicators with an indirect relation with three UN SDG indicators (Annex 10). Finally, ISO 37120 had 21 connections with the sustainable indicators, with 4 direct relations (Annex 11). In total, 93 indicators were found in a first insight.

Some of them were later drop out of the list, as Rita Nicolau found those with none potential relationship.

“Analysis 2: UN SDG VS DGT indicators systems” (Annex 12). was carry out pretty much in the same way but from an opposite angle. All SDG geo-indicators were listed (employing the SDG geo-indicators file) and for each one of them, it was possible to access to any relationship with other indicator(s) from DGT systems. 46 SDG indicators had a connection with others. It was a cross match correspondence. On that file, by clicking on an SDG indicator, or it was found none relation with other systems, or all the associations that each SDG indicator had with all the other systems was displayed. The Tier classification, the type of relationship, and, a newly added criterion, the intensity, – a personal subjective classification based in my understanding of each relation, from 1-strong relationship to 3 – weak relationship – were attainable. It is necessary to take into account that some of those relationships were purely indirect. From that file, the list of indicators was reduced after further inspection and discussion with Rita Nicolau.

To synthesise the former procedure, I have created an Excel file “final comparation” (Annex 13). Every single UN SDG indicator gathering a cross correspondence with other systems was listed with information about the total number of indicators from all correspondences, as well the number of indicators for each type of intensity. I would like to highlight indicators 1.1.1; 7.2.1; 11.2.1; 11.6.2; 14.5;1; 15.1.1 and 15.1.2. Those had 3 or more crossing relations with other systems. For indicators that I would later work on it, 11.3.1 was found to have 4 relations (one major and the other medium intensity) and 15.4.2 a single strong relation with REOT. Other interesting exercise was to access if UN SDG indicators labelled as tier I, had a relationship with other indicators. As told by Cristina Garret, those were the ones with most interest for my further application. A total of 12 indicators -11.1.1; 6.1.1; 7.1.1.; 7.1.2; 7.2.1; 9.4.1; 11.1.1; 11.6.2; 14.4.1; 14.5.1; 15.1.1; 15.1.2- were within that purpose. Once again, it must be considered that some of those relationships were indirect and not really interesting for DGT application. Thus, realistically, from those twelve, I could look that some could benefit from CAOP input, but almost all of them had just a simple cartographic purpose. Additionally, indicator 11.6.2 - Annual mean levels of fine particulate matter (e.g.PM2.5 and PM10) in cities (population weighted, was the only one that could benefit from a geospatial approach, in this case from EO.

With this work, I have produced match tables between UN SDG indicators and another indicators system hold by DGT and EU. Several comparisons were made. Relation between SDG identified geospatial indicators had matched against home and European indicators. Additionally, a quantitively analysis was subject. Hence, DSOT is now able to understand which indicators can be produced just once and included in more than one system, instead of producing more than one similar indicator in more than one system. Yet, after finalizing all those tasks, I could realize that few indicators had the LCLU component and few would benefit from DGT core geographic information products. Furthermore, for my internship purpose, I did not find something new. That is, none of those indicators' forthcoming from the analysis would benefit from the scope of my work, taking into account the goal to pick indicators that would benefit from DGT input, with exception of the indicator 11.3.1 and 15.4.2 (whose were object from my further work), and of the indicators 9.1.1, 11.2.1, and 15.1.1. In a personal lookout, I was also interesting to work on those last.

In conclusion, most part of DGT systems do not meet UN SDG global indicators, because SDG are complex and ranging from a wide sort of thematic fields, and most part of the indicators do not carry any direct relationship.

5. PRODUCTION OF CORE INFORMATION TO INTEGRATE SDG INDICATORS

The work which took more time and from which I delivered more effort was the production of core information to integrate SDG indicators using the dasymetric mapping technique. The reason was that I needed to study, to test and to apply the technique from the scratch. This line of work expressed exactly the methodology that would be further applied on the indicator 11.3.1. That research activity led to the production of the already mentioned manuscript.

The intelligent dasymetric mapping (IDM) technique, introduced in 2006 by Mennis, can be used to spatial disaggregated the population to obtain previously unknow information for a finer level of analysis (Mennis and Hultgren, 2006). This method disaggregates the data from a zonal system (e.g. municipalities, parishes) to a smaller system of smaller zones with the support of ancillary information to redistribute the input original data (Gallego et al, 2011). In other words, the downscaling approach transfers data from an initial zone to a different target zone, resulting in a finer scale raster grid output (Reibel and Agrawal, 2007). This cartographic technique, typically illustrated as the opposite of choropleth mapping, not only is useful to estimate population in small areas, as it can deliver a more realistic cartographic visualization, even with some associated limitations, e.g. the degree of uncertain (Mennis, 2009). Dasymetric mapping techniques increase the spatial accuracy compared to other conventional and traditional techniques, solving distortion problems cause by the modifiable areal unit problem (MAUP) introduced by Openshaw in 1984. (Batista et al, 2013; Openshaw, 1983). This technique is mostly exclusively applied to population data (Mennis and Hultgren, 2005).

The purpose of this work was to disaggregate mainland Portuguese resident population using LCLU data as ancillary information to generate population density grids at a finer level. The main goal behind this application was to produce core information to feed SDG, and eventually other indicators benefiting from this methodology and information. At a first insight, those SDG indicators are: 11.1.1 - Proportion of urban population living in slums, informal settlements or inadequate housing; 11.2.1 - Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities; 11.3.1. – Ratio of land consumption rate to population growth rate; 11.6.2 - Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted); 11.7.1 - Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities. The only indicator that had benefited from this information within my internship tasks was the 11.3.1. Nevertheless, more indicators from EU and DGT systems could potentially benefit from that integration at the same extend.

The GIS tool which allowed me to apply the IDM and to produce this work is made available by United States Environmental Protection Agency (EPA)[12] for ArcGIS 10.3 or higher. The toolbox (Annex 14) contains a few scripts that assist preparing vector population and raster ancillary datasets for intelligent dasymetric mapping, performs the dasymetric calculations, and generates a floating-point output raster of revised population density. In total, the tool has 5 steps (Annex 15): 1) Population Features to Raster; 2) Combine Population and Ancillary Raster; 3) Create Ancillary Class Preset Table 4) Dasymetric Calculations 5) Create Final Dasymetric Raster. The documentation of the tool is helpful and their dedicated support it works perfectly. In fact, I had to make some contacts with EPA requesting for their technical support. Eventually, their reply and help contributed to tackle some issues. The selection of the tool to be used on this working task was suggested by me. In a previously non-finalized work carried at DGT, other GIS tools for a dasymetric approach were used. This

[12] Available through: https://www.epa.gov/enviroatlas/dasymetric-toolbox

time, after I have discovered EPA´s tool with all its simplicity and efficiency, I strongly have recommended for our application.

Table 2 outlines the characteristics of the input population and ancillary LCLU data, as well the output core information produced from this work task. The statistical data source comes from INE. In the years that Census data is available, it was preferred to use that data because it is more reliable comparing with annual population estimates. Moreover, we could also work with data from a parish geography to validate the model estimations. The LCLU auxiliary information used to downscale the population was COS from DGT, and CLC from the European Copernicus programme. Both in vector format. Specific allocation rules were defined and associated to each LCLU category. Two datasets with the same name “Grid Mainland PT resident population 2011” are listed, yet, they differ in their spatial resolution due to the minimum cartographic unity (MCU) from the ancillary geospatial products. In total, 7 disaggregated mainland Portuguese resident population grids were produced and are ready to be used by DGT when necessary. Those raster datasets depict the Portuguese population distribution. Next, I will be sharing the methodological approach conducted, demonstrating a practical exercise as an example from where I have produced the output b) grid mainland PT resident population 2011 using Census population and COS 2010 as ancillary information.

Population data (INE)			**Geospatial data (DGT and EU)**			**Core Info**
Statistical data	*Year*	*Spatial Unity*	*Ancillary LCLU*	*Temporal Resolution*	*Spatial Resolution*	*Output produced*
Population estimates	2007	Municipality	COS	2007	25m	a) Grid Mainland PT resident population 2007
Census population	2011	Municipality Parish (val.)	COS	2010	25m	b) Grid Mainland PT resident population 2011

Population estimates	2015	Municipality	COS	2015	25m	c) Grid Mainland PT resident population 2015
Census population	1991	Municipality Parish (val.)	CLC	1990	100m	d) Grid Mainland PT resident population 1991
Census population	2001	Municipality Parish (val.)	CLC	2000	100m	e) Grid Mainland PT resident population 2001
Population estimates	2006	Municipality	CLC	2006	100m	f) Grid Mainland PT resident population 2006
Census population	2011	Municipality Parish (val.)	CLC	2012	100m	g) Grid Mainland PT resident population 2011

Table 2 – Input and output data. Note: (val.) = data ready to be used for validation of the population estimates. Source: author

The first step adopted was the reclassification of each LCLU dataset. Both COS and CLC nomenclature are compatible (Annex 16). That allows for comparations and facilitates analysis. Several tests with different reclassification categories were performed. This was a first important step, influencing the algorithm calculation. Thus, we needed to be sure to decide for the best reclassification. Our final decision was based onto the conjuncture of the performance and accuracy from our many tests conducted, by discussions with experts in the mapping agency, and based on the literature (Gallego et al, 2011; Gallego, 2010; Joint Research Centre, 2013; Silva, 2016). The reclassification applied was exactly the same for all datasets. Essentially, the model would later redistribute the population within areas occupied by continuous urban fabric (111), discontinuous urban fabric (112), sports, leisure and cultural facilities, and historic zones (142) and complex cultivation patterns (242). All the remaining classes are told to be inhabited (Table 3). The next pre-processing step was to convert the data from polygon to raster. Next, I will demonstrate an application example of the procedure. For the following, the feature was named COS10EPA4grd25 (Annex17).

Recode Value	Original Code	
0	1.2.% + 1.3.% + 1.4.1 + 3.3.% + 4.% + 5.%	Uninhabited areas
1	2.1.% + 2.2.% + 2.3.% + 2.4.1 + 2.4.3 + 2.4.4 + 3.1.% + 3.2.%	Uninhabited areas
2	1.4.2 % + 2.4.2 %	Less likely to reside
3	1.1.1 % + 1.1.2 %	Most likely to reside

Table 3 – COS and CL final applied reclassification. Source: author

The first step of the tool requires two inputs: COS10EPA4grd25 and a polygon feature class with a population count field to be converted to raster. I have named it MUN11, a feature class in which I joined Census 2011 statistic data with CAOP 2010. The outputs are a population raster - PopMun11grd25- and a population standalone table to perform calculations – Mun11_PopToRaster. The second step asks for inputting Mun11_PopToRaster together with COS10EPA4grd25. As outputs, it delivers a dasymetric raster with a single value for each unique combination of population and LCLU (re)classes. It was named DasyPopMun11grd25. A working table will be also created to perform the dasymetric calculations. That is told as PopMun11grd25_CombinePopAnc. Step 3 needed COS10EPA4grd25 as input. The output is COS10EPA4grd25_PrestT, a preset table to the enter density values for each recode category in order to be applied on the calculations. This was another part of the work that took some time to tune. Many tests to assure the best performance from the algorithm were performed. Thus, the final preset table comprises a density value of 0.001 for the code 2 and a value of 0 for recode 0 and 1. Code 3 was erased in order to be automatically executed. There is not an explicit clear explanation for those density values. It was, as said before, based on the tests and experiences. The same values were applied equally for all datasets. The next step is intended for dasymetric calculations. It must be added the population, the dasymetric and the preset table. Two outputs are delivered: a sampling summary table and a final summary table. The ultimate step is to create the dasymetric raster. The inputs are DasyPopMun11grd25 and PopMun11grd25_CombinePopAnc. The output is the continental resident population density grid map, with a detailed spatial resolution of 25 metres (EPopMun11_COS10EPA4grd25) (Figure 6a, b,c).

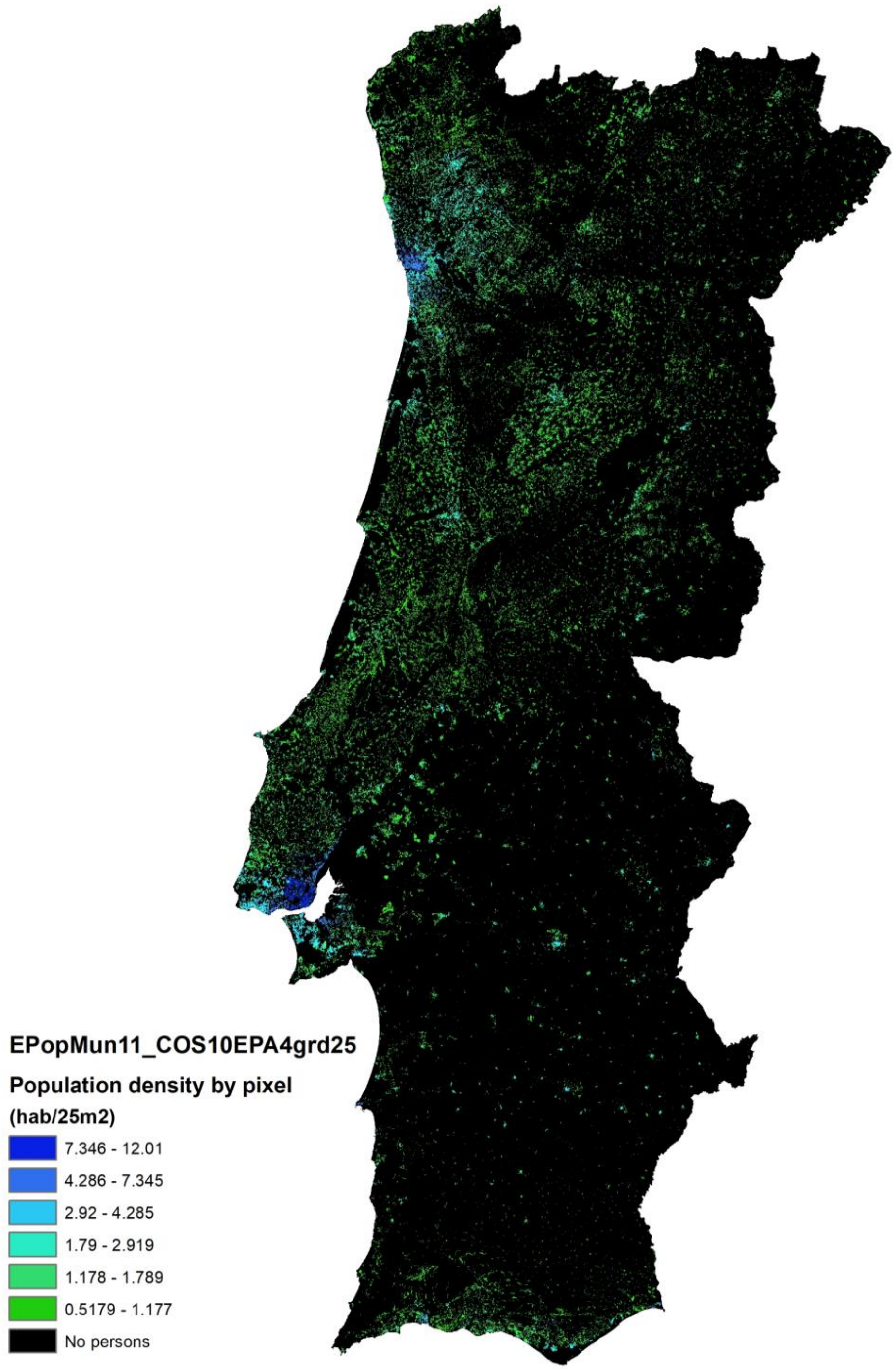

Figure 6a – Continental Resident population distribution map - EPopMun11_COS10EPA4grd25. Source: author

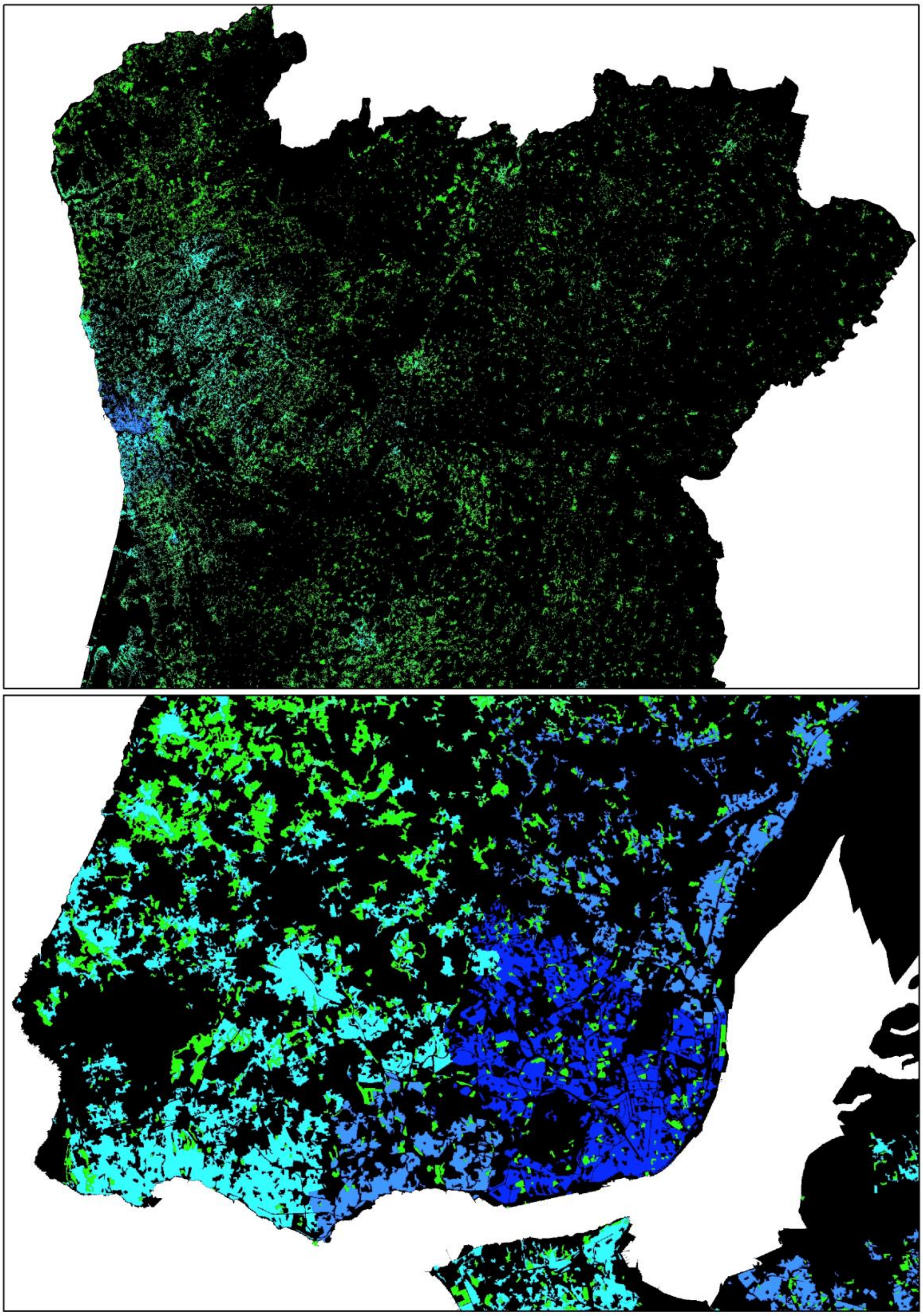

Figure 6b – Continental Resident population distribution map - EPopMun11_COS10EPA4grd25. Zoom into the North of Portugal and into Lisbon. Source: author

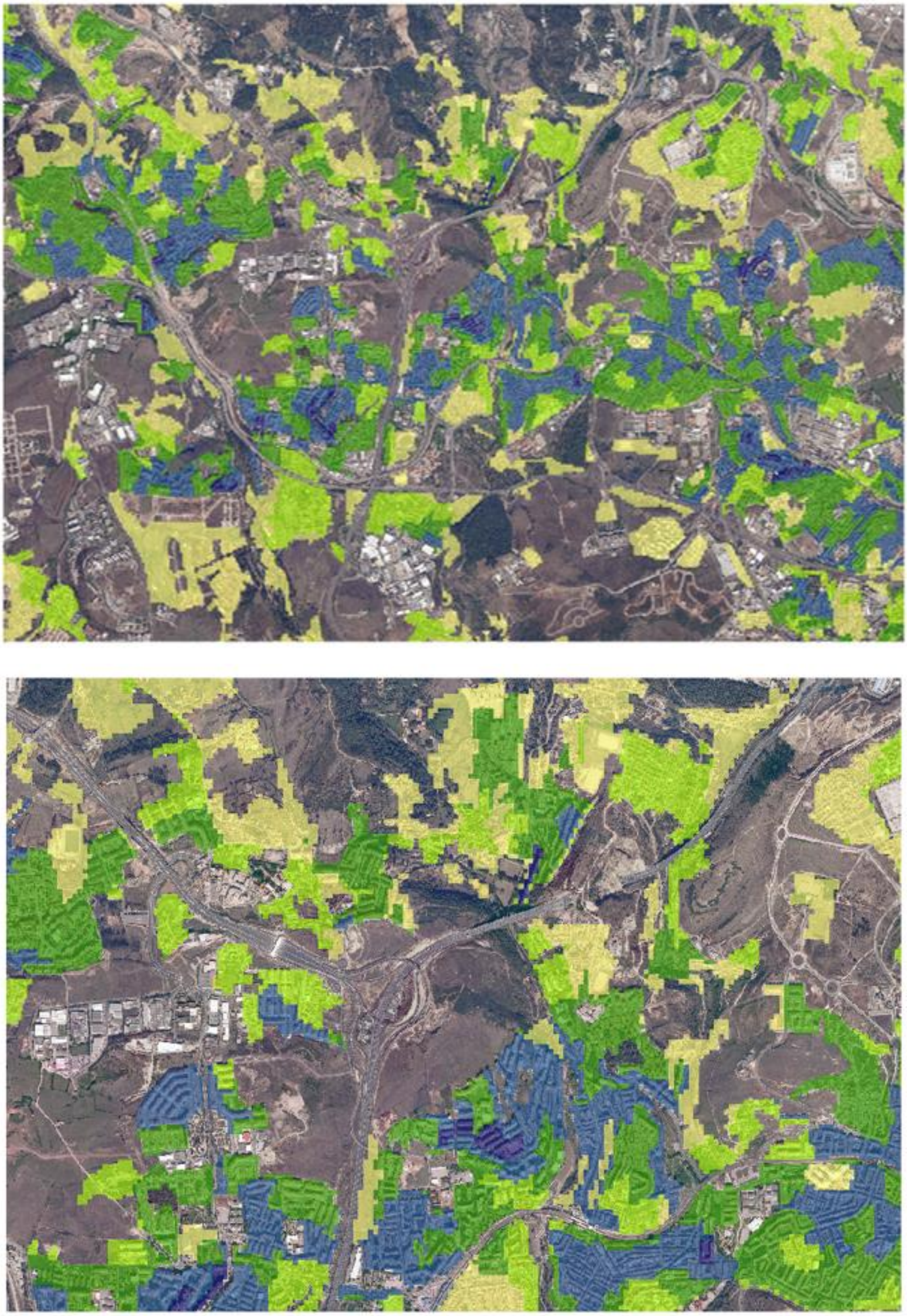

Figure 6c – Resident population map - EPopMun11_COS10EPA4grd25. Swipe visual analysis with an ortophotomap. Source: author

The accuracy assessment of the population grid map requires the quantification of the disagreement between the population estimates and the true population values for a sample of sites (Nicolau et al, 2019). Previous studies pointed the total absolute error (TAE) as the more robust parameter to be used in the validation stage (Gallego, 2001; Willmott and Matsuura, 2005). Here, it was used the relative total absolute error (RTAE), a derivation of TAE, to evaluate the ratio between the sum of the absolute estimation deviations of the modelled variable and the sum of the known values of the same variable for all the spatial units (Nicolau et al, 2019). A RTAE value of two means a total error on the estimations. A value of 0 means error absence. The spatial unit used for validation on the showcased exercise was the parish level. This was done with zonal statistics as a table tool and then joining information. For EPopMun11_COS10EPA4grd25 the RTAE wa 0.343, a considerably accepted value in order with other works. For the other datasets, the measured errors were also accordingly.

This work was fundamental to produce core information which later would be applied on SDG indicators, such as the indicator 11.3.1 – ratio of land consumption rate to population growth rate. It was not an easy and quick task with a simple methodology, as many tests are needed to perform the best product. As this work was done in the scope of the national mapping agency, all the details must be considered before coming out with the final output. The exigency is maximized. Thus, it gathered great involvement by my side. I am satisfied to learn how to apply this methodology because it is an efficient way to downscale the data, and the positive aspects of dasymetric mapping are interestingly valuable. As a matter of fact, other actors are applying this method in the line of SDG indicators, as I understood after attending to the UN congress in China. Yet, this technique has some limitations which I was able to identify in the production of this work. The more irregular is the geometric configuration of the interest areas, the more application limitations one can find, due to the potential loose of those geometries. The model is dependent of the fitness of the input data, in this case, population counts and LCLU classification. Then, errors of the LCLU classification are also inputted on these models. The geographic information detail is considerable important. CLC spatial resolution is coarse to be use for this kind of application and purpose, especially when compared with COS.

6. IMPLEMENTING SDG INDICATORS

6.1 Ratio of land consumption rate to population growth rate

The ratio of land consumption rate to population growth rate was the main indicator towards my work at DGT. This indicator was picked by INE in the workflow context of UN GGIM: Europe, working Group B, subgroup on the territorial dimension of SDG indicators. INE and DGT were nominated coordinators to complete the global metadata systematization, and to develop and produce the indicator.

The indicator 11.3.1, under responsibility of the custodian agency UN-Habitat, is part of the goal 11 - make cities and human settlements inclusive, safe, resilient and sustainable and target 11.1 - By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries. The indicator can be unfolded into two principal concepts. As presented in the indicator metadata file, the population growth rate “is the increase of a population in a country during a period, usually one year, expressed as a percentage of the population at the start of that period. It reflects the number of births and deaths during a period and the number of people migrating to and from a country”; and the “land consumption includes: (a) The expansion of built-up area which can be directly measured; (b) the absolute extent of land that is subject to exploitation by agriculture, forestry or other economic activities; and (c) the over-intensive exploitation of land that is used for agriculture and forestry.” (UN-Habitat, 2018). The mathematical formula proposed is abbreviated to LCRPGR.

The work plan started after the INE-DGT meeting regarding SDG subject thematic. Nevertheless, by some contacts stablished before with INE and by the activities followed from the UN GGIM: Europe group, I already knew that this would be the focus for my in-depth application. After that reunion, it was my task to prepare and deliver to INE a document that systematize the operational methodologies to be applied for the indicator. That would be a first important step to determine the base LCLU (and statistical) information to be used for the indicator calculation.

Hence, I have started to compile a document gathering all the data sources to be taken into considering for an operational stage. The first draft of that document gathered several datasets: COS, CLC, imperviousness (from the high-resolution layer from Copernicus programme), global human settlement layer (from Joint Research Centre of the European Commission) and the urban morphological zones produced by Rita Nicolau (Nicolau and Cavaco, 2018). Others, such as the urban atlas, the global urban footprint, or the European settlement map were excluded due to incompatibilities to produce the indicator (e.g. temporal resolution) as discuss internally. Those, at first glance, seemed to be suitable datasets and where afterwards proposed as such on a new document that along with the data, it also discussed the indicator hot topic: the conceptualization of its definition. This document, named conceptualization discussion, brought into question those referred data sources for a calculation production, together with their necessary metainformation. For each proposal, several methods of calculation were suggested in order to test which could be the best classes to represent the soil consumption component. At the time, for COS and CLC, three different methods to access soil consumption were proposed: a) the soil consumption could be represented as the built-up areas of the COS/CLC class 1; b) the soil consumption could be represented as the built-up areas of the COS/CLC classes 1.1 + 1.2 + 1.4; c) the soil consumption could be represented as the built-up areas of the COS/CLC classes 1.1.1 +1.1.2. With that approach, three different scales of analysis could be study. I had a major involvement on those tasks.

From that document requested by INE, from a next meeting with their SDG team, and after several GIS application tests made, it was decided that the datasets to be used for implementing the indicator would be confined to COS and CLC, due to their importance for national reporting and European application (this was specifically important for the scope of UN GGIM: Europe group). Additionally, in the encounter of the difficulties that we faced to integrally understand the formula proposed by UN-Habitat, an additional formula proposed by the Joint Research Centre (JRC), the land use efficiency (LUE) was adopted and added to our work production (Corbane et al, 2017). Thus, we would further calculate them both. Meanwhile, the issue for the conceptual delimitation of the built-up areas arise again. Until today, there is none consensus of the exact definition to be used for the land consumption variable. Some have the vision that all the urban area should be taking into account (built up area + open space). Others only acknowledged the built-up areas. After an internal and external debates with INE regarding which land cover land use classes from COS/CLC should be used to better represent land consumption, the selection was made over the mega class 1 artificial surfaces, excluding the class construction sites. This class was excluded because it could contemplate areas under construction when, the construction is over, the land cover may change to other classes from outside of artificial areas. Using GIS, it was possible to determine the area of each municipality occupied by the class 1 minus the class areas under construction. The population variable from the indicator was assumed to be the total resident population in each administrative unit (municipality). This direct approach based on data on artificial surfaces and population estimates at municipality level was designated at DGT by the calculation of the indicator in a simplified approach.

As requested by INE, LCRPGR and LUE (proxy to 11.3.1.) formulas were applied at a national and at municipality level, using CAOP 2015 geometry. Table 4 shares all indicators produced and information regarding the reference period and data sources used in their application (Table 4). The calculations results were shared to INE, in an institutional official document. I have contributed and produced maps and calculations for that document. Positive LUE values mean that the urban soil consumption is slower than urban population growth. This is the ideal situation that a city needs to achieve in terms of urban sustainability. Those statistical results were later published as official statistical data[13]. LUE is easier to interpret and more suitable for monitoring urban development and to capture urban dynamics than LCRPGR. The question if the mathematically expression from the official indicator metadata is suitable and adequate to represent the phenomena is inclined to have a negative answer due to the limitations, such as the results interpretation difficulties – e.g. it delivers extreme either positive and negative values. For this work application, some of the results delivered to INE are shared in Figure 7 (Figure 7). Additionally, from a further analysis, it is shared other results by the application of this indicator with both formulas assuming that the resident population lives in urban areas (Figure 8a,b). On those results from figure 8, it is important to mentioned that the LCRPGR values ranging from 38.6 to -124.2; the LUE maximum and minimum values are 0.1 and -1.01.

[13] Available through: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_perfsdg&objetivo=11&indicador=11.3&indicador2=11.3.1

Indicator short name	Reference Period	Data sources used to produce the indicator
LUE_COS07_11	2007-2011	COS 2007 + Resident population estimates per municipality in 2007 COS 2010 + Resident population by municipality (Census) 2011
LUE_COS11_15	2011-2015	COS 2010 + Resident population by municipality (Census) 2011 COS 2015 + Resident population estimates per municipality in 2015.
LUE_COS07_15	2007-2015	COS 2007 + Resident population estimates per municipality in 2007 COS 2015 + Resident population estimates per municipality in 2015
LUE_CLC91_01	1991-2001	CLC 1990 + Resident population by municipality (Census) 1991 CLC 2000 + Resident population by municipality (Census) 2001.
LUE_CLC01_06	2001-2006	CLC 2000 + Resident population by municipality (Census) 2001 CLC 2006 + Resident population estimates per municipality in 2006.
LUE_CLC06_11	2006-2011	CLC 2006 + Resident population estimates per municipality in 2006; CLC 2012 + Resident population by municipality (Census) 2011
LUE_CLC91_11	1991-2011	CLC 1990 + Resident population by municipality (Census) 1991 CLC 2012 + Resident population by municipality (Census) 2011
LCRPGR_COS07_11	2007-2011	COS 2007 + Resident population estimates per municipality in 2007 COS 2010 + Resident population by municipality (Census) 2011.
LCRPGR_COS11_15	2011-2015	COS 2010 + Resident population by municipality (Census) 2011; COS 2015 + Resident population estimates per municipality in 2015
LCRPGR_COS07_15	2007-2015	COS 2007 + Resident population estimates per municipality in 2007; COS 2015 + Resident population estimates per municipality in 2015.
LCRPGR _CLC91_01	1991-2001	CLC 1990 + Resident population by municipality (Census) 1991; CLC 2000 + Resident population by municipality (Census) 2001
LCRPGR _CLC01_06	2001-2006	CLC 2000 + Resident population by municipality (Census) 2001 CLC 2006 + Resident population estimates per municipality in 2006.
LCRPGR _CLC06_11	2006-2011	CLC 2006 + Resident population estimates per municipality in 2006 CLC 2012 + Resident population by municipality (Census) 2011
LCRPGR _CLC91_11	1991-2011	CLC 1990 + Resident population by municipality (Census) 1991 CLC 2012 + Resident population by municipality (Census) 2011

Table 4 – Indicators produced and their metainformation summary. Source: author

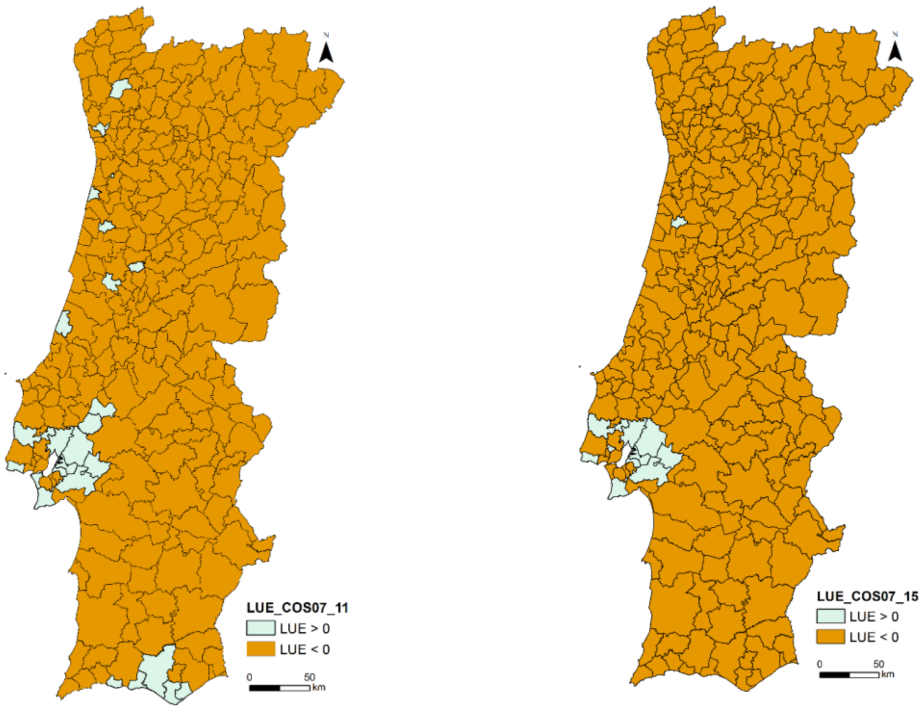

Figure 7 – Some of the results delivered to INE. Source: author

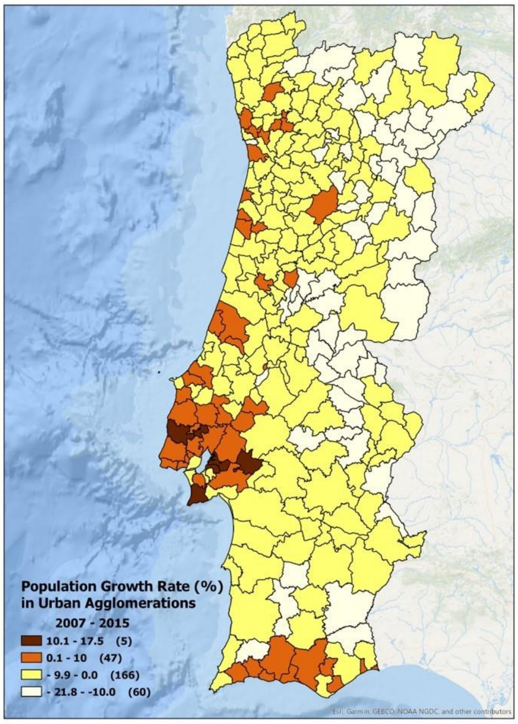

Figure 8a – Population Growth Rate in Urban Agglomerations (%) 2007-2015. Source: author

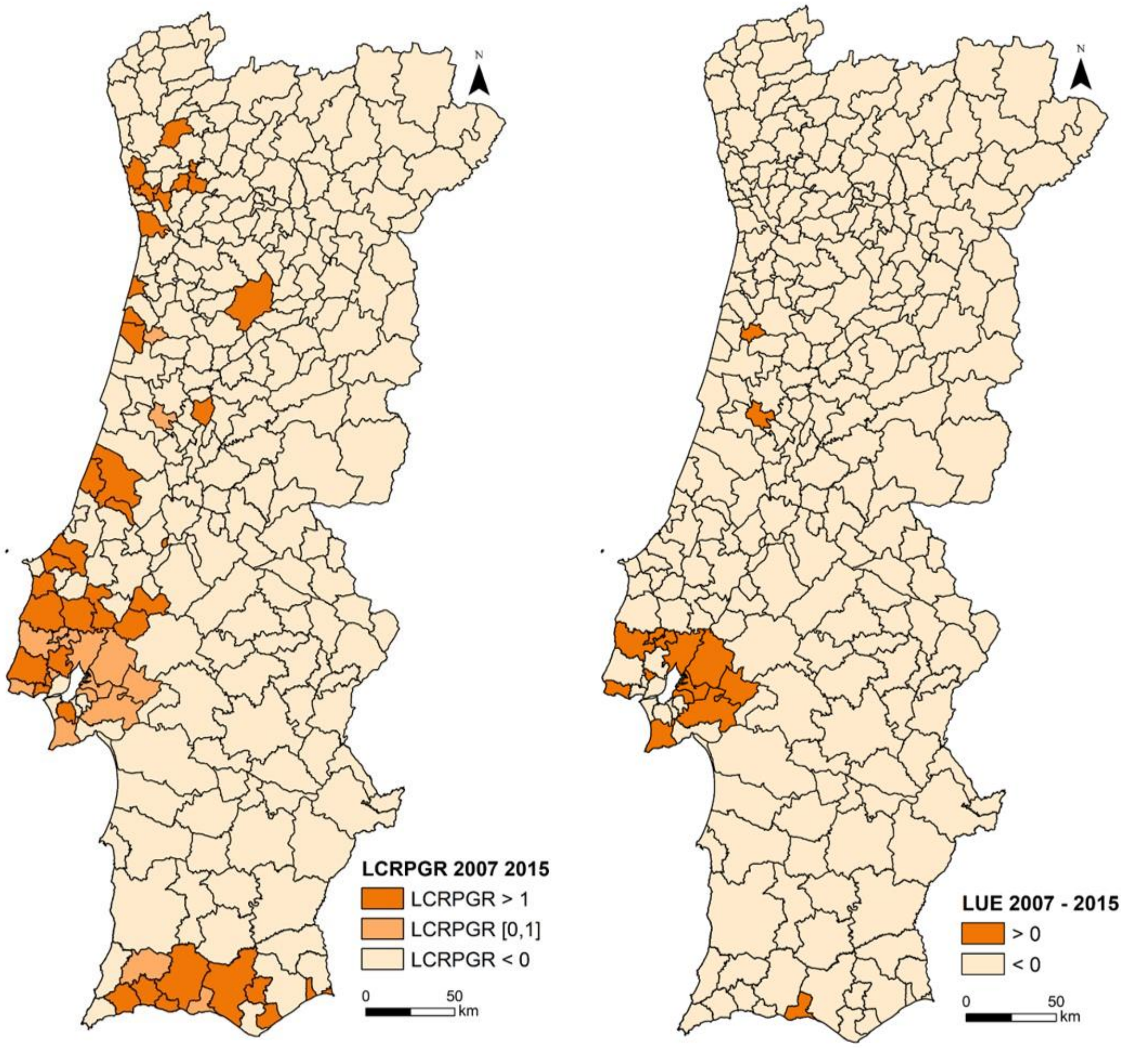

Figure 8b – Indicator 11.3.1 application with LCRPGR and LUE formula assuming that the population of interest lives in urban agglomerations. Source: author

6.2 The article Ratio of Land Consumption Rate to Population Growth Rate — Analysis of Different Formulations Applied to Mainland Portugal

The production of a scientific article was a main intention even before I started the internship. In my view, I would only maximize the internship experience if I could employ my research developed at DGT for a scientific purpose. After recognizing that the internship major investigation focus would be dedicated to indicator 11.3.1, it was then orderly to prepare the investigation background towards that intention.

The article “Ratio of Land Consumption Rate to Population Growth Rate—Analysis of Different Formulations Applied to Mainland Portugal” is a recognition for all the effort inputted on the internship (Annex 17). This article demonstrates and shares the internal investigation line approached and developed at DGT, in counterpart with the work articulated with INE over the same indicator. The approach is based on the intelligent dasymetric mapping method to estimate the distribution of the Portuguese population living in urban agglomerations in each analysed period. That data was mostly provided from the work produced in chapter 5. It was discussed and employed two mathematical formulas (LCRPGR and LUE) to access the ratio using COS and CLC, assuming that the population of interest for the indicator are only residents in urban areas. Major conclusions are that the computation of the indicator with the LCRPGR formula is difficult to interpret; LUE formula is more suitable to capture urban area dynamics and to monitor urban development. Yet, in the case of this specific indicator and considering both investigation research lines driven at DGT, the application of the dasymetric mapping technique does not produce substantial different results when applying the total of residents for each municipality administrative unit.

As Rita Nicolau was leading the investigation, I am naturally the manuscript´s second (and correspondent) author. I have contributed with the formal analysis, with research applications (e.g. conducting several tests which lead me to took decisions), with the methodology applied, and, with the writing – reviewing and editing. The suggestion and selection of the journal came from my initiative. As I was keeping an eye on many subjects and initiatives related with geospatial information and SDG, I found an appealing special issue "Geo-Information and the Sustainable Development Goals (SDGs)" of ISPRS International Journal of Geo-Information.

As the outputs produced from my work regarding this investigation line are explicitly reported on the manuscript, I close this section by sharing the article´s abstract (Nicolau et al, 2019): “This paper presents a methodological approach for the assessment of the indicator 11.3.1: “Ratio of Land Consumption Rate to Population Growth Rate” proposed by the United Nations (UN), discussing the definitions and assumptions that support the indicator quantification, and analysing the results provided by different formulations applied to mainland Portugal, at the municipality level. Due to specific limitations related to the actual formula proposed by the UN (LCRPGR) for the computation of the indicator, an alternative formulation derived from Land Use Efficiency (LUE) was explored. Considering that the land to which the indicator refers may be described by specific classes represented in Land Cover Land Use (LCLU) maps, in the estimation of the land consumption rate we tested two LCLU datasets: Corine Land Cover and COS—the Portuguese LCLU reference map. For the estimation of the population growth rate, prior allocation of inhabitants to the areas where people are most likely to reside was deemed necessary, using a dasymetric mapping technique based on LCLU information. The results obtained for 2007–2011 and 2011–2015 showed, in most municipalities, an increase in the urban area and a decrease in urban population, leading to negative values both in LCRPGR and LUE in most of the territory. Clearly, LUE performed better than LCRPGR in what urban development monitoring and urban area dynamics trends are concerned. Furthermore, LUE was much easier to interpret.”

This article is a significant outcome from my work experience at DGT. Hence, it must be recognized as a constituent intrinsic element of this internship report. The full article can be open accessed on the following web link: https://www.mdpi.com/2220-9964/8/1/10/html.

6.3 Mountain green cover index

Before my arrival, in the first and only INE-DGT meeting regarding SDG cooperation, mountain green cover index (and ratio of land consumption rate to population growth rate) was identified as an indicator from which DGT pledged to study ascertaining if COS could be used for its production, communicating those findings to INE.

FAO, the custodian agency for the indicator, had estimated provisional baseline data for Portugal (Annex 18). In order to officially publish the data, FAO requested reviewing and validation to Statistics Portugal. As DGT was the agency in charge for this indicator, INE forward the issue to Mário Caetano, who consequently delivered the subject to me. My task was to evaluate the data considering FAO´s methodology and, based on the results, decide if we would rather accept the indicator´s production, or, instead, provide alternative data at a national level along with a technical motivation response explaining our decision. To do that, I needed to investigate the global indicator metadata file and the way that FAO produced the indicator. Additionally, I needed to study COS as an alternative suitable data source to produce this indicator, based on its own classes, metainformation, and in the relationship with the indicator

The IAEG-SDG classified the indicator as tier II, recognizing the methodology fully stablished into a global approach. The indicator can be disassembled into two concepts: the mountains and the green land cover classes. The mountains are defined as describe by Kapos et al (Kapos et al, 2000), that classify them into six classes considering the slope, altitude and local elevation range. The

LCLU component is classified according to the intergovernmental panel on climate change (IPCC) scheme, which defines six main classes (IPCC, 2006). The land cover classes defining the green component are forests, grassland and cropland. The remaining classes of settlements, wetlands, and otherland, are excluded of the green cover index formula. FAO computed the indicator using Collect Earth tool[14] based on visual interpretation of remote sensing imagery to create a stratified systematic grid sample plots generating LCLU classes.

Meanwhile, three important aspects were addressed to for FAO, in order to access: a) if there was a fixed reference year for the reporting of this indicator, since the identified source for the indicator was COS, which is not updated on a yearly basis; b) if FAO could send us the georeferenced information (shapefile) with the definition of the mountain areas that they have used to implement the indicator; c) if FAO could confirm the number of sample units used for Portugal. From all those questions, it was just replied that no document was available because Collect Earth software is used for several applications, each of them having their own customization. The idea behind that application is that the fields included in the database are intuitive and self-explanatory. For the other questions addressed, it did not reach me any answer. Hence, I needed to deliberate and find GIS mountain data, and posteriorly analyse FAO sample unites. I have decided to produce the indicator with COS 2010 – later I would updated with COS 2015 after discussing the issue with Nuno David at the time of the SDG transitioning to DSOT- as well with CLC 2012 - in order to have data from the Portuguese islands.

[14] Additional information available through: http://www.openforis.org/tools/collect-earth.html

GIS data for mountains was easy to find. I have downloaded it from FAO official website[15]. It is a global vector mountain area map produced in 2015 based on Kapos classification. I clipped the map just to my interest area, continental Portugal, Azores and Madeira island. Then, I noticed that Portugal only had the following mountain classifications: Kapos 4 = elevation of 1 500–2 500 m and slope ≥ 2°; Kapos 5 = elevation of 1 000–1 500 m and slope ≥ 5° or LER (Local Elevation Range in the radius of 7 kilometres) > 300 m; and Kapos 6 = elevation of 300–1 000 m and LER (Local Elevation Range in the radius of 7 kilometres) > 300 m. I had then created three new shapefiles representing each Kapos classification for Portugal (Annex 19). From that data, I was able to make some calculations (Table 5).

Total Area*	
PT region	**Area (km²)**
Continent	89102.14
Madeira	801.51
Azores	2321.96
Total	**92225.61**

*Calculated with CAOP 2016

Total Mountain Area	
PT region	**Area (%)**
Continent	31.22%
Madeira	65.84%
Azores	45.65%
Total	**31.11%**

Mountain area by Class (km²)				
PT region	**K4**	**K5**	**K6**	**Total**
Continent	70.11	1553.20	26198.19	**27821.49**
Madeira	6.50	157.35	364.54	**528.39**
Azores	8.74	22.88	1028.31	**1059.93**
Total	**85.34**	**1733.43**	**27591.04**	**29409.81**

Table 5 – Portuguese mountain area. Source author

[15] Available through: http://www.fao.org/mountain-partnership/our-work/advocacy/2030-agenda-for-sustainable-development/mountain-green-cover-index/data-available-for-validation/en/

For land cover classes, it was necessary a correspondence between IPCC and COS/CLC classification categories. Cristina Igreja, a technician of the geographic information section, made me available that correspondence in a word file. From that information, I reclassified COS and CLC into the six main IPCC categories. With all the materials already collected and processed, I was then able to produce statistics for this indicator, applying national (Annex 20) and European (Annex 21) data products. The production was later updated with COS 2015 (Annex 22).

It was time to understand and study FAO´s indicator application methodology for Portugal. On the same website from where I downloaded GIS mountain data, a CSV file with data for Portugal was also available. The CSV had X and Y coordinate fields and the classification of the land cover category for that analysed plot. From the CSV, I have added the XY coordinates to the map, geolocating the areas of analysis by FAO operators using their software (Annex 23). Surprisingly, none of the points were recorded in both islands, as none was observed in mountain areas with Kapos 4 classification. In fact, when I returned to analyse FAO baseline data, I checked that Kapos 4 classification was non-existent. I wondered how the GIS data used by FAO have Kapos 4 classification for Portugal, yet, FAO analysis did not assume that in the indicator´s production (Annex 24). Their land cover classes analysed were mainly forest classes. Other classes had none or few analysis plots. Also, perchance due to different coordinate reference system, in a total of 107 points analysed for the country, five were found outside of mountain areas and two outside the Portuguese territory. Yet, the points were nearby both locations (mountains and Portugal).

The final indicator production for each data source is showed on Table 6 (Table 6). The index is calculated based on the summation of the green cover classes divided by the total mountain area. The scale is simple: 0 means no green vegetation; 1 indicates that the entire area is covered by vegetation. The methodology summary scheme can be found in the annexes section (annex 25). An additional comparison was made from FAO points classified by the photointerpreter against CLC and COS land reclassification (annex 26). I could understand that the LCLU classification of the FAO points had some accuracy problems when comparing with CLC or COS classes.

COS 2010 Indicator Calculation Method (km²):						**Mountain Green Cover**
PT region	**Cropland**	**Forest**	**Grassland/ Shrubland**	**Total Green Cover Classes**	**Total Mountain Area**	**Index**
Continent	6529.74	12790.63	7135.36	26455.73	27821.49	**0.95**

CLC 2012 Indicator Calculation Method (km²):						**Mountain Green Cover**
PT region	**Cropland**	**Forest**	**Grassland/ Shrubland**	**Total Green Cover Classes**	**Total Mountain Area**	**Index**
Continent	9433.10	12272.75	5188.44	26894.30	27821.49	**0.97**
Madeira	53.23	307.82	113.87	474.93	528.39	**0.90**
Azores	238.17	224.62	508.95	971.74	1059.93	**0.92**
Total	9724.50	12805.19	5811.27	28340.96	29409.81	**0.96**

COS 2015 Indicator Calculation Method (km²):						**Mountain Green Cover**
PT region	**Cropland**	**Forest**	**Grassland/ Shrubland**	**Total Green Cover Classes**	**Total Mountain Area**	**Index**
Continent	6243.23	12598.56	7594.89	26436.68	27821.49	**0.95**

Table 6 – Indicator 15.4.2 Mountain green cover index final calculations applying different data sources. Source: author

The presented work aimed to check the accuracy of FAO´s approach towards indicator 15.4.2 – mountain green cover index, in order to decide for validation of that data. From the carried analysis, we can see that there is a gap on the results and methods considering the application done by FAO and the work I have produced. FAO results differed in all aspects from the calculations that I have made. The mountain area, the Kapos classification and the results are all far from the ones I have computed using COS, CLC, CAOP and the mountains map. I found that FAO´s approach is not so robust as expected considering a local geography. Their methodology can be suitable for a global approach, yet, if better data sources and methodologies are found at a national or regional level, they should be used. CLC have higher green cover index value because its spatial resolution is lower than COS. Therefore, it is more generalized and catches less detailed. However, CLC application was important to access the index and other calculations for both islands. I believe we have conducted this process in the best way. Hence, COS is the dataset that needs to be used to produce this indicator in terms of the land cover component. With COS, I already produced the indicator for two years. We can visualize that even if variations happened in the green cover classes, the index value is the same. This work is now with DSOT, who probably will report those results in order to publish the data. Nevertheless, I would recommend using another mountain GIS data, derivate from the DGT geographic products, such as the digital elevation model (DEM). The global map did not catch some Portuguese mountain areas, due to low spatial resolution.

From this analysis, we conclude and decide that FAO should not publish the base line data for Portugal, as we found their method inaccurate. Oppositely, our approach was more accurate and reliable when comparing both applications. The decision was communicated to FAO by INE´S interlocution. The production of this indicator was only possible using GIS tools. A last remark: I found that this analysis and the indicator application was never done before in Portugal.

7. CONCLUSIONS

This document aims to report the internship accomplished at the national mapping agency. It was from my most interest to produce a compelling structured document, sharing the outcomes from my work and experience at DGT. At the same time, I tried to deliver a holistic lookout of what have been done, how it was done, whom I have contacted, what I found in the starting period, and, what I have produced and left done to DGT, which was fundamentally all the work I was constantly developing and consequently, it is exhibited along the report. In between, the internship thematic subject was deliberated.

My internship at DGT was a remarkable experience. I had the opportunity to meet with key actors from the national geospatial community. By the research I have conducted, it was published a scientific article in a reference journal. Additionally, I was a presenter/panellist in the United Nations World Geospatial Information Congress. If an article production was an academic goal for this internship, I was far from imagine that I could attend to such a congress, one of the biggest geospatial events ever. Those are the two most significant aspects that highlighted and valued my involvement. Even if not necessarily integrally inserted on the report document, the presentation and the article are primary instruments of the achievements from my internship. This internship also reinforced my CV and GIS professional experience.

I took the internship as an open opportunity to learn and upgrade my know-how. At an individual level, I truly believe that I have chosen the most suitable modality comparing with other options to complete my master’s degree, namely the development of a theoretical thesis or a more practical work project. I have improved my GIS capabilities in a practical way, detaining more organized skills for conducted a GIS workflow or project. My research skills and background were also improved with the investigation carried at DGT. I was competent and comfortable in both working alone or together with another member. I have learned a lot with others, mainly with Rita Nicolau and Cristina Garret. And, I have always positively accepted and contributed to different types of work when requested.

Employing COS/CLC, CAOP, and statistical data in a hands-on environment was meaningful because such data sources are constantly needed in GIS applications. Now, I possess supplemental understanding of those sources due to the active operational work using them. Recognizing other data sources for the first time, such as urban atlas, urban morphological zones, urban typology areas, degree of urbanization, functional urban areas, European settlement map or the high resolution layers, was relevant for further exercises in the future. In an internal perspective, it was effectively necessary to learn and to get to know deeply about DGT reality and about their geospatial products. I obtained further geospatial knowledge and another perspective of the urban and territorial reality.

Learning new applications, techniques, and methodologies raised my GIS capabilities. I learnt to apply the dasymetric mapping technique, I worked with raster and vector data models, I made data reclassifications, I acquire information about LCLU products and geospatial and EO initiatives, and I had access to internal restrict geospatial information products. Those are among the topmost benefits from my work period. The direct contact with all this reality was gratifying. Moreover, I upheld a positive and adequately collaboration with INE, representing DGT in the best manner. Attending to several meetings, presenting the advancements of my work, respond to requests and collaborate with UN-GGIM:Europe, certainly had a positive impact on my internship pathway.

The dedicated theorical approach was essential. In fact, I barely heard about SDG before the internship. Now, I have a much vaster knowledge of SDG and other indicators systems rather than before. The possibility to get to know the goals enlarged my commitment to make the world a better place. The internship at DGT had in fact a major importance to my acknowledgment of the international activities willing to leverage geospatial information and EO capacities to contribute for the sustainable development. I retain the idea that there is out there a new opportunity for our community, the GIS community. Thus, I intend to continue with those investigation lines. I have all possibilities to do that, thanks to the period that I spent at DGT.

My work had a good impact on DGT. Some of the work developed was not done before in the mapping agency neither in Portugal. The results were well received internally and externally. I believe that It had a supplementary signification because of the institutional cooperation with INE and with UN-GGIM: Europe, and due to the need to response to the geographic information necessities to produce sustainable indicators. I left for DGT an interesting exercise that they could review and apply to avoid unnecessary efforts. With the work of comparing indicators systems, DGT assures that indicators to be reported will not be repeated in several systems, and, that they will only be produced once. The geospatial indicators from the six analysed systems were crossed matched, and the UN SDG geo indicators benefiting from DGT data input are identified. Also, I left done the production of two important indicators needing a geospatial input: the 11.3.1 Ratio of land consumption rate to population growth rate and the 15.4.2 Mountain green cover index. Both were calculated with a national and a European approach using different datasets and different years of temporal resolution. In the case of 11.3.1, DGT has two implicit methodologies. If desired for other purposes, DGT could use the core information from the disaggregation of mainland resident population produced using LCLU, to integrate other (SDG) indicators. Therefore, I left geospatial information not limited to my applications during the internship, but to DGT, who is able to produce other indicators from that input and work. Apart from that, I left all the support documentation including maps, methodological notes, and guidelines from the tests and completed experiences. It is important to remember that I found the SDG workflow in DGT at its very beginning on the agency. With time, I contributed with my own part for the SDG implementation on the institution.

Overall, I am very satisfied with my period at DGT. Yet, I will mention next some fewer positive aspects. I would had like to implement other SDG indicators. Even if just with a cartographic output production. Also, I was interested to work over other specific indicators, such as the 11.2.1 - proportion of population that has convenient access to public transport, by sex, age and persons with disabilities. At the same extend, I would not mind participating in the production of the REOT and PNPOT geo indicators. Yet, the time was effectively managed to produce the indicators 11.3.1 and 15.4.2. One of the less positive points was the dismissed of one idea and work intention: I have created a general and a geospatial indicators setlist to be considered to measure and monitor the sustainable progress at a national level. I supported the list by investigate other several indicators systems not mentioned on the report, by the support from the literature and presentations which I had consulted, and by my creative and territorial vision. Still, I believe that some of those indicators proposed could be compiling and further accepted for testing, development and validation. I had the inspiration for that idea after questioning Cristina Garret, who gave me a positive feedback, sharing that the "new" indicators eventually could become object of interesting for the SDG itself. Finally, I had the wish to employ similar activities that are being developed and recommended by international activities and, at some point, I was interested to use EO for my work. In a non-individual perspective, a late action was to involve Nuno David on the SDG framework, which was done in the ending time of my internship. The SDG workflow would benefit even more if I could have worked together with a person from DSOT, in this case, with Nuno. From another perspective, DGT could suggest and discuss to INE the creation of a geoportal, a WEBGIS platform or a specific module in the national spatial data infrastructure (NSDI). Several nations have an SDG hub. Even countries with less resources. I think it makes sense to have a national SDG portal with geographic information and representation. The only SDG monitoring website can be found at INE official website. It is purely statistical, and It lacks a geographic approach. I have tried to do something related with that issue, bringing the discussion to start to implement the idea, but I did not have success. Another aspect is that, in my view, the creation of national SDG indicators setlist should be a priority. It would be necessary to involve all key actors, such as governmental agencies, data producers and universities. Maybe even follow the same approach that I have conducted, harmonizing indicators systems to understand which indicators already under production would be suitable to integrate a national SDG indicator system. Also, indicators from Tier I could already be methodological reviewed, produced and calculated considering spatial disaggregation and other geospatial issues. Altogether, the SDG implementation and monitoring processes would be leveraged if this would be taken into consideration.

At the end of the day, my geospatial knowledge is far enhanced by the internship. Learning from experts considerable upgraded my GIS competences. And for that, I am sincerely grateful to DGT, which gave me an opportunity and contributed for my growing process.

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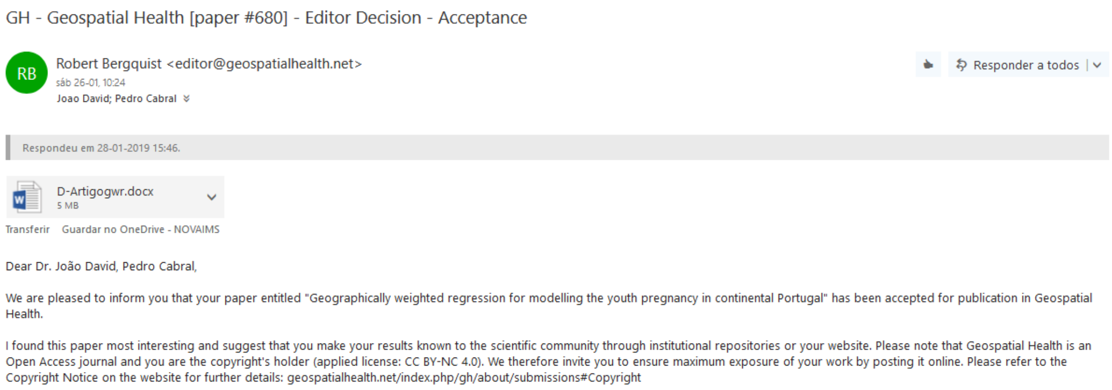
ANNEXES

Annex 1 – Proof of acceptance of the manuscript to be published in Geospatial Health journal


GH - Geospatial Health [paper #680] - Editor Decision - Acceptance

RB Robert Bergquist <editor@geospatialhealth.net>
sáb 26-01, 10:24
Joao David; Pedro Cabral

Responder a todos

Respondeu em 28-01-2019 15:46.

D-Artigogwr.docx
5 MB

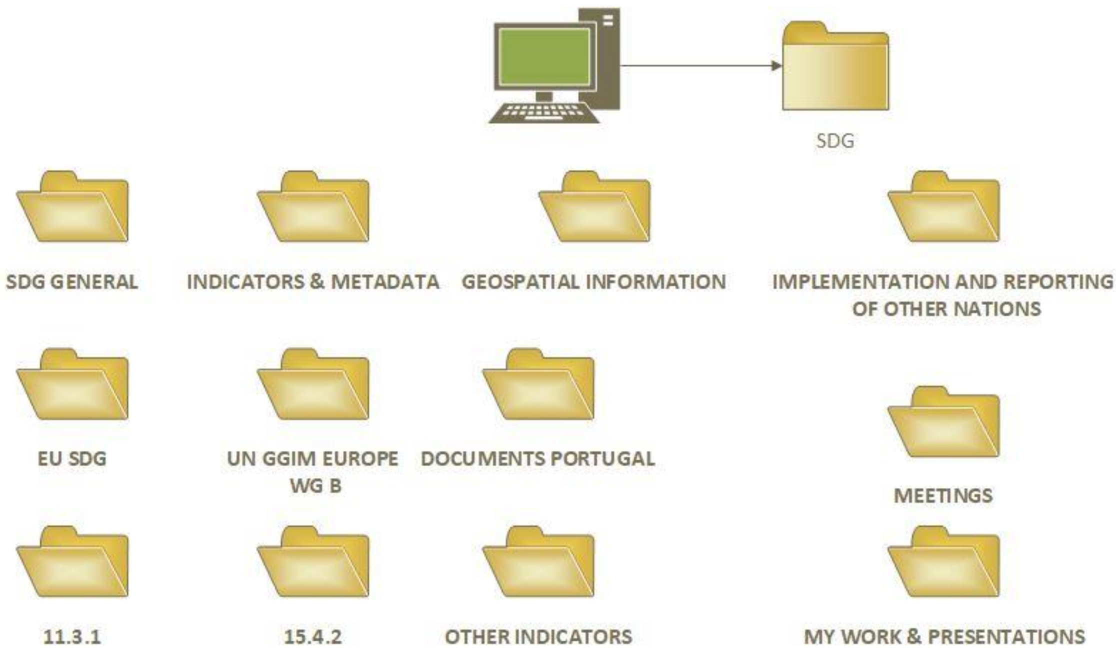
Transferir Guardar no OneDrive - NOVAIMS

Dear Dr. João David, Pedro Cabral,

We are pleased to inform you that your paper entitled "Geographically weighted regression for modelling the youth pregnancy in continental Portugal" has been accepted for publication in Geospatial Health.

I found this paper most interesting and suggest that you make your results known to the scientific community through institutional repositories or your website. Please note that Geospatial Health is an Open Access journal and you are the copyright's holder (applied license: CC BY-NC 4.0). We therefore invite you to ensure maximum exposure of your work by posting it online. Please refer to the Copyright Notice on the website for further details: geospatialhealth.net/index.php/gh/about/submissions#Copyright

Annex 2 – SDG desktop folder organization



Annex 3 – Side work done for DSOT

National Level						
SOURCE	**INDICATOR DEFINITION**	**METHODOLOGY**	**DATASETS**	**DATA RESOLUTION**	**DATA COVERAGE**	**REFERENCES**
DGT/INE	Urban land use (%)	Land classified as urban / total area	Directorate-General for Territory: Planned Land Use Map (CRUS) Official Portuguese Administrative Map (CAOP)		National	Statistical Council, Portugal 2020 Context and Result Indicator System (GT PT2020) (June 2016)
	Urban land use density	Present population / Land classified as urban	Directorate-General for Territory: Planned Land Use Map (CRUS) Official Portuguese Administrative Map (CAOP) Statistics Portugal (INE): Census Population data		National	
	Change of artificial territory areas	% of change of artificial territory area by municipality taking into account the initial and last referenced years	Land Use Land Cover Map (COS) COS is a vector data model national product under the responsibility of the Directorate-General for Territory (NMCA Portugal) and corresponds to polygonal maps that represent homogenous land use/cover units.	The reference mapping unit corresponds to 1 hectare, with a defined distance between lines equal or higher than 20 meters and a percentage equal or higher than 75% of a given land use/cover thematic class.	National (Continental) Data series of COS is available for t reference years – 1995, 2007,2010. COS 2015 is currently under production.	National Spatial Development Policy Program (PNPOT, 2018) (Diagnosis Document, currently under development, 20 September 2017)
	Percentage of land use classified as artificial territories		COS 2010	The reference mapping unit corresponds to 1 hectare, with a defined distance between lines equal or higher than 20 meters and a percentage equal or higher than 75% of a given land use/cover thematic class.	National (Continental)	National Spatial Development Policy Program (PNPOT, 2018) (Diagnosis Document, currently under development, 20 September 2017)
	Ratio of land consumption rate to population growth rate	Currently testing the implementation of this indicator by following the UN SDG metadata with some adaptations Some other indicators may derivate from this one (e.g. Total of urban expansion in km^2)	COS 1995-2007-2010 CLC 1990-2000-2006-2012	The reference mapping unit corresponds to 1 hectare, with a defined distance between lines equal or higher than 20 meters and a percentage equal or higher than 75% of a given land use/cover thematic class.	COS - National (Continental) CLC – National	

Annex 4 – SDG Geo-indicators Excel file list

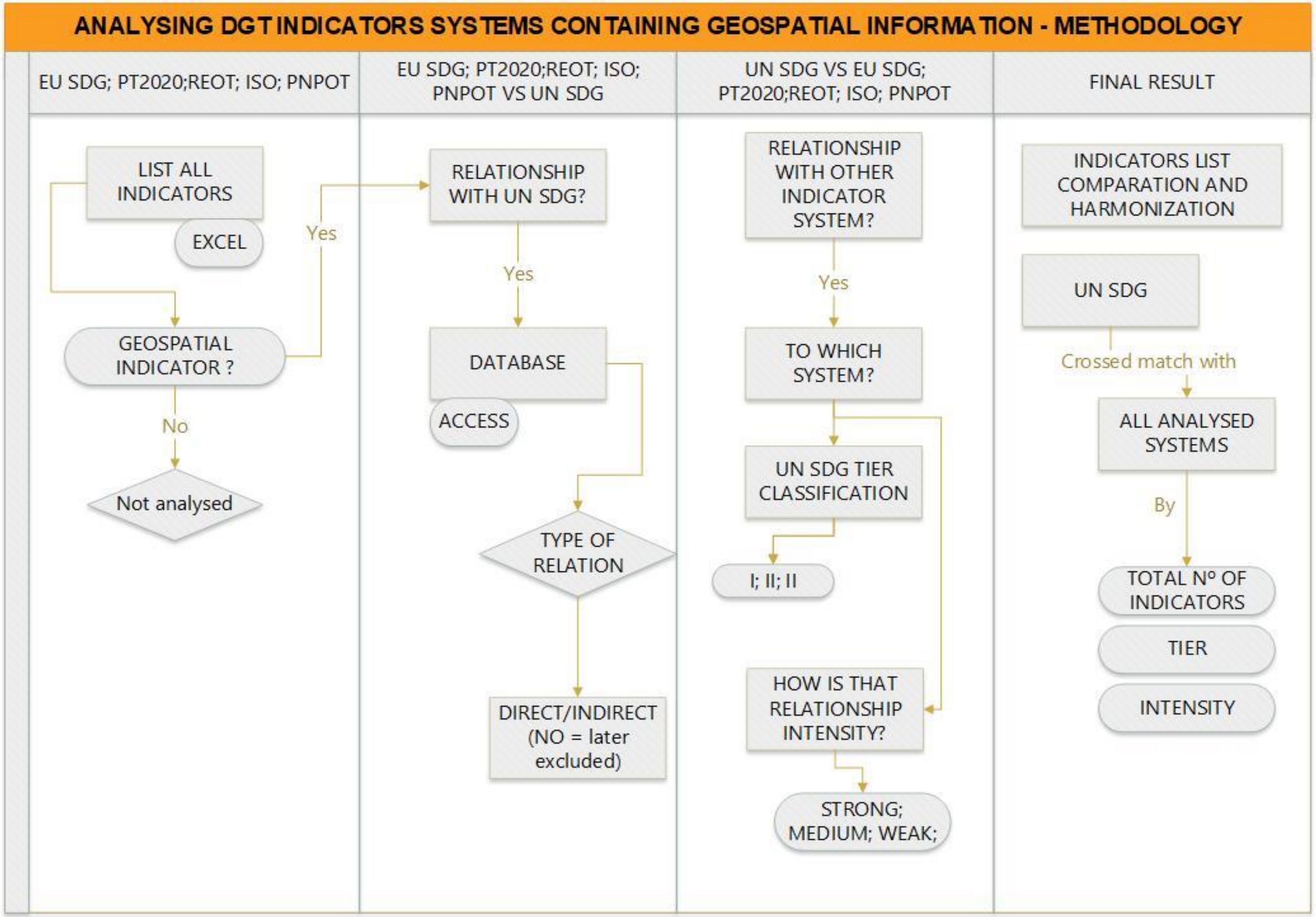
IND.	TIER	NAME	GI CONTRIBUTION	IDENTIFIED BY:	OBSERVATIONS	INE DATA (by 18/10/17)
1.1.1	I	Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)	Indirect: "geographical location (urban/rural)"	- IAEG SDG WG GI	GI or/and EO can significantly support the production of this indicator	
1.4.2	II	Proportion of total adult population with secure tenure rights to land, (a) with legally recognized documentation, and (b) who perceive their rights to land as secure, by sex and type of tenure	Indirect: "their rights to land" ; "type of tenure"	- IAEG SDG WG GI - GEO		
2.1.1.	I	Prevalence of undernourishment		-ESRI		
2.3.1	III	Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size		-ESRI		
2.4.1	III	Proportion of agricultural area under productive and sustainable agriculture	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	Proportion of agricultural area with organic farming (%) by Geographic localization (NUTS - 2013); Irregular
3.3.1	II	Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations		- UN-GGIM Academic Network		Incidence rate of notified cases of HIV per 1000 inhabitants (No.) by Sex; Annual
3.3.2	I	Tuberculosis incidence per 100,000 population		- UN-GGIM Academic Network		Incidence rate of notified cases of tuberculosis per 100 000 inhabitants (No.) by Place of residence (NUTS - 2013) and Sex; Annual
3.3.3	I	Malaria incidence per 1,000 population		- UN-GGIM Academic Network		Incidence rate of notified cases of malaria per 1000 inhabitants (No.) by Place of residence (NUTS - 2013) and Sex; Annual
3.3.4	II	Hepatitis B incidence per 100,000 population		- UN-GGIM Academic Network		Incidence rate of notified cases of hepatitis B per 100 000 inhabitants (No.) by Place of residence (NUTS - 2013) and Sex; Annual
3.9.1	I	Mortality rate attributed to household and ambient air pollution		-GEO		SDG Indicators Global Database - Portugal
3.9.2	I	Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)		- UN-GGIM Academic Network		SDG Indicators Global Database - Portugal
4.5.1	MT	Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated	Indirect: "rural/urban"	- IAEG SDG WG GI	GI or/and EO can significantly support the production of this indicator	
4.7.1	III	Extent to which (i)global citizenship education and (ii)education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in (a)national education policies; (b)curricula; (c)teacher education; and (d)student assessment		- UN-GGIM Academic Network		
5.2.2	II	Proportion of women and girls aged 15years and older subjected to sexual violence by persons other than anintimate partner in the previous 12months, by age and place of occurrence	Indirect: "place of occurrence"	- IAEG SDG WG GI	GI or/and EO can significantly support the production of this indicator	
5.4.1	II	Proportion of time spent on unpaid domestic and care work, by sex, age and location	Indirect: "location"	- IAEG SDG WG GI	GI or/and EO can significantly support the production of this indicator	
5.a.1	II	(a)Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b)share of women among owners or rights-bearers of agricultural land, by type of tenure	Indirect: "agricultural land"	- IAEG SDG WG GI - GEO	GI or/and EO can significantly support the production of this indicator	1. Proportion of managers with owner farming type of tenure (UAA) on the agricultural population (%) by Geographic localization (NUTS - 2013); Irregular 2. Proportion of women in total managers with owner farming type of tenure (UAA) (%) by Geographic localization (NUTS - 2013); Irregular
5.a.2	II	Proportion of countries where the legal framework (including customary law) guarantees women's equal rights to land ownership and/or control	Indirect: "land ownership"	- IAEG SDG WG GI		

IND.	NAME	GI CONTRIBUTION	IDENTIFIED BY:	OBSERVATIONS	INE DATA (by 18/10/17)
6.1.1	Proportion of population using safely managed drinking water services		- UN-GGIM Academic Network		Population served by public water supply systems (Series 2006-2009 - %) by Geographic localization (NUTS - 2001); Annual
6.3.1	Proportion of wastewater safely treated		-GEO		Proportion of wastewater treated (Series 2006-2009 - %) by Geographic localization (NUTS - 2002); Annual
6.3.2	Proportion of bodies of water with good ambient water quality	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	Proportion of surface water bodies (%) by Geographic localization (NUTS - 2013) and Classification of chemical status; Triennial
6.4.2	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources		-GEO		
6.5.1	Degree of integrated water resources management implementation (0–100)		-GEO		
6.5.2	Proportion of transboundary basin area with an operational arrangement for water cooperation	Direct	- IAEG SDG WG GI	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
6.6.1	Change in the extent of water-related ecosystems over time	Direct	- IAEG SDG WG GI - GEO - INE / DGT	Discuss methodology and relevance with other PT institutions (lead by INE) Pilot project in the Copernicus implementation program GI or/and EO integrated with SI can directly contribute for the production of this indicator	
7.1.1	Proportion of population with access to electricity		-GEO		SDG Indicators Global Database - Portugal
7.1.2	Proportion of population with primary reliance on clean fuels and technology		- UN-GGIM Academic Network		SDG Indicators Global Database - Portugal
7.2.1	Renewable energy share in the total final energy consumption		- UN-GGIM Academic Network		Share of renewable in gross final electricity consumption (%) by Type of renewable energy; Annual (2)
8.3.1	Proportion of informal employment in non-agriculture employment, by sex		- INEGI Mexico		
8.4.1	Material footprint, material footprint per capita, and material footprint per GDP		- UN-GGIM Academic Network	Repeated indicator (12.2.1)	SDG Indicators Global Database - Portugal
9.1.1	Proportion of the rural population who live within 2km of an all-season road	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
9.4.1	CO2 emission per unit of value added		-GEO		CO2 emission per unit of value added (Kg CO2/ €); Annual
9.c.1	Proportion of population covered by a mobile network, by technology	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
10.7.2	Number of countries that have implemented well-managed migration policies		- UN-GGIM Academic Network		
11.1.1	Proportion of urban population living in slums, informal settlements or inadequate housing		-GEO		

IND.	NAME	GI CONTRIBUTION	IDENTIFIED BY:	OBSERVATIONS	INE DATA (by 18/10/17)
11.2.1	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
11.3.1	Ratio of land consumption rate to population growth rate	Direct	- IAEG SDG WG GI - GEO - INE / DGT	Reference indicator for INE and UN GGIM WG B SB 2 in a direct articulation with DGT GI or/and EO integrated with SI can directly contribute for the production of this indicator	
11.3.2	Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically		- INE / DGT	Excluded from DGT working plans. DGT needs to present to INE a technical note justifying and explaining the reasons	
11.5.2	Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters		- UN-GGIM Academic Network		SDG Indicators Global Database - Portugal
11.6.1	Proportion of urban solid waste regularly collected and with adequatefinal discharge out of total urban solid waste generated, by cities		- UN-GGIM Academic Network		Urban waste collected (t) by Geographic localization (NUTS - 2013), Type of collection and Kind of destination (waste); Annual (3)
11.6.2	Annual mean levels of fine particulate matter (e.g.PM2.5 and PM10) in cities (population weighted)		- IAEG SDG WG GI - GEO		
11.7.1	Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
11.7.2	Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months	Indirect: "place of occurrence"	- IAEG SDG WG GI		European Union Agency for Fundamental Rights - Violence against women survey
11.a.1	Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city		- INE / DGT	Excluded from DGT working plans. DGT needs to present to INE a technical note justifying and explaining the reasons	
12.4.2	Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment		- UN-GGIM Academic Network		
12.a.1	Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies		-GEO		
13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population		-GEO	Repeated indicator (1.5.1 and 11.5.1)	UN Office for Disaster Risk Reduction - indicators for Portugal
13.1.2	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030		- UN-GGIM Academic Network	Repeated indicator (1.5.3 and 11.b.1)	
14.1.1	Index of coastal eutrophication and floating plastic debris density		- UN-GGIM Academic Network		
14.2.1	Proportion of national exclusive economic zones managed using ecosystem-based approaches	Direct	- IAEG SDG WG GI	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
14.3.1	Average marine acidity (pH) measured at agreed suite of representative sampling stations		-GEO		

IND.	NAME	GI CONTRIBUTION	IDENTIFIED BY:	OBSERVATIONS	INE DATA (by 18/10/17)
14.4.1	Proportion of fish stocks within biologically sustainable levels		-GEO		
14.5.1	Coverage of protected areas in relation to marine areas	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	Protected areas (ha) by Geographic localization (NUTS - 2013) and Type of protected area; Annual (3)
15.1.1	Forest area as a proportion of total land area	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	Proportion of forest area (%) by Geographic localization (NUTS - 2013); Decennial
15.1.2	Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	Direct	- IAEG SDG WG GI	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
15.2.1	Progress towards sustainable forest management		-GEO		
15.3.1	Proportion of land that is degraded over total land area	Direct	- IAEG SDG WG GI - GEO - INE / DGT	Needs articulation from several other PT institutions regarding "degraded land" concept from the metadata GI or/and EO integrated with SI can directly contribute for the production of this indicator	
15.4.1	Coverage by protected areas of important sites for mountain biodiversity	Direct	- IAEG SDG WG GI - GEO	GI or/and EO integrated with SI can directly contribute for the production of this indicator	
15.4.2	Mountain Green Cover Index	Indirect: "Mountain Green Cover "	- GEO - INE /DGT	GI or/and EO can significantly support the production of this indicator DGT needs to study COS as datasource for this indicator	
16.7.2	Proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group		- UN-GGIM Academic Network		
17.6.1	Number of science and/or technology cooperation agreements and programmes between countries, by type of cooperation		-GEO		
17.8.1	Proportion of individuals using the Internet		-GEO		Persons aged between 16 and 74 years old using Internet in the first 3 months of the year per 1000 inhabitants (No.); Annual (2)

Annex 5 – Summary of the applied methodology for analysing DGT indicators systems containing geospatial information



Annex 6 – Analysed indicators systems (by order: PT2020; ISO; PNPOT; REOT; EU)

	INDICADOR PT2020	RELAÇ	INDICADOR SDG	COMENTÁRIO
1	Proporção da população residente em aglomerados urbanos >ou= 50.000 residentes	NÃO		
2	Proporção dos territórios de baixa conectivida	SIM	9.1.1 Proporção de população residente em áreas rurais que vive num raio de 2 km de acesso a uma estrada transitável em todas as estações do ano; 11.2.1 Proporção de população residente com acesso adequado a transportes públicos, por sexo, idade e população com deficiência	SDG 9.1.1 reflete sobre as áreas rurais, a população e rede viária; SDG 11.2.1 engloba já a população e os transportes mais a nível urbano
3	Densidade populacional do solo urbano	NÃO		
4	Densidade de utilização do solo urbano	SIM	11.3.1 Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	Designação com dúvida (segundo o doc. PT2020); O 11.3.1 tem a variável do "consumo do solo" que pode relacionar-se com a "utilização do solo urbano" do PT2020
5	Solo urbano (%)	NÃO		
6	População residente em solo urbano (%)	NÃO		SDG 11.1.1 "Proporção de população residente em áreas urbanas que vive em alojamentos não clássicos ou em alojamentos com falta de condições de habitação" diz qual a proporção de população residente em áreas urbana mas refere-se apenas à população que tem falta de condições de habitação (no entanto nesse indicador é possível saber a % da população residente em solo urbano)

#	SECÇÃO	ELAÇ	INDICADOR ISO 37120	INDICADOR SDG
1	Economia	SIM	Taxa de risco de pobreza, após transferências sociais	**1.1.1** Proporção da população cujo rendimento equivalente se encontra abaixo da linha de pobreza internacional, por sexo, grupo etário, condição perante o trabalho e grau de urbanização
2	Educação	NÃO		
3	Energia	SIM	Percentagem de energia total proveniente de fontes renováveis, como uma quota do consumo total de energia da cidade	**7.2.1** Peso das energias renováveis no consumo total final de energia (dados proxy)
4	Energia	SIM	Percentagem da população da cidade com serviço de eletricidade autorizado	**7.1.1** Percentagem da população com acesso à eletricidade
5	Ambiente	SIM	Concentração de partículas finas (PM2,5); Concentração de partículas (PM10)	**11.6.2** Nível médio anual de partículas inaláveis (ex: com diâmetro inferior a 2,5 µm e 10
6	Finanças	NÃO		
7	Resposta a incêndios e a emerge	SIM	Número de mortes relacionadas com catástrofes naturais por 100 000 habitantes	**13.1.1** Número de pessoas falecidas, pessoas desaparecidas e pessoas diretamente afetadas devido a desastres por 100 mil habitantes (dados proxy)
8	Governança	NÃO		
9	Saúde	NÃO		
10	Recreio	SIM	Área de espaços de recreio de utilização coletiva ao ar livre per capita	**11.7.1** Proporção de espaço aberto para uso público nas cidades para o total da população, por sexo, idade e população com deficiência
11	Segurança	NÃO		
12	Alojamento	SIM	Percentagem da população da cidade a viver em barracas	**11.1.1** Proporção de população residente em áreas urbanas que vive em alojamentos não clássicos ou em alojamentos com falta de condições de habitação
13	Resíduos	Determin	Percentagem de população da cidade com recolha regular de resíduos urbanos	**11.6.1** Proporção de resíduos sólidos urbanos regularmente coletados e com descarga final adequada no total de resíduos sólidos urbanos gerados, por cidades (dados proxy)
14	Resíduos	SIM	Percentagem de resíduos perigosos per capita	**12.4.2** Quantidade de resíduos perigosos gerados per capita e proporção de resíduos perigosos tratados, por tipo de tratamento
15	Resíduos	SIM	Percentagem de resíduos urbanos reciclados Percentagem de resíduos urbanos depositados em aterros Percentagem de resíduos urbanos incinerados	**11.6.1** Proporção de resíduos sólidos urbanos regularmente coletados e com descarga final adequada no total de resíduos sólidos urbanos gerados, por cidades (dados proxy)

	FIGURA	RELAÇÃ(
13	Áreas Protegidas e Rede Natura 2000 do Continente e Região Autónoma dos Açores e das Áreas Protegidas e Classificadas da Região Autónoma da Madeira	SIM
14	Peso por freguesia da superfície territorial que está sujeita à condicionalidade da PAC	NÃO
15	Susceptibilidade à desertificação	Determinar
17	Classificação do estado ecológico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	SIM
18	Classificação do estado químico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	SIM
19	Classificação do estado quantitativo das massas de água subterrâneas, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal continental	NÃO
20	Classificação do estado químico das massas de água subterrâneas, no 2º ciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	SIM
21	Identificação e localização das 22 Zonas Críticas e respetivos cursos de água, por RH, selecionadas para a elaboração da cartografia e dos PGRI	NÃO
22	Troços da linha de costa em situação de erosão (período 1958-2000)	NÃO
23	Áreas potenciais relativas aos principais recursos minerais e nacionais: a) Minerais metálicos e, b) Minerais não metálicos	NÃO
24	SAU por habitante; SAU por exploração; SAU por ocupação (culturas permanentes; culturas temporárias e prados e pastagens permanentes)	Determinar

DOMÍNIOS TEMÁTICOS TERRITORIAIS	RELAÇÃO	INDICADOR SDG	COMENTÁRIO
População,povoamento e sistema urbano	SIM	**1.1.1** Proporção da população cujo rendimento equivalente se encontra abaixo da linha de pobreza internacional, por sexo, grupo etário, condição perante o trabalho e grau de urbanização; **11.1.1** Proporção de população residente em áreas urbanas que vive em alojamentos não clássicos ou em alojamentos com falta de condições de habitação; **11.3.1** Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	
Equipamentos de utilização coletiva, infraestruturas (territoriais e urbanas)	SIM	**3.9.2** Taxa de mortalidade atribuída a fontes de água insalubres e a condições de saneamento e de higiene débeis ou inexistentes (acesso inadequado a serviços de saneamento de águas residuais); **6.1.1** Proporção da população que utiliza serviços de água potável (dados proxy); **6.3.1** Proporção de águas residuais sujeitas a tratamento (dados proxy); **6.5.1** Grau de implementação da gestão integrada de recursos hídricos (0-100); **7.1.1** Percentagem da população com acesso à eletricidade; **9.1.1** Proporção de população residente em áreas rurais que vive num raio de 2 km de acesso a uma estrada transitável em todas as estações do ano; **9.c.1** Proporção da população coberta por rede móvel, por tipo de tecnologia; **11.2.1** Proporção de população residente com acesso adequado a tansportes públicos, por sexo, idade e população com deficiência; **11.6.1** Proporção de resíduos sólidos urbanos regularmente coletados e com descarga final adequada no total de resíduos sólidos urbanos gerados, por cidades (dados proxy); **17.8.1** Proporção de indivíduos que utilizam a Internet	
Sistema de gestão territorial	SIM	**11.a.1** Proporção de população residente em cidades que implementam planos de desenvolvimento urbano e regional que incluem projeções de população e avaliação de recursos, por dimensão da cidade; **11.3.2** Proporção de cidades com uma estrutura de participação direta da sociedade civil no planeamento e gestão urbana que opera de forma regular e democrática; **13.1.2** Número de paises que adotaram e implementaram estratégias nacionais de redução de risco de desastres em linha com o Quadro de Sendai para a Redução de Risco de Desastres 2015-2030; **16.7.2** Proporção da população que considera que os processos de tomada de decisão são inclusivos e adequados, por sexo, grupo etário, incapacidade e grupo populacional	
Regime de uso do solo vs ocupação do solo	SIM	**2.4.1** Proporção da SAU afeta a práticas agrícolas produtivas e sustentáveis (dados proxy) **5.a.1** (a) Proporção da população agrícola proprietária ou com direitos de posse das terras agrícolas, por sexo; e (b) proporção de mulheres entre os proprietários ou detentores de direitos de posse das terras agrícolas, por forma de exploração das terras agrícolas (dados proxy) **11.3.1** Rácio entre a taxa de consumo do solo e a taxa de crescimento da população **11.7.1** Proporção de espaço aberto para uso público nas cidades para o total da população, por sexo, idade e população com deficiência **14.5.1** Cobertura de áreas marinhas protegidas relativamente às áreas marinhas (dados proxy) **15.1.1** Proporção do território que é área florestal **15.2.1** Progressos para a gestão florestal sustentável **15.3.1** Proporção do território com solos degradados **15.4.1** Sítios importantes para a biodiversidade de montanha cobertos por áreas protegidas **15.4.2** Índice do coberto vegetal das regiões de montanha	14.5.1 / 15.2.1 / 15.4.1 - "Regime de uso do solo vs ocupação do solo" e/ou "Riscos e alterações climáticas" ?
Riscos e alterações climáticas	SIM	**3.9.1** Taxa de mortalidade atribuída a poluição ambiente e doméstica do ar; **6.3.2** Proporção de massas de água com boa qualidade ambiental (dados proxy); **6.4.2** Nível de stress hídrico: proporção das descargas de água doce no total dos recursos de água doce disponíveis; **6.6.1** Alteração na extensão dos ecossistemas aquáticos ao longo do tempo; **7.1.2** Percentagem da população com acesso primário a combustíveis e tecnologias limpas; **7.2.1** Peso das energias renováveis no consumo total final de energia (dados proxy); **8.4.1** Pegada material, pegada material per capita e pegada material em percentagem do PIB; **9.4.1** Emissão de CO2 por unidade de valor acrescentado; **11.6.1** Proporção de resíduos sólidos urbanos regularmente coletados e com descarga final adequada no total de resíduos sólidos urbanos gerados, por cidades (dados proxy); **11.6.2** Nível médio anual de partículas inaláveis (ex: com diâmetro inferior a 2,5 µm e 10 µm) nas cidades (população ponderada); **13.1.1** Número de pessoas falecidas, pessoas desaparecidas e pessoas diretamente afetadas devido a desastres por 100 mil habitantes (dados proxy); 14.1.1 Índice de eutrofização das águas costeiras e índice de densidade de resíduos plásticos flutuantes; **14.2.1** Percentagem da Zona Económica Exclusiva nacional gerida através de abordagens ecossistémicas; **14.3.1** Acidificação do oceano (pH médio) medida num conjunto representativo de estações de amostragem;	Existem indicadores que não estão diretamente relacionados com este domínio, mas aos quais sugere-se incluir como temática ambiental (ex: 14.2.1; 15.1.2 etc.)

Nº	SDG	INDICADOR EU SDG	RELAÇÃO	INDICADOR SDG
01.11	1	People at risk of poverty or social exclusion	SIM	1.1.1 Proporção da população cujo rendimento equivalente se encontra abaixo da linha de pobreza internacional, por sexo, grupo etário, condição perante o tr
01.22	1	Share of total population living in a dwelling with a leaking roof, damp wal	Determinar	
02.31	2	Area under organic farming	SIM	2.4.1 Proporção da SAU afeta a práticas agrícolas produtivas e sustentáveis (dados proxy)
05.33	5	Physical and sexual violence by a partner or a non-partner	SIM	5.2.2 Proporção de mulheres e raparigas de 15 anos ou mais que foram objeto de violência sexual por outras pessoas que não parceiras íntimas nos últimos 1
06.11	6	Share of total population having neither a bath, nor a shower, nor indoor flu	Determinar	
06.13	6	Population connected to urban wastewater treatment with at least seconda	Determinar	6.1.1 Proporção da população que utiliza serviços de água potável (dados proxy) 6.3.1 Proporção de águas residuais sujeitas a tratamento (dados proxy);
07.10	7	Percentage of people affected by fuel poverty (inability to keep home adequ	Determinar	
07.20	7	Share of renewable energy in gross final energy consumption	SIM	7.2.1 Peso das energias renováveis no consumo total final de energia (dados proxy)
10.31	10	Number of first time asylum applications (total and accepted) per capita	Determinar	10.7.2 Número de países que implementaram políticas de migração bem geridas
11.21	11	Distribution of population by level of difficulty in accessing public transport	SIM	11.2.1 Proporção de população residente com acesso adequado a transportes públicos, por sexo, idade e população com deficiência
11.31	11	Urban population exposure to air pollution by particulate matter	SIM	11.6.2 Nível médio anual de partículas inaláveis (ex: com diâmetro inferior a 2,5 µm e 10 µm) nas cidades (população ponderada)
13.11	13	Greenhouse gas emissions (indexed totals and per capita)	SIM	9.4.1 Emissão de CO2 por unidade de valor acrescentado
13.45	13	Economic losses caused by climate extremes (consider climatological, hydro	SIM	11.5.2 Perdas económicas diretas em relação ao PIB, incluindo danos causados por desastres em infraestruturas críticas e na interrupção de serviços básicos (

Annex 7 – EU SDG vs UN SDG

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5_SDG_EU

SDG_RELAÇÕES

5_SDG_EU

	SDG_EU_	EU_SDG_INDICADOR_NOME	RELAÇÃC	COMENTÁRIO
1	01.11	People at risk of poverty or social exclusion	Indirecta	Por causa das unidades distintas
2	01.22	Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor	SIM	Indicador UN SDG 11.1.1 "Proporção de população residente em áreas urbanas que vive em alojamentos não clá
3	02.31	Area under organic farming	Indirecta	Por causa das unidades distintas
4	05.33	Physical and sexual violence by a partner or a non-partner	Indirecta	Inclui ambos os sexos. O SDG refere-se apenas a mulheres e raparigas. os indicadores apresentam unidades e u
5	06.11	Share of total population having neither a bath, nor a shower, nor indoor flushing toilet in their household	Indirecta	Indicador UN SDG 11.1.1 "Proporção de população residente em áreas urbanas que vive em alojamentos não clá
6	06.13	Population connected to urban wastewater treatment with at least secondary treatment	Indirecta	Estes dois indicadores UN SDG podem relacionar-se com o indicador EU SDG
7	07.10	Percentage of people affected by fuel poverty (inability to keep home adequately warm)	Indirecta	Indicador UN SDG 11.1.1 "Proporção de população residente em áreas urbanas que vive em alojamentos não clá
8	07.20	Share of renewable energy in gross final energy consumption	SIM	
9	10.31	Number of first time asylum applications (total and accepted) per capita	Indirecta	O EU SDG pode ser relfetido no UN SDG 10.7.2
10	11.21	Distribution of population by level of difficulty in accessing public transport	NÃO	O indicador UN SDG 9.1.1 "Proporção de população residente em áreas rurais que vive num raio de 2 km de aces
11	11.31	Urban population exposure to air pollution by particulate matter	Indirecta	As unidades deste indicador são nº habitantes. Relativamente ao SDG 11.6.2 falta calcular a população exposta a
12	13.11	Greenhouse gas emissions (indexed totals and per capita)	SIM?	UN SDG pode ser uma das variáveis que o indicador EU SDG procura quantificar
13	13.45	Economic losses caused by climate extremes (consider climatological, hydrological, meteorological)	Indirecta	Unidades distintas? O SDG 11.5.2 é relativo ao PIB e este indicador é geral
14	14.21	Sufficiency of marine sites designated under the EU habitats directive	SIM?	O que quantifica sufficiency? 3 Indicadores UN SDG relacionam-se com este indicador EU SDG
15	14.31	Ocean acidification (CLIM 043)	SIM	
16	14.43	Assessed fish stocks exceeding fishing mortality at maximum sustainable yield (Fmsy)	Indirecta	
17	15.11	Forest area as a proportion of total land area	SIM	
18	15.21	Artificial land cover per capita	Indirecta	Este indicador é apenas relativo a uma instância temporal, enquanto que o SDG 11.3.1 é relativo a duas instânci
19	15.24	Change in artificial land cover per year	Indirecta	Este indicador inclui apenas o numerador do SDG 11.3.1
20	15.32	Sufficiency of terrestrial sites designated under the EU habitats directive	SIM?	O que quantifica sufficiency? Apenas 2 dos indicadores UN SDG se relacionam com este indicador EU SDG
21	16.50	Corruption Perception Index	Indirecta	
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5_SDG_EU

SDG_RELAÇÕES

5_SDG_EU

	SDG_EU_	EU_SDG_INDICADOR_NOME	RELAÇÃC	COMENTÁRIO
8	07.20	Share of renewable energy in gross final energy consumption	SIM	

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
27	7.2.1	Peso das energias renováveis no consumo total final de energia (dados proxy)	I			
#####						

	SDG_EU_	EU_SDG_INDICADOR_NOME	RELAÇÃC	COMENTÁRIO
12	13.11	Greenhouse gas emissions (indexed totals and per capita)	SIM?	UN SDG pode ser uma das variáveis que o indicador EU SDG procura quantificar

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
31	9.4.1	Emissão de CO2 por unidade de valor acrescentado	I			
#####						

	SDG_EU_	EU_SDG_INDICADOR_NOME	RELAÇÃC	COMENTÁRIO
14	14.21	Sufficiency of marine sites designated under the EU habitats directive	SIM?	O que quantifica sufficiency? 3 Indicadores UN SDG relacionam-se com este indicador EU SDG

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
52	14.5.1	Cobertura de áreas marinhas protegidas relativamente às áreas marinhas (dados proxy)	I	?		
54	15.1.2	Proporção de sítios importantes para a biodiversidade terrestre e de água doce cobertos por áreas protegidas, por tipo de ecossistema	I	?		
57	15.4.1	Sítios importantes para a biodiversidade de montanha cobertos por áreas protegidas	II	Indirecta		
#####						

	SDG_EU_	EU_SDG_INDICADOR_NOME	RELAÇÃC	COMENTÁRIO
15	14.31	Ocean acidification (CLIM 043)	SIM	

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
50	14.3.1	Acidificação do oceano (pH médio) medida num conjunto representativo de estações de amostragem	III			
#####						

Annex 8 – PNPOT vs UN SDG

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3_PNPOT
SDG_RELAÇÕES

3_PNPOT | SDG_RELAÇÕES

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
1	13	Áreas Protegidas e Rede Natura 2000 do Continente e Região Autónoma dos Açores e das Áreas Protegidas e Classificadas da Região Autónoma da Madeira	Indirecta	O indicador PNPOT é expresso em termos absoluto
2	15	Susceptibilidade à desertificação	Indirecta	O indicador mais ajustado é o indice de aridez
3	17	Classificação do estado ecológico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado ecológi
4	18	Classificação do estado químico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado quimico
5	20	Classificação do estado químico das massas de água subterrâneas, no 2º ciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado quimico
6	24	SAU por habitante; SAU por exploração; SAU por ocupação (culturas permanentes; culturas temporárias e prados e pastagens permanentes)	Indirecta: Desagregar em 5? Indicadores	Estes indicadores potencialmente podem relaciona
7	25	Territórios ocupados com floresta e identificação das áreas sujeitas a regime florestal e integrados em ZIF	Desagregar em 3? Indicadores	Indicador também presente na figura 63 do diagnós
8	44	Níveis de acessibilidade	Indirecta: Desagregar em 2 Indicadores	O indicador PNPOT mais ajustado é "Tempos de ace
9	46	Distribuição geográfica da penetração de acessos residenciais à Internet em banda larga	Indirecta	No indicador PNPOT a entidade contabilizada são u
10	63	Percentagem de uso do solo, de território artificializado, agricultura, sobro e floresta, em 2010	Desagregar em 4 Indicadores	Desagregado, obtém-se o que o SDG 15.1.1 pretend
11	64	Variação das áreas dos territórios artificilizados, agrícolas, agrícolas-florestais e florestais (1995-2010)	Indirecta	O indicador PNPOT só é representativo do numera
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All Access Obje...
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3_PNPOT
SDG_RELAÇÕES

3_PNPOT | SDG_RELAÇÕES

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
1	13	Áreas Protegidas e Rede Natura 2000 do Continente e Região Autónoma dos Açores e das Áreas Protegidas e Classificadas da Região Autónoma da Madeira	Indirecta	O indicador PNPOT é expresso em termos absolu
2	15	Susceptibilidade à desertificação	Indirecta	O indicador mais ajustado é o indice de aridez

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
56	15.3.1	Proporção do território com solos degradados	III			
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
3	17	Classificação do estado ecológico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado ecoló
4	18	Classificação do estado químico das massas de água superficiais, no 2ºciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado quimi
5	20	Classificação do estado químico das massas de água subterrâneas, no 2º ciclo, nas oito Regiões Hidrográficas (RH) existentes em Portugal Continental	Indirecta	O indicador PNPOT só se reporta ao estado quimi
6	24	SAU por habitante; SAU por exploração; SAU por ocupação (culturas permanentes; culturas temporárias e prados e pastagens permanentes)	Indirecta: Desagregar em 5? Indicadores	Estes indicadores potencialmente podem relacio
7	25	Territórios ocupados com floresta e identificação das áreas sujeitas a regime florestal e integrados em ZIF	Desagregar em 3? Indicadores	Indicador também presente na figura 63 do diagn

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
53	15.1.1	Proporção do território que é área florestal	I	SIM	Apenas para Territórios ocupados com floresta	
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
8	44	Níveis de acessibilidade	Indirecta: Desagregar em 2 Indicadores	O indicador PNPOT mais ajustado é "Tempos de a

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
30	9.1.1	Proporção de população residente em áreas rurais que vive num raio de 2 km de acesso a uma estrada transitável em todas as estações dc	III			
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
9	46	Distribuição geográfica da penetração de acessos residenciais à Internet em banda larga	Indirecta	No indicador PNPOT a entidade contabilizada sãc

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
61	17.8.1	Proporção de indivíduos que utilizam a Internet	I			
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
10	63	Percentagem de uso do solo, de território artificializado, agricultura, sobro e floresta, em 2010	Desagregar em 4 Indicadores	Desagregado, obtém-se o que o SDG 15.1.1 prete

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
63	15.1.1	Proporção do território que é área florestal	I	SIM	Apenas há equivalência com o indicador relativo a florest	
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
11	64	Variação das áreas dos territórios artificilizados, agrícolas, agrícolas-florestais e florestais (1995-2010)	Indirecta	O indicador PNPOT só é representativo do numer

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
36	11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	II			
(New)						

PN	FIG_Nº	PNPOT_INDICADOR	RELAÇÃO	
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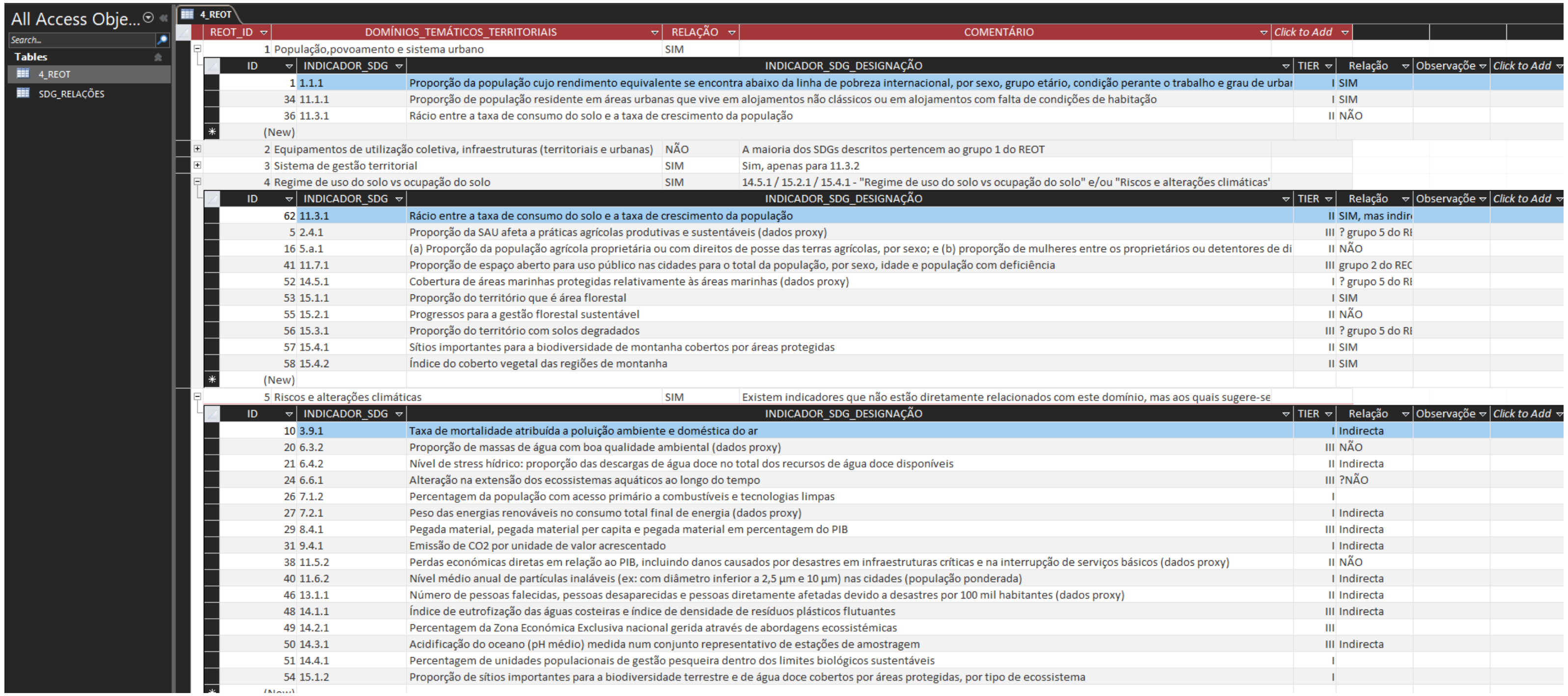
Annex 9 – REOT vs UN SDG

REOT_ID	DOMÍNIOS_TEMÁTICOS_TERRITORIAIS	RELAÇÃO	COMENTÁRIO	Click to Add
1	População,povoamento e sistema urbano	SIM		
2	Equipamentos de utilização coletiva, infraestruturas (territoriais e urbanas)	NÃO	A maioria dos SDGs descritos pertencem ao grupo 1 do REOT	
3	Sistema de gestão territorial	SIM	Sim, apenas para 11.3.2	
4	Regime de uso do solo vs ocupação do solo	SIM	14.5.1 / 15.2.1 / 15.4.1 - "Regime de uso do solo vs ocupação do solo" e/ou "Riscos e alterações climáticas'	
5	Riscos e alterações climáticas	SIM	Existem indicadores que não estão diretamente relacionados com este domínio, mas aos quais sugere-se	
(New)				



REOT_ID	DOMÍNIOS_TEMÁTICOS_TERRITORIAIS	RELAÇÃO	COMENTÁRIO	Click to Add
1	População,povoamento e sistema urbano	SIM		

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
1	1.1.1	Proporção da população cujo rendimento equivalente se encontra abaixo da linha de pobreza internacional, por sexo, grupo etário, condição perante o trabalho e grau de urbai	I	SIM		
34	11.1.1	Proporção de população residente em áreas urbanas que vive em alojamentos não clássicos ou em alojamentos com falta de condições de habitação	I	SIM		
36	11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	II	NÃO		
(New)						

REOT_ID	DOMÍNIOS_TEMÁTICOS_TERRITORIAIS	RELAÇÃO	COMENTÁRIO
2	Equipamentos de utilização coletiva, infraestruturas (territoriais e urbanas)	NÃO	A maioria dos SDGs descritos pertencem ao grupo 1 do REOT
3	Sistema de gestão territorial	SIM	Sim, apenas para 11.3.2
4	Regime de uso do solo vs ocupação do solo	SIM	14.5.1 / 15.2.1 / 15.4.1 - "Regime de uso do solo vs ocupação do solo" e/ou "Riscos e alterações climáticas'

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
62	11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	II	SIM, mas indir		
5	2.4.1	Proporção da SAU afeta a práticas agrícolas produtivas e sustentáveis (dados proxy)	III	? grupo 5 do RE		
16	5.a.1	(a) Proporção da população agrícola proprietária ou com direitos de posse das terras agrícolas, por sexo; e (b) proporção de mulheres entre os proprietários ou detentores de di	II	NÃO		
41	11.7.1	Proporção de espaço aberto para uso público nas cidades para o total da população, por sexo, idade e população com deficiência	III	grupo 2 do REC		
52	14.5.1	Cobertura de áreas marinhas protegidas relativamente às áreas marinhas (dados proxy)	I	? grupo 5 do RE		
53	15.1.1	Proporção do território que é área florestal	I	SIM		
55	15.2.1	Progressos para a gestão florestal sustentável	II	NÃO		
56	15.3.1	Proporção do território com solos degradados	III	? grupo 5 do RE		
57	15.4.1	Sítios importantes para a biodiversidade de montanha cobertos por áreas protegidas	II	SIM		
58	15.4.2	Índice do coberto vegetal das regiões de montanha	II	SIM		
(New)						

REOT_ID	DOMÍNIOS_TEMÁTICOS_TERRITORIAIS	RELAÇÃO	COMENTÁRIO
5	Riscos e alterações climáticas	SIM	Existem indicadores que não estão diretamente relacionados com este domínio, mas aos quais sugere-se

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observaçõe	Click to Add
10	3.9.1	Taxa de mortalidade atribuída a poluição ambiente e doméstica do ar	I	Indirecta		
20	6.3.2	Proporção de massas de água com boa qualidade ambiental (dados proxy)	III	NÃO		
21	6.4.2	Nível de stress hídrico: proporção das descargas de água doce no total dos recursos de água doce disponíveis	II	Indirecta		
24	6.6.1	Alteração na extensão dos ecossistemas aquáticos ao longo do tempo	III	?NÃO		
26	7.1.2	Percentagem da população com acesso primário a combustíveis e tecnologias limpas	I			
27	7.2.1	Peso das energias renováveis no consumo total final de energia (dados proxy)	I	Indirecta		
29	8.4.1	Pegada material, pegada material per capita e pegada material em percentagem do PIB	III	Indirecta		
31	9.4.1	Emissão de CO2 por unidade de valor acrescentado	I	Indirecta		
38	11.5.2	Perdas económicas diretas em relação ao PIB, incluindo danos causados por desastres em infraestruturas críticas e na interrupção de serviços básicos (dados proxy)	II	NÃO		
40	11.6.2	Nível médio anual de partículas inaláveis (ex: com diâmetro inferior a 2,5 µm e 10 µm) nas cidades (população ponderada)	I	Indirecta		
46	13.1.1	Número de pessoas falecidas, pessoas desaparecidas e pessoas diretamente afetadas devido a desastres por 100 mil habitantes (dados proxy)	II	Indirecta		
48	14.1.1	Índice de eutrofização das águas costeiras e índice de densidade de resíduos plásticos flutuantes	III	Indirecta		
49	14.2.1	Percentagem da Zona Económica Exclusiva nacional gerida através de abordagens ecossistémicas	III			
50	14.3.1	Acidificação do oceano (pH médio) medida num conjunto representativo de estações de amostragem	III	Indirecta		
51	14.4.1	Percentagem de unidades populacionais de gestão pesqueira dentro dos limites biológicos sustentáveis	I			
54	15.1.2	Proporção de sítios importantes para a biodiversidade terrestre e de água doce cobertos por áreas protegidas, por tipo de ecossistema	I			
(New)						

Annex 10 – PT2020 vs UN SDG

All Access Obje...
Search...
Tables
1_PT2020
SDG_RELAÇÕES

1_PT2020

P	PT2020_INDICADOR	RELAÇÃO	COMENTÁRIO
1	Proporção dos territórios de baixa conectividade	Indirecta	A proporção de habitantes não permite saber a proporção de uma superfície territorial

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
30	9.1.1	Proporção de população residente em áreas rurais que vive num raio de 2 km de acesso a uma estrada transitável em todas as estações do ano	III	indirecta		
35	11.2.1	Proporção de população residente com acesso adequado a transportes públicos, por sexo, idade e população com deficiência	II	indirecta		
######						

P	PT2020_INDICADOR	RELAÇÃO	COMENTÁRIO
2	Densidade de utilização do solo urbano	Indirecta	As unidades são =s mas este indicador refere-se apenas a uma instância temporal. O 11.3.1 tem a variável do "consumo do solo" que pode relacionar-se com a "utilização do solo urbano" do PT2020

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
36	11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	II	Indirecta		
######						

####

Annex 11 – ISO vs UN SDG

All Access Obje...
Search...
Tables
2_ISO
SDG_RELAÇÕES

2_ISO

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
15	Água e saneamento	Percentagem de população da cidade com serviço de abastecimento de água para consumo humano	SIM	
20	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento terciário	Indirecta	A mesma água pode sofrer mais do que um tratamento
19	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento secundário	Indirecta	A mesma água pode sofrer mais do que um tratamento
14	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento primário	Indirecta	A mesma água pode sofrer mais do que um tratamento
7	Alojamento	Percentagem da população da cidade a viver em barracas	SIM	
24	Ambiente	Concentração de partículas (PM10)	Indirecta	O indicador SDG 11.6.2 é mais abrangente e ponderado pela população
4	Ambiente	Concentração de partículas finas (PM2,5)	Indirecta	O indicador SDG 11.6.2 é mais abrangente e ponderado pela população
1	Economia	Taxa de risco de pobreza, após transferências sociais	Indirecta	Poderá haver uma relação indirecta se excluirmos "por sexo, grupo etário, condição p
2	Energia	Percentagem de energia total proveniente de fontes renováveis, como uma quota do consumo total de energia da cidade	SIM	Este indicador ISO refere-se apenas às cidades e o SDG não
3	Energia	Percentagem da população da cidade com serviço de eletricidade autorizado	SIM	O ISO refere-se apenas às cidades; SDG 7.1.1 engloba todo o território
16	Indicadores de perfil; Anexo B (Informativo)	Variação anual da população	Indirecta	O ISO só inclui o denominador do SDG
6	Recreio	Área de espaços de recreio de utilização coletiva ao ar livre per capita	Indirecta	Verificar conceito do indicador ISO "espaços abertos para uso público" e confirmar a c
10	Resíduos	Percentagem de resíduos urbanos reciclados	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que é diferente da %
17	Resíduos	Percentagem de resíduos urbanos depositados em aterros	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que que é diferente
9	Resíduos	Percentagem de resíduos perigosos per capita	SIM	Relação do Indicador ISO "Percentagem de resíduos perigosos da cidade que são recic
8	Resíduos	Percentagem de população da cidade com recolha regular de resíduos urbanos	NÃO	O ISO corresponde a uma proporção de habitantes e o SDG corresponde a uma propor
18	Resíduos	Percentagem de resíduos urbanos incinerados	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que é diferente da %
5	Resposta a incêndios e a emergências	Número de mortes relacionadas com catástrofes naturais por 100 000 habitantes	Indirecta	Porque o SDG também contabiliza afectados...
12	Telecomunicações e inovação	Número de ligações de telemóvel por 100 000 habitantes	Indirecta	Enquanto que o ISO representa o nº ligações / habitantes, o SDG representa uma % d
11	Telecomunicações e inovação	Número de ligações à internet por 100 00 habitantes	Indirecta	Enquanto que o ISO representa o nº ligações / habitantes, o SDG representa uma % d
13	Transportes	Extensão da rede de transportes públicos terrestres de elevada capacidade por 100 000 habitantes	NÃO	
####				

All Access Obje...

Search...

Tables

- 2_ISO
- SDG_RELAÇÕES

2_ISO

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
15	Água e saneamento	Percentagem de população da cidade com serviço de abastecimento de água para consumo humano	SIM	

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
18	6.1.1	Proporção da população que utiliza serviços de água potável (dados proxy)	I	Directa		
#####						

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
20	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento terciário	Indirecta	A mesma água pode sofrer mais do que um tratamento
19	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento secundário	Indirecta	A mesma água pode sofrer mais do que um tratamento
14	Águas residuais	Percentagem de águas residuais domésticas da cidade que recebe tratamento primário	Indirecta	A mesma água pode sofrer mais do que um tratamento
7	Alojamento	Percentagem da população da cidade a viver em barracas	SIM	

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
34	11.1.1	Proporção de população residente em áreas urbanas que vive em alojamentos não clássicos ou em alojamentos con	I	Directa		
#####						

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
24	Ambiente	Concentração de partículas (PM10)	Indirecta	O indicador SDG 11.6.2 é mais abrangente e ponderado pela população
4	Ambiente	Concentração de partículas finas (PM2,5)	Indirecta	O indicador SDG 11.6.2 é mais abrangente e ponderado pela população
1	Economia	Taxa de risco de pobreza, após transferências sociais	Indirecta	Poderá haver uma relação indirecta se excluirmos "por sexo, grupo etário, condição p
2	Energia	Percentagem de energia total proveniente de fontes renováveis, como uma quota do consumo total de energia da cidade	SIM	Este indicador ISO refere-se apenas às cidades e o SDG não

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
27	7.2.1	Peso das energias renováveis no consumo total final de energia (dados proxy)	I			
#####						

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
3	Energia	Percentagem da população da cidade com serviço de eletricidade autorizado	SIM	O ISO refere-se apenas às cidades; SDG 7.1.1 engloba todo o território

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
25	7.1.1	Percentagem da população com acesso à eletricidade	I	Directa		
#####						

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
16	Indicadores de perfil; Anexo B (Informativo)	Variação anual da população	Indirecta	O ISO só inclui o denominador do SDG

ID	INDICADOR_SDG	INDICADOR_SDG_DESIGNAÇÃO	TIER	Relação	Observações	Click to Add
36	11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	II	Muito indirect:		
#####						

IS	ISO_SECÇÃO	ISO_INDICADOR	RELAÇÃO	COMENTÁRIO
6	Recreio	Área de espaços de recreio de utilização coletiva ao ar livre per capita	Indirecta	Verificar conceito do indicador ISO "espaços abertos para uso público" e confirmar a c
10	Resíduos	Percentagem de resíduos urbanos reciclados	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que é diferente da !
17	Resíduos	Percentagem de resíduos urbanos depositados em aterros	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que que é diferente
9	Resíduos	Percentagem de resíduos perigosos per capita	SIM	Relação do Indicador ISO "Percentagem de resíduos perigosos da cidade que são reci
8	Resíduos	Percentagem de população da cidade com recolha regular de resíduos urbanos	NÃO	O ISO corresponde a uma proporção de habitantes e o SDG corresponde a uma propo
18	Resíduos	Percentagem de resíduos urbanos incinerados	Indirecta	O SDG representa a % dos resíduos com descarga final adequada que é diferente da !
5	Resposta a incêndios e a emergências	Número de mortes relacionadas com catástrofes naturais por 100 000 habitantes	Indirecta	Porque o SDG também contabiliza afectados...
12	Telecomunicações e inovação	Número de ligações de telemóvel por 100 000 habitantes	Indirecta	Enquanto que o ISO representa o nº ligações / habitantes, o SDG representa uma % d
11	Telecomunicações e inovação	Número de ligações à internet por 100 00 habitantes	Indirecta	Enquanto que o ISO representa o nº ligações / habitantes, o SDG representa uma % d
13	Transportes	Extensão da rede de transportes públicos terrestres de elevada capacidade por 100 000 habitantes	NÃO	
####				

Annex 12 – UN SDG vs DGT and EU SDG Indicators systems

0_SDG | SDG_SISTEMAS

SDG	SDG_INDICADOR_NAME	TIER
11.1.1	Proportion of urban population living in slums, informal settlements or inadequate housing	I

ID	SISTEMA	INDICADOR	INTENSIDADE	RN_observ	Click to Add
12	ISO	Percentagem da população da cidade a viver em barracas	2	SIM	
51	REOT	População,povoamento e sistema urbano	1	SIM	
(New)			0		

SDG	SDG_INDICADOR_NAME	TIER
11.2.1	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	II
11.3.1	Ratio of land consumption rate to population growth rate	II

ID	SISTEMA	INDICADOR	INTENSIDADE	RN_observ	Click to Add
3	PT2020	Densidade de utilização do solo urbano	2	Indirecta	
14	ISO	Variação anual da população	2	Indirecta	
53	REOT	Regime de uso do solo vs ocupação do solo	1	Indirecta	
82	EU_SDG	15.21 Artificial land cover per capita	2	Indirecta	
(New)			0		

SDG	SDG_INDICADOR_NAME	TIER
11.3.2	Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically	III
11.5.2	Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters	II
11.6.1	Proportion of urban solid waste regularly collected and with adequatefinal discharge out of total urban solid waste generated, by cities	II
11.6.2	Annual mean levels of fine particulate matter (e.g.PM2.5 and PM10) in cities (population weighted)	I
11.7.1	Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	III
11.7.2	Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months	III
11.a.1	Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city	III
12.4.2	Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment	III
12.a.1	Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies	III
13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	II
13.1.2	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030	II
14.1.1	Index of coastal eutrophication and floating plastic debris density	III
14.2.1	Proportion of national exclusive economic zones managed using ecosystem-based approaches	III
14.3.1	Average marine acidity (pH) measured at agreed suite of representative sampling stations	III
14.4.1	Proportion of fish stocks within biologically sustainable levels	I
14.5.1	Coverage of protected areas in relation to marine areas	I
15.1.1	Forest area as a proportion of total land area	I
15.1.2	Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	I
15.2.1	Progress towards sustainable forest management	II
15.3.1	Proportion of land that is degraded over total land area	III
15.4.1	Coverage by protected areas of important sites for mountain biodiversity	II
15.4.2	Mountain Green Cover Index	II

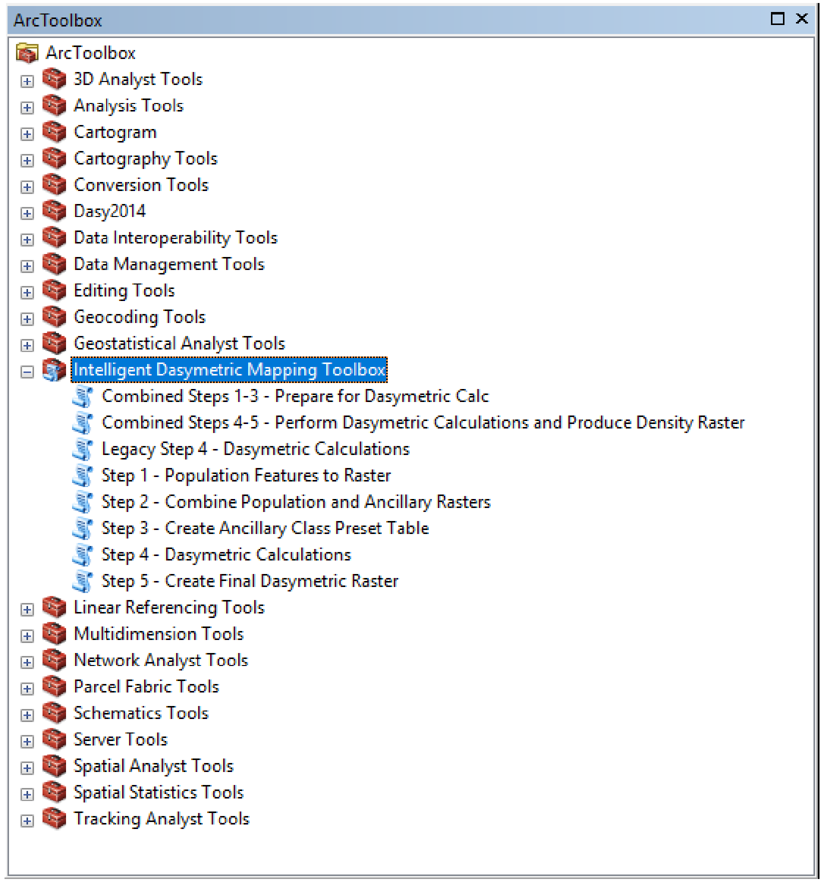
ID	SISTEMA	INDICADOR	INTENSIDADE	RN_observ	Click to Add
72	REOT	Regime de uso do solo vs ocupação do solo	1	SIM	
(New)			0		

SDG	SDG_INDICADOR_NAME	TIER
16.7.2	Proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group	III
17.6.1	Number of science and/or technology cooperation agreements and programmes between countries, by type of cooperation	III

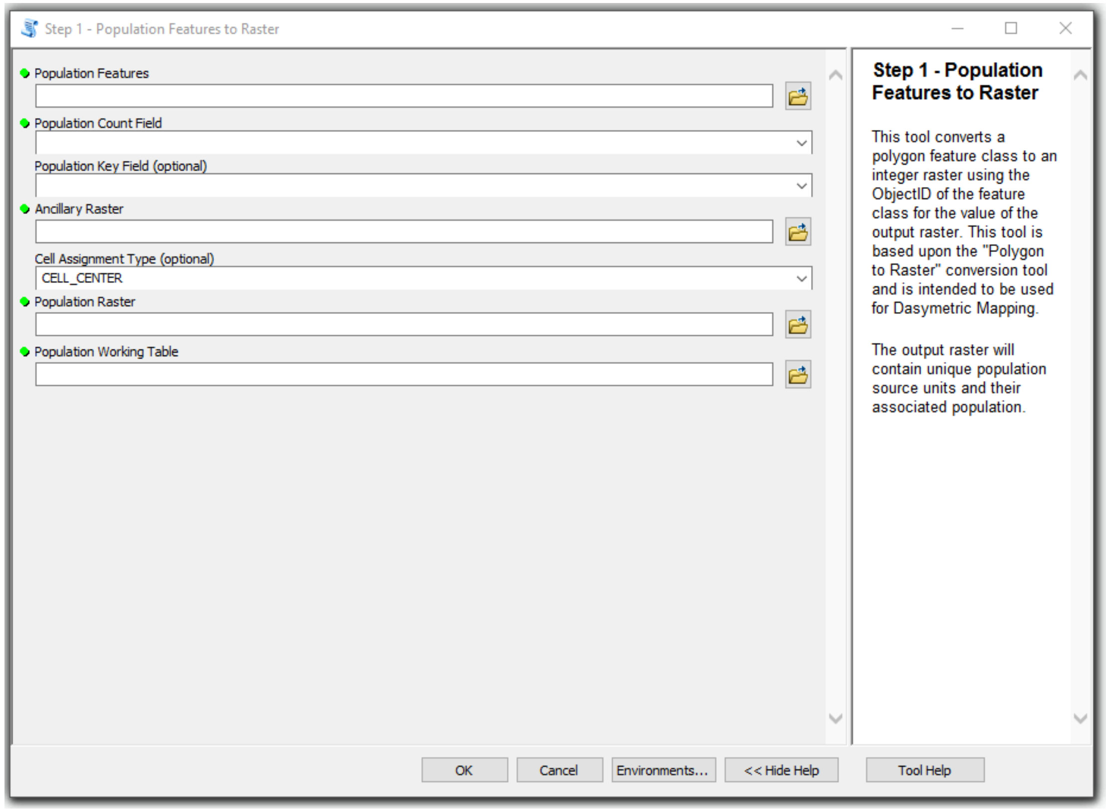
Annex 13 – Final comparation draft version

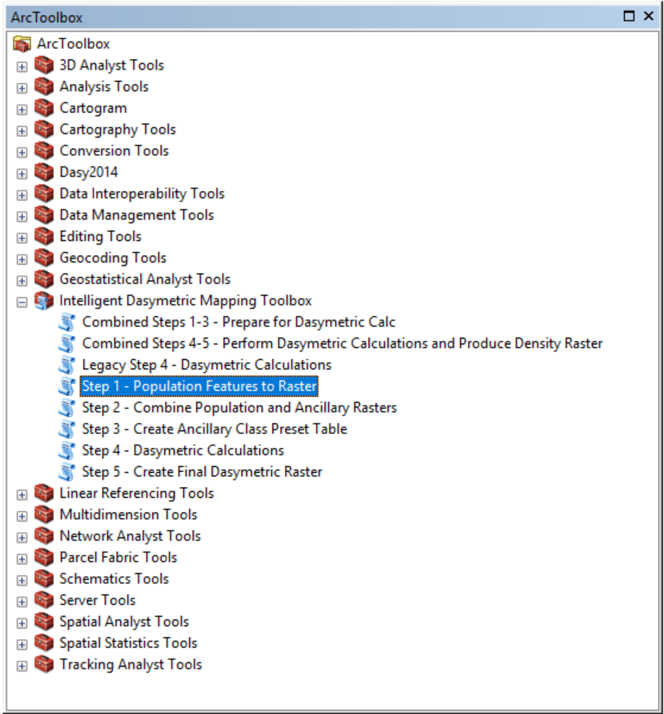
		PT 2020		ISO		PNPOT		REOT		EU SDG		COMPARAÇÃO FINAL				
Ind.	DESIGNAÇÃO	IND	INT	IND	INT	FIG	INT	Temas	Int.	IND	INT	Nº INDICADORES POR INTENSIDADE			TOTAL INDICADORES	TIER
9.4.1	Emissão de CO2 por unidade de valor acrescentado							x	2	x	2		2		2	I
11.2.1	Proporção de população residente com acesso adequado a transportes públicos, por sexo, idade e população com deficiência	x	2	x	2			x	2	x	2		4		4	II
11.3.1	Rácio entre a taxa de consumo do solo e a taxa de crescimento da população	x	2	x	2			x	1	x	2	1	3		4	II
11.5.2	Perdas económicas diretas em relação ao PIB, incluindo danos causados por desastres em infraestruturas críticas e na interrupção de serviços básicos (dados proxy)									x	2		1		1	II
11.6.2	Nível médio anual de partículas inaláveis (ex: com diâmetro inferior a 2,5 µm e 10 µm) nas cidades (população ponderada)			x + x	1			x	2	x	1	2	1		3	I
14.3.1	Acidificação do oceano (pH médio) medida num conjunto representativo de estações de amostragem							x	2	x	1	1	1		2	III
14.5.1	Cobertura de áreas marinhas protegidas relativamente às áreas marinhas (dados proxy)					x	3	x	2	x + x	2		2	1	3	I

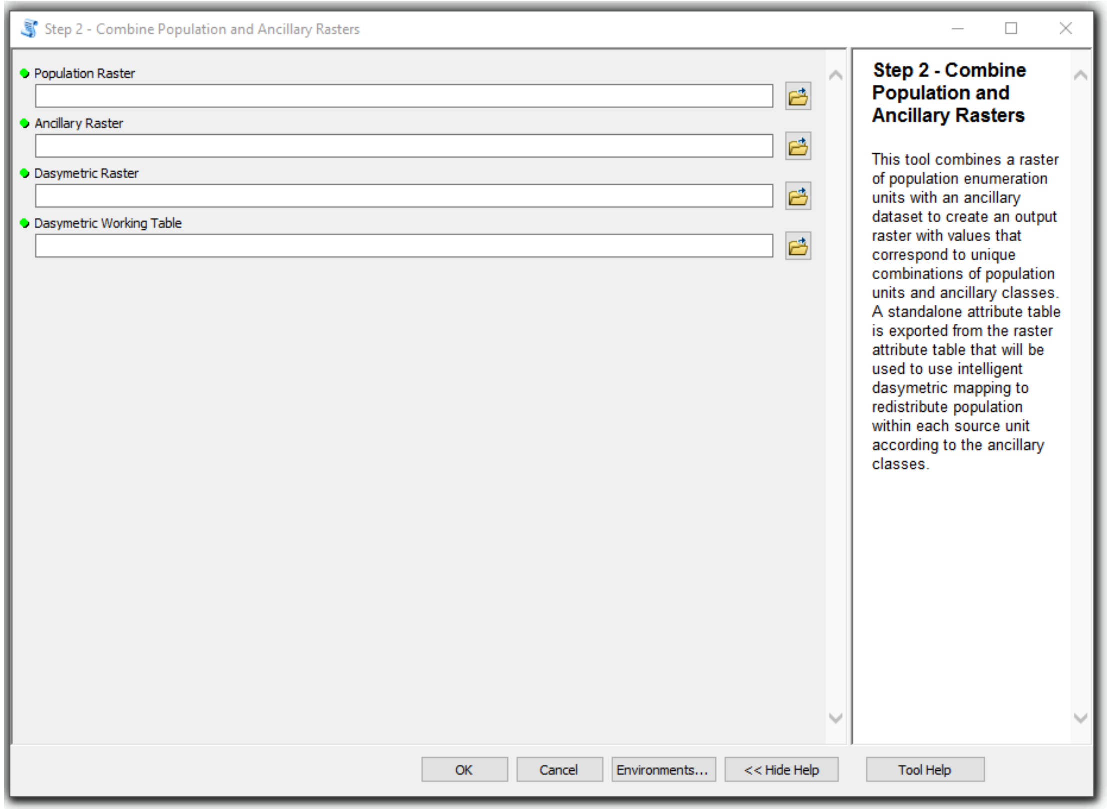
Annex 14 – EPA IDM toolbox for ArcGIS 10.3



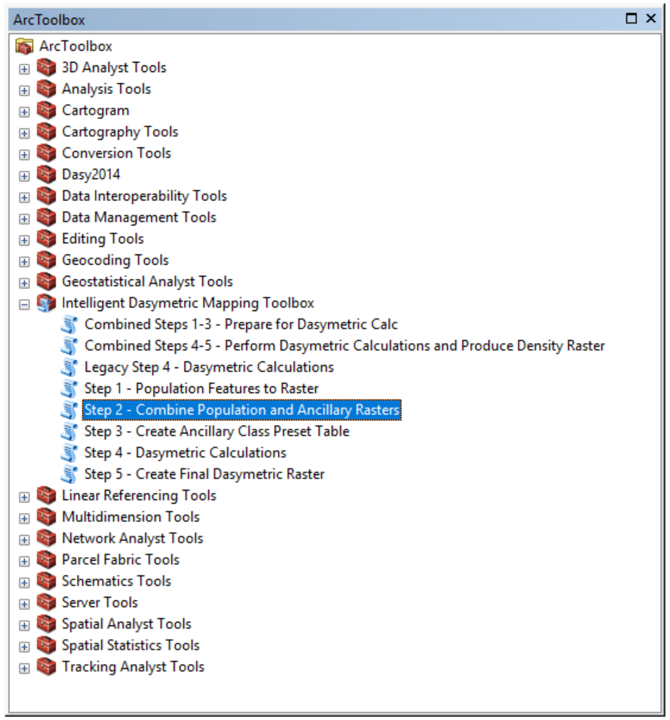
Annex 15 – EPA IDM toolbox for ArcGIS - Steps 1 to 5



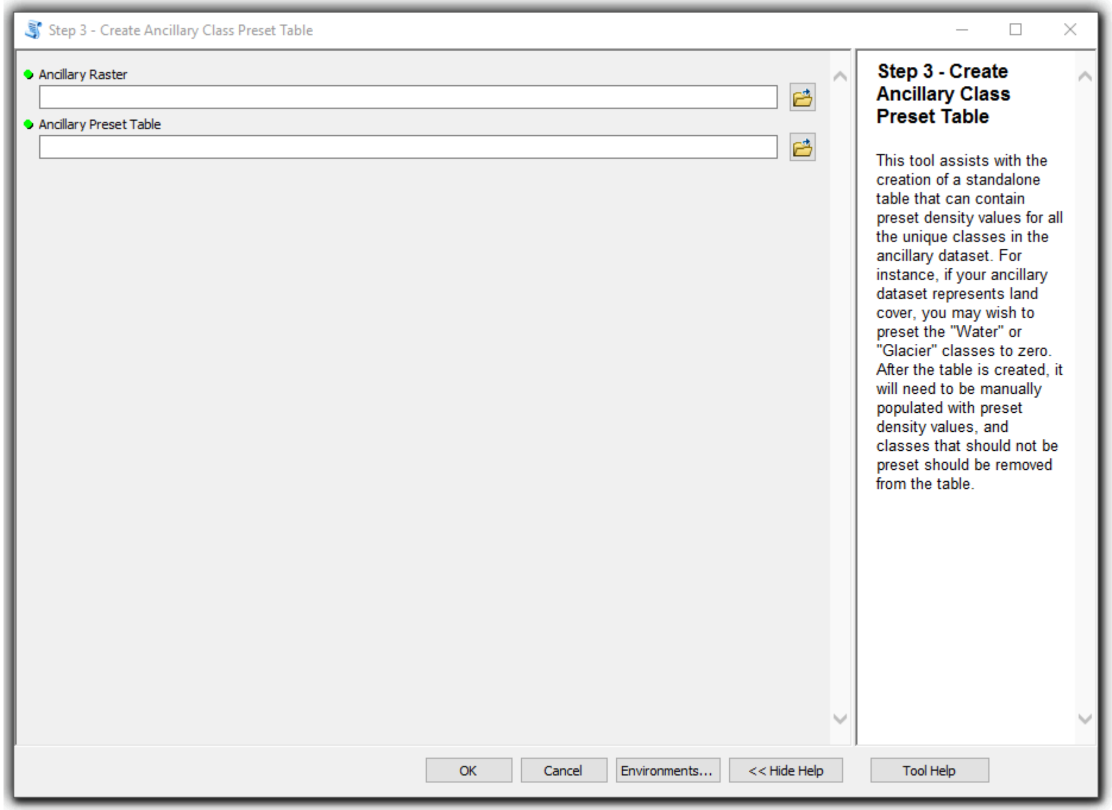


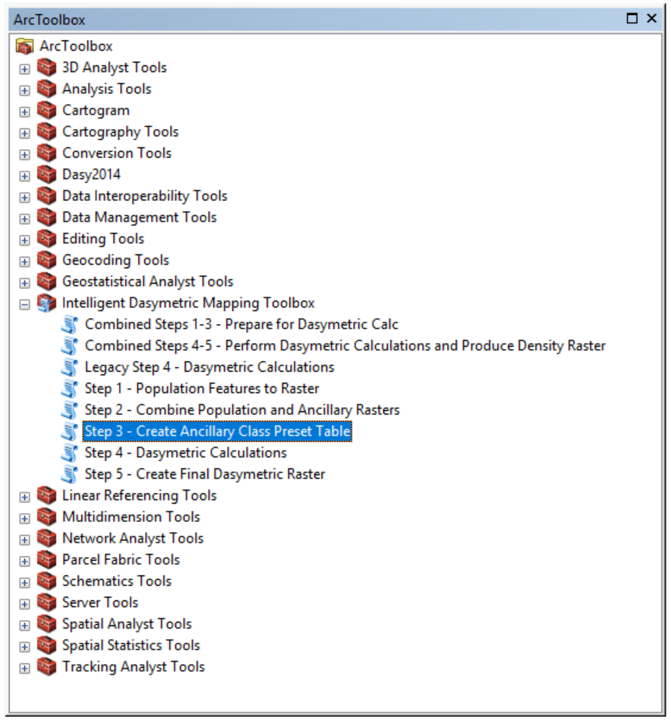


Step 2 - Combine Population and Ancillary Rasters
Population Raster
Ancillary Raster
Dasymetric Raster
Dasymetric Working Table
Step 2 - Combine Population and Ancillary Rasters
This tool combines a raster of population enumeration units with an ancillary dataset to create an output raster with values that correspond to unique combinations of population units and ancillary classes. A standalone attribute table is exported from the raster attribute table that will be used to use intelligent dasymetric mapping to redistribute population within each source unit according to the ancillary classes.
OK
Cancel
Environments...
<< Hide Help
Tool Help



ArcToolbox
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartogram
Cartography Tools
Conversion Tools
Dasy2014
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Intelligent Dasymetric Mapping Toolbox
Combined Steps 1-3 - Prepare for Dasymetric Calc
Combined Steps 4-5 - Perform Dasymetric Calculations and Produce Density Raster
Legacy Step 4 - Dasymetric Calculations
Step 1 - Population Features to Raster
Step 2 - Combine Population and Ancillary Rasters
Step 3 - Create Ancillary Class Preset Table
Step 4 - Dasymetric Calculations
Step 5 - Create Final Dasymetric Raster
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools


Step 3 - Create Ancillary Class Preset Table
Ancillary Raster
Ancillary Preset Table
Step 3 - Create Ancillary Class Preset Table
This tool assists with the creation of a standalone table that can contain preset density values for all the unique classes in the ancillary dataset. For instance, if your ancillary dataset represents land cover, you may wish to preset the "Water" or "Glacier" classes to zero. After the table is created, it will need to be manually populated with preset density values, and classes that should not be preset should be removed from the table.
OK
Cancel
Environments...
<< Hide Help
Tool Help


ArcToolbox
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartogram
Cartography Tools
Conversion Tools
Dasy2014
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Linear Referencing Tools
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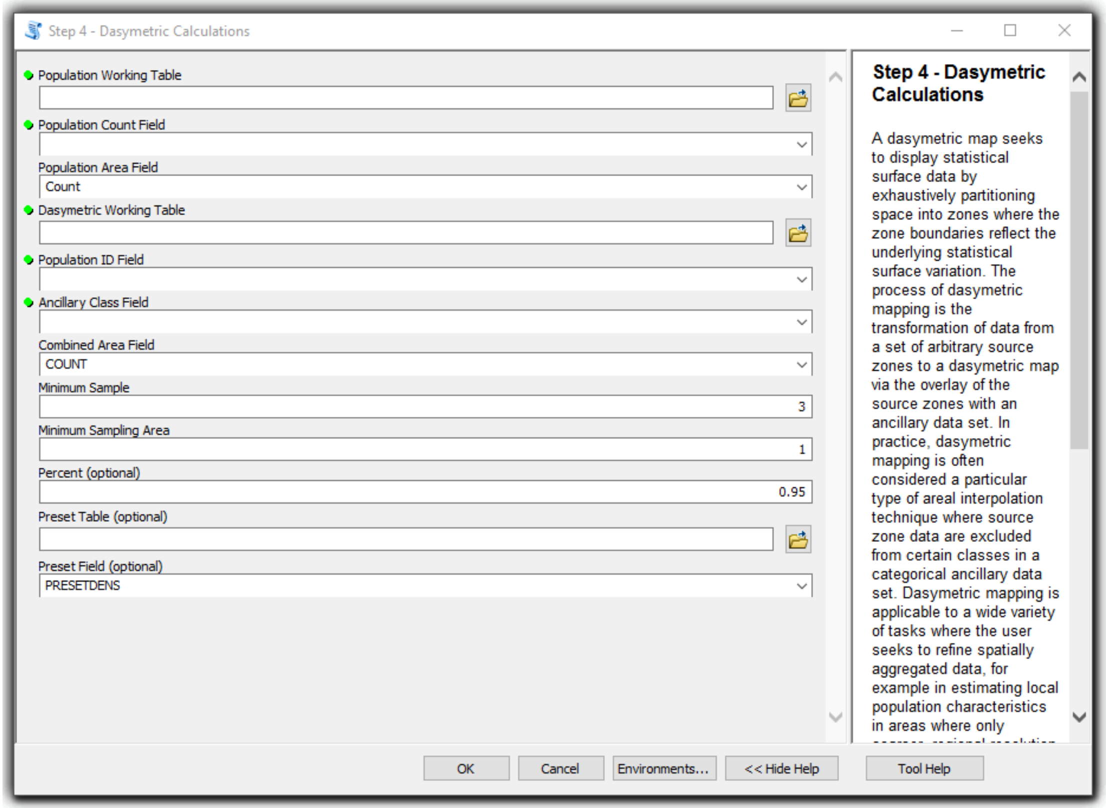
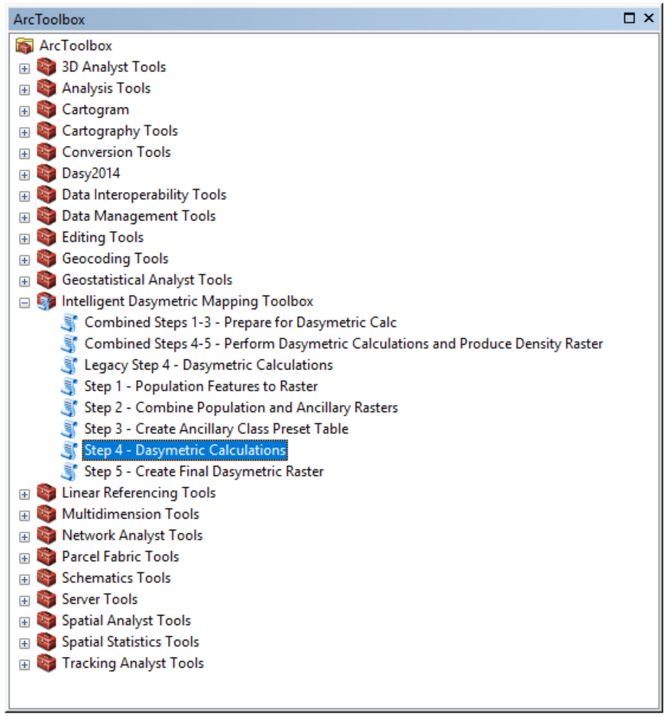
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools


Step 4 - Dasymetric Calculations
Population Working Table
Population Count Field
Population Area Field
Count
Dasymetric Working Table
Population ID Field
Ancillary Class Field
Combined Area Field
COUNT
Minimum Sample
3
Minimum Sampling Area
1
Percent (optional)
0.95
Preset Table (optional)
Preset Field (optional)
PRESETDENS
Step 4 - Dasymetric Calculations
A dasymetric map seeks to display statistical surface data by exhaustively partitioning space into zones where the zone boundaries reflect the underlying statistical surface variation. The process of dasymetric mapping is the transformation of data from a set of arbitrary source zones to a dasymetric map via the overlay of the source zones with an ancillary data set. In practice, dasymetric mapping is often considered a particular type of areal interpolation technique where source zone data are excluded from certain classes in a categorical ancillary data set. Dasymetric mapping is applicable to a wide variety of tasks where the user seeks to refine spatially aggregated data, for example in estimating local population characteristics in areas where only
OK
Cancel
Environments...
<< Hide Help
Tool Help


ArcToolbox
ArcToolbox
3D Analyst Tools
Analysis Tools
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Cartography Tools
Conversion Tools
Dasy2014
Data Interoperability Tools
Data Management Tools
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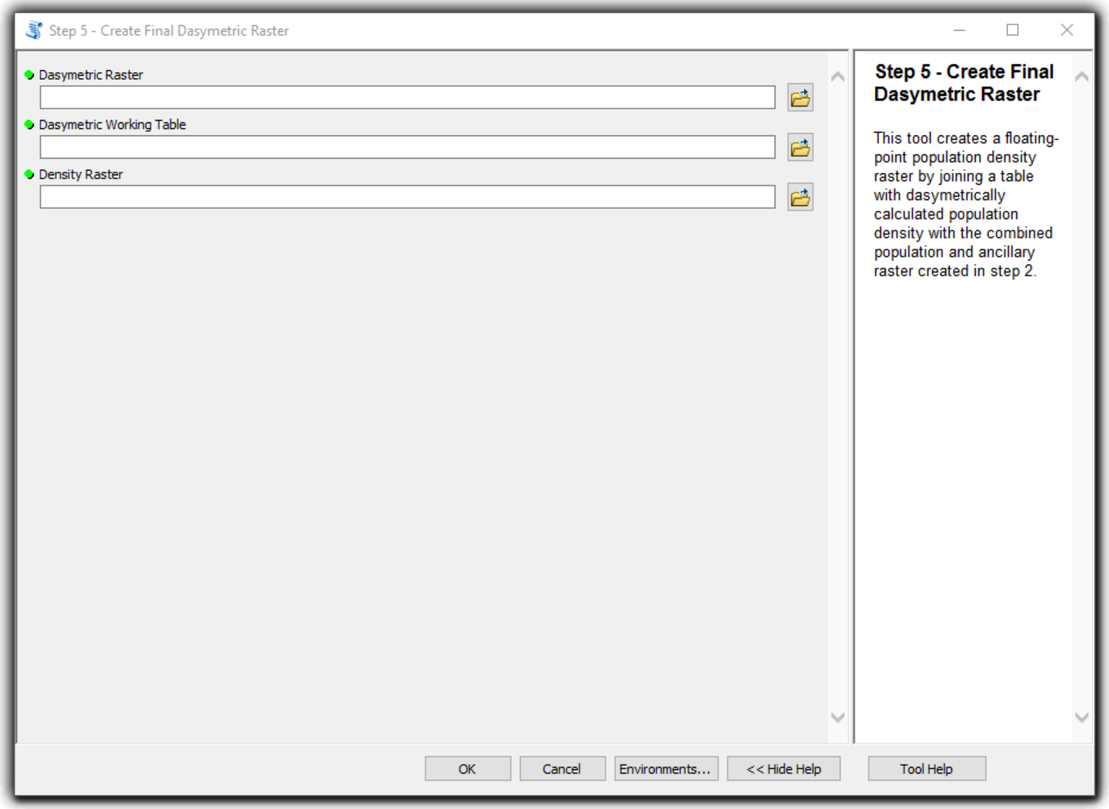
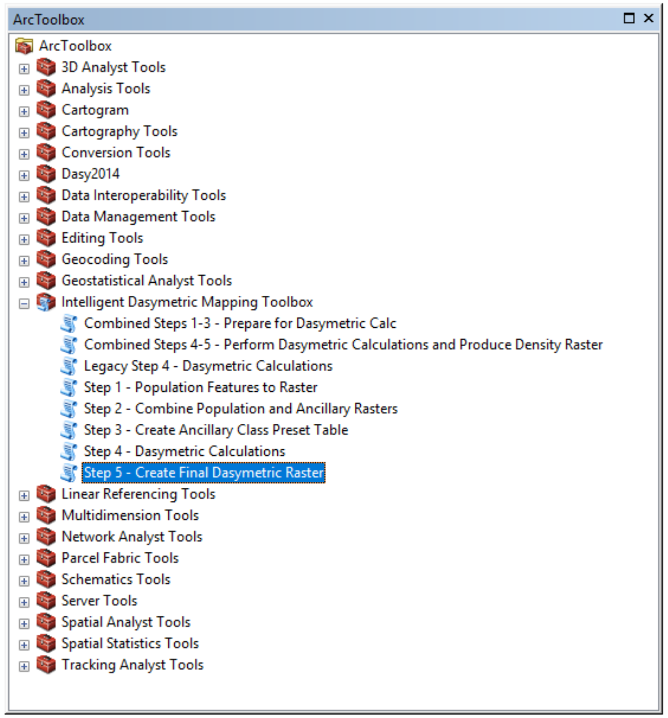
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools


Step 5 - Create Final Dasymetric Raster
Dasymetric Raster
Dasymetric Working Table
Density Raster
Step 5 - Create Final Dasymetric Raster
This tool creates a floating-point population density raster by joining a table with dasymetrically calculated population density with the combined population and ancillary raster created in step 2.
OK
Cancel
Environments...
<< Hide Help
Tool Help


ArcToolbox
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartogram
Cartography Tools
Conversion Tools
Dasy2014
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Intelligent Dasymetric Mapping Toolbox
Combined Steps 1-3 - Prepare for Dasymetric Calc
Combined Steps 4-5 - Perform Dasymetric Calculations and Produce Density Raster
Legacy Step 4 - Dasymetric Calculations
Step 1 - Population Features to Raster
Step 2 - Combine Population and Ancillary Rasters
Step 3 - Create Ancillary Class Preset Table
Step 4 - Dasymetric Calculations
Step 5 - Create Final Dasymetric Raster
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools

Annex 16 – CLC original nomenclature (same as COS). Source: https://land.copernicus.eu

Corine land cover classes

1. Artificial surfaces

1.1 Urban fabric

- 1.1.1. Continuous urban fabric
- 1.1.2. Discontinuous urban fabric

1.2 Industrial, commercial and transport units

- 1.2.1. Industrial or commercial units
- 1.2.2. Road and rail networks and associated land
- 1.2.3. Port areas
- 1.2.4. Airports

1.3 Mine, dump and construction sites

- 1.3.1. Mineral extraction sites
- 1.3.2. Dump sites
- 1.3.3. Construction sites

1.4 Artificial, non-agricultural vegetated areas

- 1.4.1. Green urban areas
- 1.4.2. Sport and leisure facilities

2. Agricultural areas

2.1 Arable land

- 2.1.1. Non-irrigated arable land
- 2.1.2. Permanently irrigated land
- 2.1.3. Rice fields

2.2 Permanent crops

- 2.2.1. Vineyards
- 2.2.2. Fruit trees and berry plantations
- 2.2.3. Olive groves

2.3 Pastures

- 2.3.1. Pastures

2.4 Heterogeneous agricultural areas

- 2.4.1. Annual crops associated with permanent crops
- 2.4.2. Complex cultivation patterns
- 2.4.3. Land principally occupied by agriculture
- 2.4.4. Agro-forestry areas

3. Forest and seminatural areas

3.1 Forests

- 3.1.1. Broad-leaved forest
- 3.1.2. Coniferous forest
- 3.1.3. Mixed forest

3.2 Shrub and/or herbaceous vegetation associations

- 3.2.1. Natural grassland
- 3.2.2. Moors and heathland
- 3.2.3. Sclerophyllous vegetation
- 3.2.4. Transitional woodland shrub

3.3 Open spaces with little or no vegetation

- 3.3.1. Beaches, dunes, and sand plains
- 3.3.2. Bare rock
- 3.3.3. Sparsely vegetated areas
- 3.3.4. Burnt areas
- 3.3.5. Glaciers and perpetual snow

4. Wetlands

4.1 Inland wetlands

- 4.1.1. Inland marshes
- 4.1.2. Peat bogs

4.2 Coastal wetlands

- 4.2.1. Salt marshes
- 4.2.2. Salines
- 4.2.3. Intertidal flats

5. Water bodies

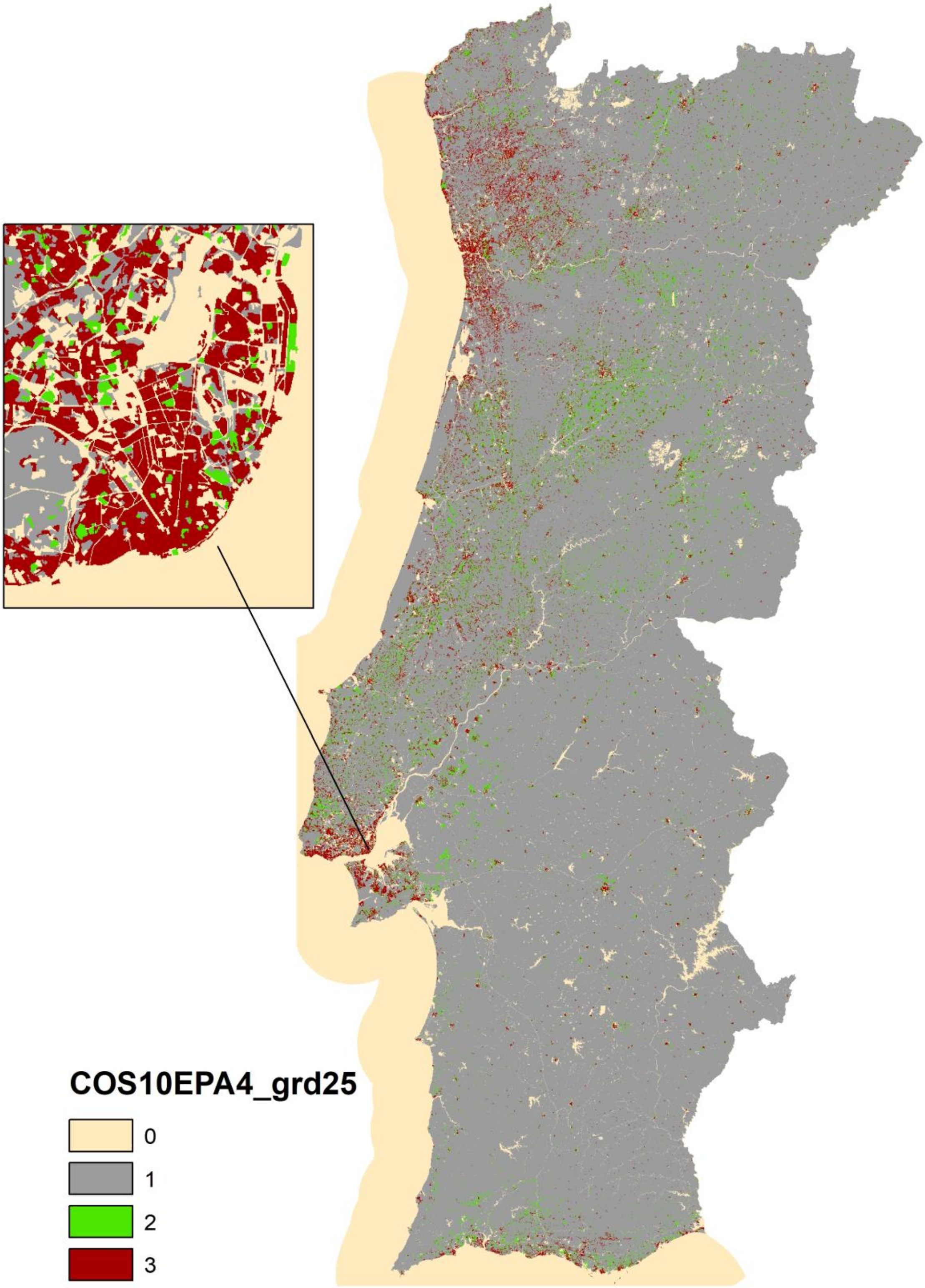
5.1 Inland waters

- 5.1.1. Water courses
- 5.1.2. Water bodies

5.2 Marine waters

- 5.2.1. Coastal lagoons
- 5.2.2. Estuaries
- 5.2.3. Sea and ocean

Annex 17 – Cos2010 reclassification: COS10EPA4_grd25



Annex 17 – Article published from the work scope of my internship at DGT. Accessible through: https://www.mdpi.com/2220-9964/8/1/10/html

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ISPRS Int. J. Geo-Inf. **2019**, *8*(1), 10; doi:10.3390/ijgi8010010

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Article

Ratio of Land Consumption Rate to Population Growth Rate—Analysis of Different Formulations Applied to Mainland Portugal

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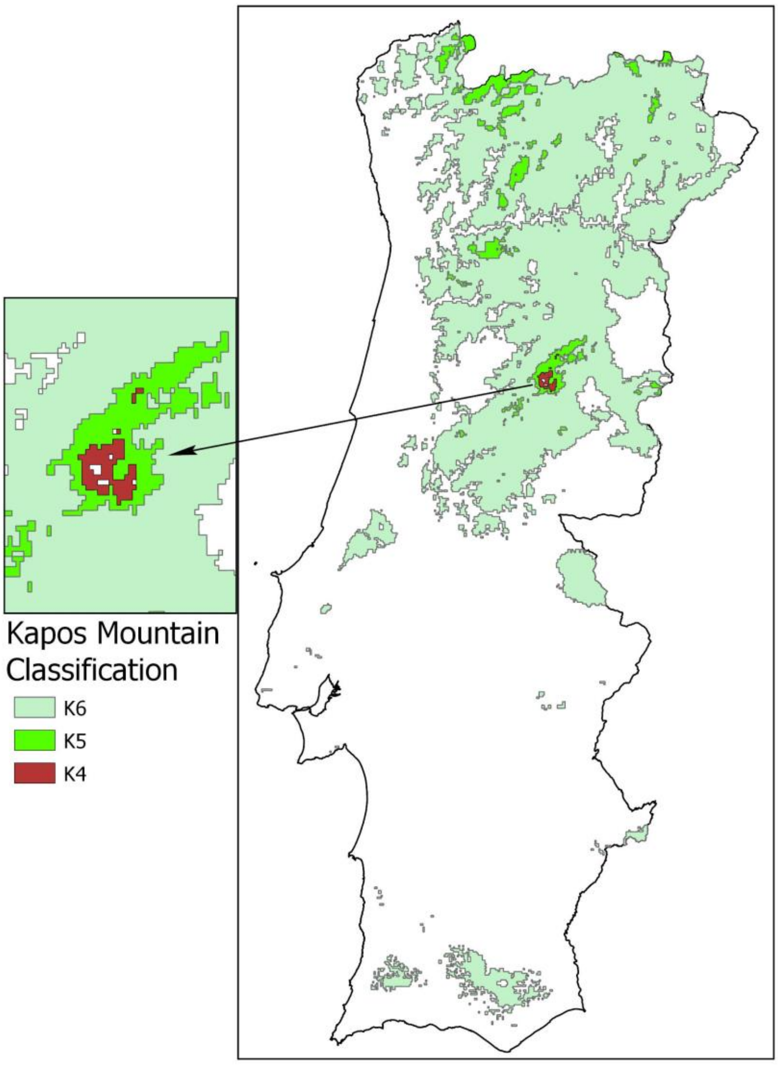
Annex 18 – FAO´s baseline data for the Portugal (2017) for reporting the indicator 15.4.2 mountain green cover index

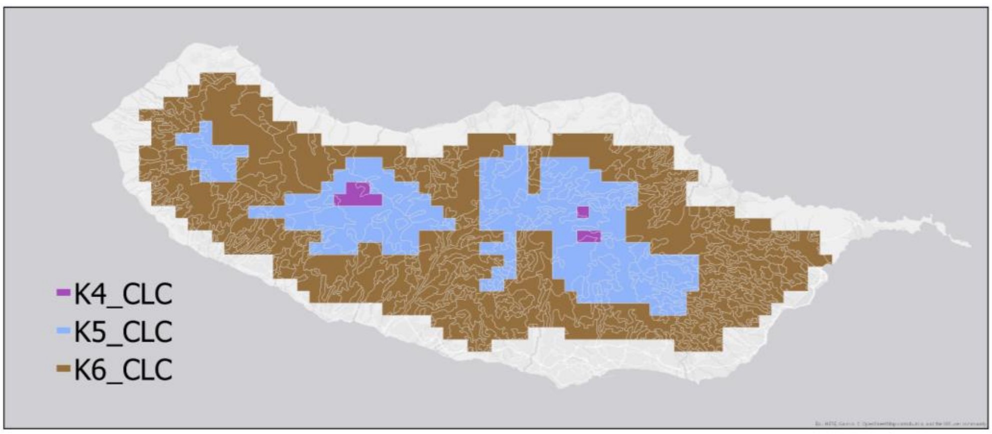
PORTUGAL
MOUNTAIN GREEN COVER INDEX
Baseline data 2017: 89%

PORTUGAL							
Land Cover - Land Use Area (Km2 '000)							
KAPOS	Forest	Grassland - Shrubland	Cropland	Otherland	Wetland	Settlement	TOTAL AREA KAPOS
K1	-	-	-	-	-	-	-
K2	-	-	-	-	-	-	-
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
K5	0,3	1,0	0,3	0,0	0,0	0,0	1,5
K6	13,2	4,2	5,9	1,3	0,0	1,8	26,2
SUM	13,4	5,2	6,1	1,3	0,0	1,8	27,8
	Sum of green cover classes 24,7			Sum of other land cover classes 3,1			

PORTUGAL							
Land Cover - Land Use Area %							
KAPOS	Forest	Grassland - Shrubland	Cropland	Otherland	Wetland	Settlement	TOTAL AREA KAPOS
K1	-	-	-	-	-	-	-
K2	-	-	-	-	-	-	-
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
K5	16,7%	66,7%	16,7%	0,0%	0,0%	0,0%	100%
K6	50,1%	15,8%	22,4%	4,9%	0,0%	6,8%	100%
SUM	48,3%	18,6%	22,0%	4,6%	0,0%	6,4%	100%
	Sum of green cover classes 89%			Sum of other land cover classes 11%			

Annex 19 – Mountain Kapos classification in mainland Portugal and Madeira





Annex 20 – Indicator 15.4.2 results: applying COS 2010 for mainland Portugal

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	Forest land	Cropland	Grassland/ Shrubland	Wetlands	Settlements	Otherland	Total area Kapos
K4	5,4	0,1	35,6	1,5	0,2	27,3	70,1
K5	453,4	111,8	812,9	1,3	9,6	164,1	1553,2
K6	12331,8	6417,8	6286,8	117,1	793,8	250,8	26198,2
SUM	12790,6	6529,7	7135,4	119,8	803,7	442,3	27821,5
	SUM of green cover classes: 26455,7			SUM of other land cover classes: 1365,7			

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	Forest land	Cropland	Grassland/ Shrubland	Wetlands	Settlements	Otherland	Total area Kapos
K4	7,7%	0,1%	50,8%	2,1%	0,3%	39,0%	100%
K5	29,2%	7,2%	52,3%	0,1%	0,6%	10,6%	100%
K6	47,1%	24,5%	24,0%	0,4%	3,0%	1,0%	100%
SUM	46,0%	23,5%	25,6%	0,4%	2,9%	1,6%	100%
	SUM of green cover classes: 95,1%			SUM of other land cover classes: 4,9%			

Annex 21 – Indicator 15.4.2 results: applying CLC 2012 for mainland Portugal, Azores and Madeira

PORTUGAL: Total							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4	6.92	0.37	31.92	1.37	0.10	44.66	85.34
K5	470.43	173.85	901.69	2.28	5.29	179.88	1733.42
K6	12327.84	9550.28	4877.66	150.99	446.46	237.70	27590.93
SUM	12805.19	9724.50	5811.27	154.64	451.85	462.24	29409.69
	SUM of green cover classes: 28 340.96			**SUM of other land cover classes: 1 068.73**			

PORTUGAL: Total							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4	8.11%	0.44%	37.40%	1.61%	0.12%	52.33%	100%
K5	27.14%	10.03%	52.02%	0.13%	0.31%	10.38%	100%
K6	44.68%	34.61%	17.68%	0.55%	1.62%	0.86%	100%
SUM	43.54%	33.07%	19.76%	0.53%	1.54%	1.57%	100%
	SUM of green cover classes: 96.37%			**SUM of other land cover classes: 3.63%**			

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4	4.75		25.74	1.37	0.10	38.15	70.11
K5	385.09	169.89	829.36	1.11	4.09	163.65	1553.19
K6	11882.91	9263.21	4333.35	89.37	395.32	234.02	26198.18
SUM	12272.75	9433.10	5188.44	91.85	399.51	435.82	27821.48
	SUM of green cover classes: 26 894.30			**SUM of other land cover classes: 927.18**			

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	Forest land	Cropland	Grassland/ Shrubland	Wetlands	Settlements	Otherland	Total area Kapos
K4	6.77%		36.72%	1.95%	0.14%	54.41%	100%
K5	24.79%	10.94%	53.40%	0.07%	0.26%	10.54%	100%
K6	45.36%	35.36%	16.54%	0.34%	1.51%	0.89%	100%
SUM	44.11%	33.91%	18.65%	0.33%	1.44%	1.57%	100%
	SUM of green cover classes: 96.67%			SUM of other land cover classes: 3.33%			

PORTUGAL: Madeira							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	Forest land	Cropland	Grassland/ Shrubland	Wetlands	Settlements	Otherland	Total area Kapos
K4	2.17	0.37	3.95				6.50
K5	85.22	3.94	60.47		1.20	6.52	157.35
K6	220.42	48.92	49.46	0.01	44.94	0.70	364.45
SUM	307.82	53.23	113.87	0.01	46.14	7.22	528.29
	SUM of green cover classes: 474.93			SUM of other land cover classes: 53.37			

PORTUGAL: Madeira							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	Forest land	Cropland	Grassland/ Shrubland	Wetlands	Settlements	Otherland	Total area Kapos
K4	33.48%	5.72%	60.80%				100%
K5	54.16%	2.51%	38.43%		0.76%	4.14%	100%
K6	60.48%	13.42%	13.57%	0.00%	12.33%	0.19%	100%
SUM	58.27%	10.08%	21.56%	0.00%	8.73%	1.37%	100%
	SUM of green cover classes: 89.90%			SUM of other land cover classes: 10.10%			

PORTUGAL: Azores							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4			2.23			6.51	8.74
K5	0.11	0.02	11.86	1.18		9.71	22.88
K6	224.51	238.15	494.86	61.61	6.19	2.98	1028.30
SUM	224.62	238.17	508.95	62.79	6.19	19.20	1059.92
	SUM of green cover classes: 971.74			**SUM of other land cover classes: 88.18**			

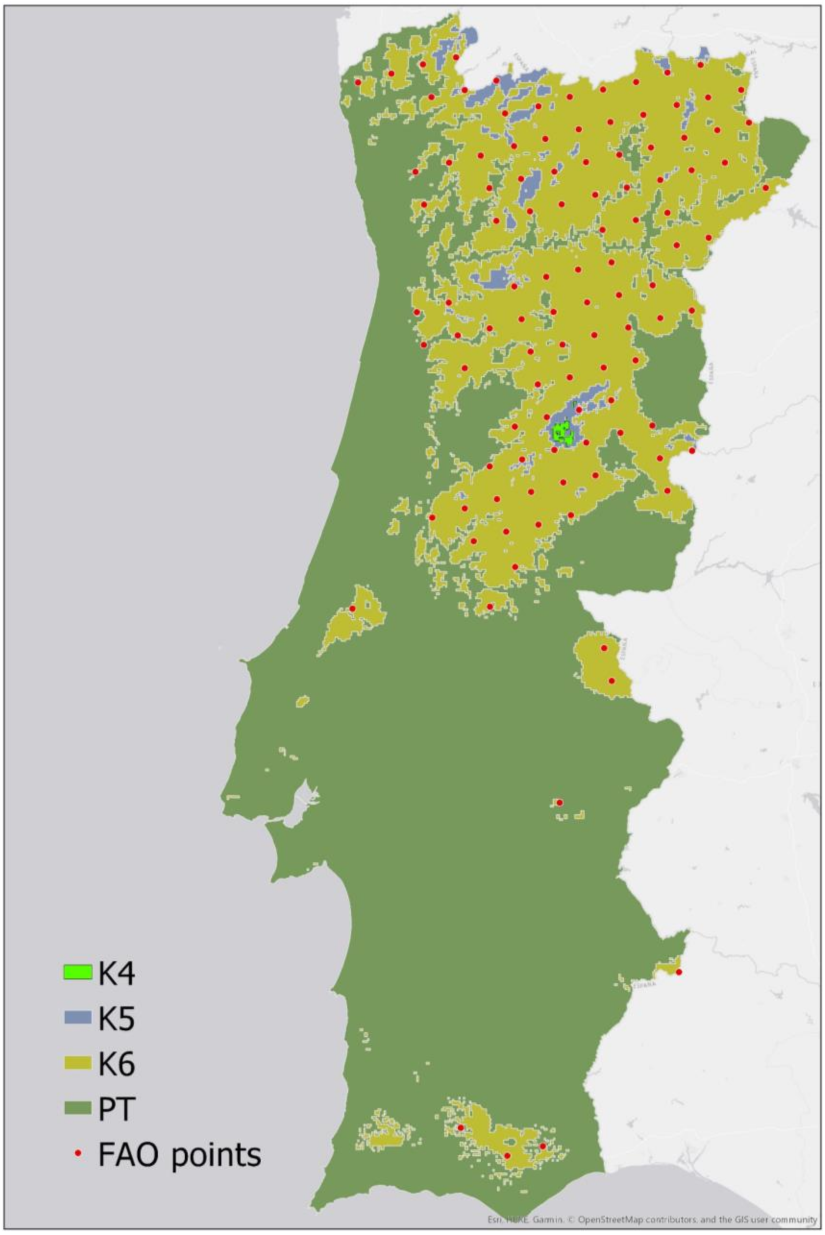
PORTUGAL: Azores							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4			25.49%			74.51%	100%
K5	0.44%	0.00%	51.97%	5.24%		42.36%	100%
K6	21.83%	23.16%	48.12%	5.99%	0.60%	0.29%	100%
SUM	21.19%	22.47%	48.02%	5.92%	0.58%	1.81%	100%
	SUM of green cover classes: 91.68%			**SUM of other land cover classes: 8.32%**			

Annex 22 – Indicator 15.4.2 results: applying COS 2015 for mainland Portugal

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (km²)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4	2.27	0.06	38.75	1.46	0.20	27.36	70.11
K5	365.64	104.78	908.09	1.26	10.10	163.32	1553.19
K6	12230.65	6138.39	6648.05	120.41	811.03	249.66	26198.18
SUM	12598.56	6243.23	7594.89	123.13	821.33	440.34	27821.48
	SUM of green cover classes: 26436.68			**SUM of other land cover classes: 1384.80**			

PORTUGAL: Continent							
Mountain Area and Land Cover - Land Use Relation (%)							
Kapos	**Forest land**	**Cropland**	**Grassland/ Shrubland**	**Wetlands**	**Settlements**	**Otherland**	**Total area Kapos**
K4	3.24%	0.08%	55.28%	2.08%	0.28%	39.03%	100%
K5	23.54%	6.75%	58.47%	0.08%	0.65%	10.52%	100%
K6	46.69%	23.43%	25.38%	0.46%	3.10%	0.95%	100%
SUM	45.28%	22.44%	27.30%	0.44%	2.95%	1.58%	100%
	SUM of green cover classes: 95.02%			**SUM of other land cover classes: 4.98%**			

Annex 23 – Indicator 15.4.2: FAO data points accuracy examination

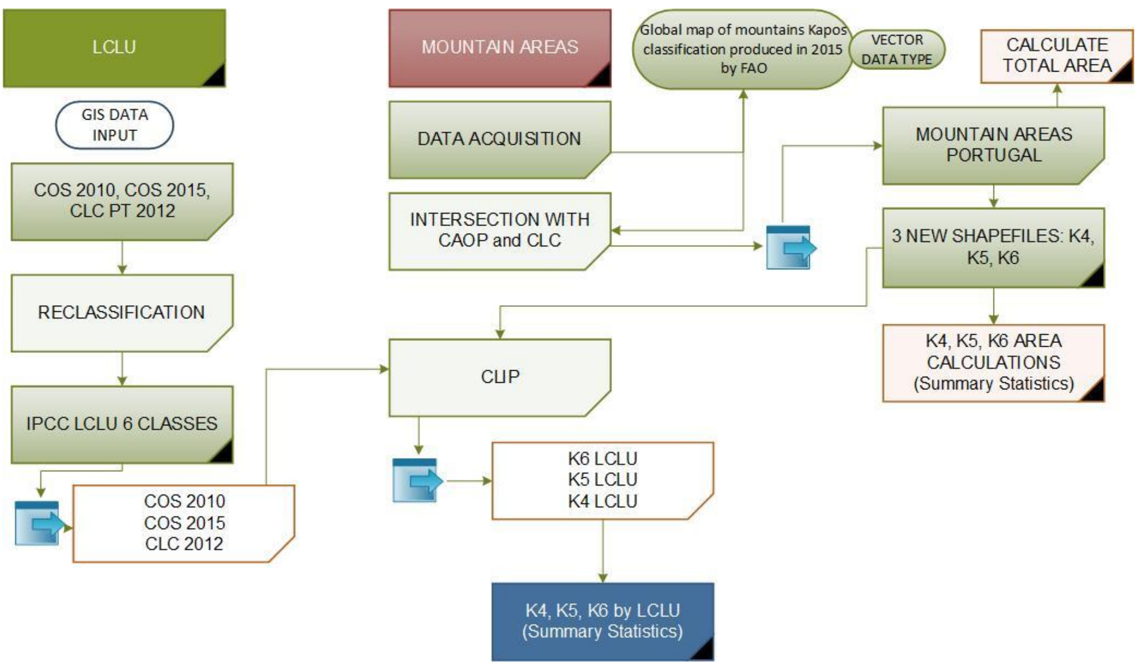


Annex 24 – FAO data points accuracy examination – Quantifying FAO results obtained from the application of their methodology and analysis

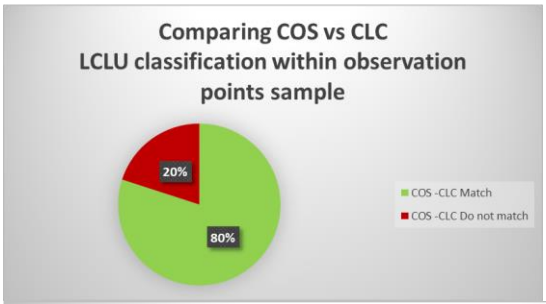
Mountain Classification	FAO points*
K4	0
K5	10
K6	102
Total	**107**

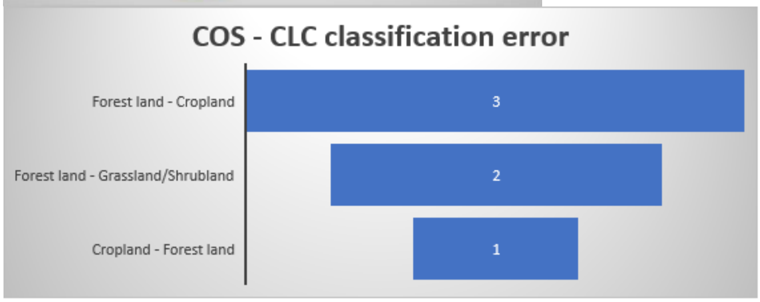
		FAO Classification						
Mountain Classification	**FAO points***	**Forest**	**Cropland**	**Grassland**	**Wetlands**	**Settlements**	**Otherland**	**Total**
K4	0							0
K5	5	2	1	2				5
K6	102	44	22	18		7	4	95
Total	**107**	**46**	**23**	**20**	**0**	**7**	**4**	**100**

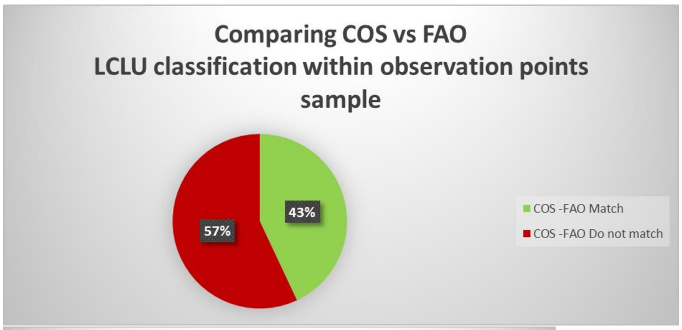
Annex 25 – Summary of the methodology for the production of indicator 15.4.2

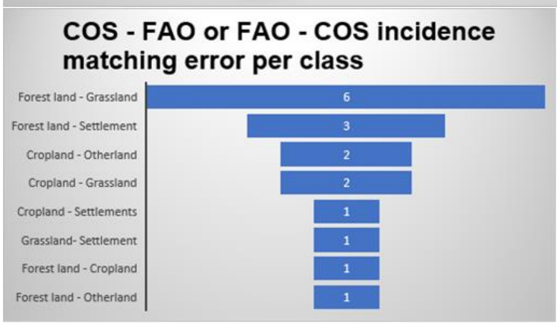


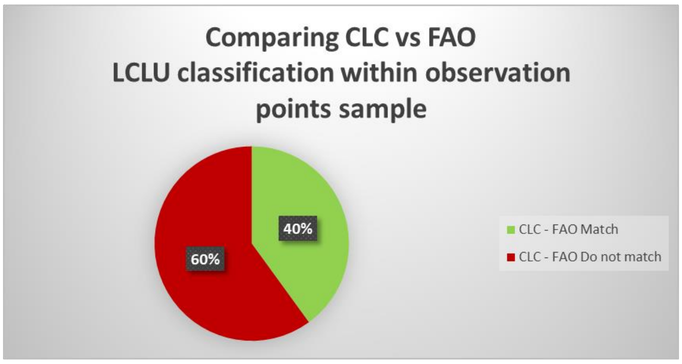
Annex 26 – Comparison of LCLU classes within observation points;











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