



# Table of Contents

|                               |          |
|-------------------------------|----------|
| <b>TABLE OF CONTENTS.....</b> | <b>2</b> |
| <b>INTRODUCTION.....</b>      | <b>3</b> |
| <b>NEXUS WORKFLOWS.....</b>   | <b>4</b> |
| <b>DEMONSTRATOR .....</b>     | <b>5</b> |
| <b>SUMMARY .....</b>          | <b>7</b> |
| <b>REFERENCES.....</b>        | <b>8</b> |

## Introduction

In the context of the food, water and energy (FWE) nexus, Geo-Essential WP6 is contributing to the GEOEssential knowledge base infrastructure with the determination of the required FWE Essential Variables (EV) considering the related European policies, Sustainable Development Goals (SDG) and modelling requirements. Workflows have been established from EVs derived via multiple EV Services (WP3). This includes multiple open data streams (e.g. remote sensing, in-situ, citizen science, social media, telecommunications, socioeconomic data and more) obtained via a variety of sources. Several case studies have been selected for implementation across Europe, with the results being integrated into a nexus approach. Finally, the information will be transferred to the SDG dashboard (WP7).

Geo-Essential Deliverable-6.3 describes the integration of the Food, Water and Energy (FWE) workflows in the form of an online Demonstrator available [here](#). This Deliverable builds upon the efforts to date in WP6 which is tasked with exploring the FWE Nexus. In particular, WP 6.2 has developed a variety of workflows based upon earth observation derived essential variables for the food, water and energy domain, upon which this Demonstrator is built.

## Nexus Workflows

The following describes the various nexus workflows which have been established over the course of activities in WP 6.2:

### ***Subtask 6.2.2 EVs for water and agricultural monitoring (JFZ)***

Integrative water fluxes for Europe from groundwater to the upper atmosphere were simulated by the TerrSysMP system to assess agricultural drought, related irrigation demand, and groundwater depletion. (*Scale: Europe*)

### ***Subtask 6.2.4 EVs for FWE monitoring/modeling (IIASA)***

The GLOBIOM model was investigated for data needs to guide nexus monitoring efforts via earth observation. In particular, the Water Scarcity Index (WSI) was estimated, taking into account climate change and water constraints for agriculture and industry (*Scale: Global*)

### ***Subtask 6.2.5 EVs for agricultural monitoring (SRI)***

Involved monitoring of essential environmental variables (e.g. LAI) and essential agricultural variables (e.g. land use, cropland area, crop type areas) based on data fusion of Copernicus land Services (low resolution), Sentinel 1-2 (high resolution) satellite data and crowdsourcing (citizen science). (*Scale: Ukraine*)

## Demonstrator

The Food, Water and Energy Nexus integration is available [here](#) in the form of an online Demonstrator. The Demonstrator is fully open and publicly available. The Demonstrator provides basic access to several datasets produced from various workflows in WP6 and demonstrates the possibilities for the integration of this information (Figure 1,2). This is the beta version, with improvements planned for the future. More information [here](#).

As a demonstrator, it provides the results from three GEO-Essential workflows, allowing the user to explore the outcomes in a nexus context.

1. **Food:** SDG 2.4.1 Vegetation land cover and productivity across Ukraine
2. **Water:** SDG 6.4.2 Evaporative Drought Index across [Europe](#)
3. **Nexus:** Water Scarcity Index, taking into account climate change and water constraints for agriculture and industry. [Global](#).

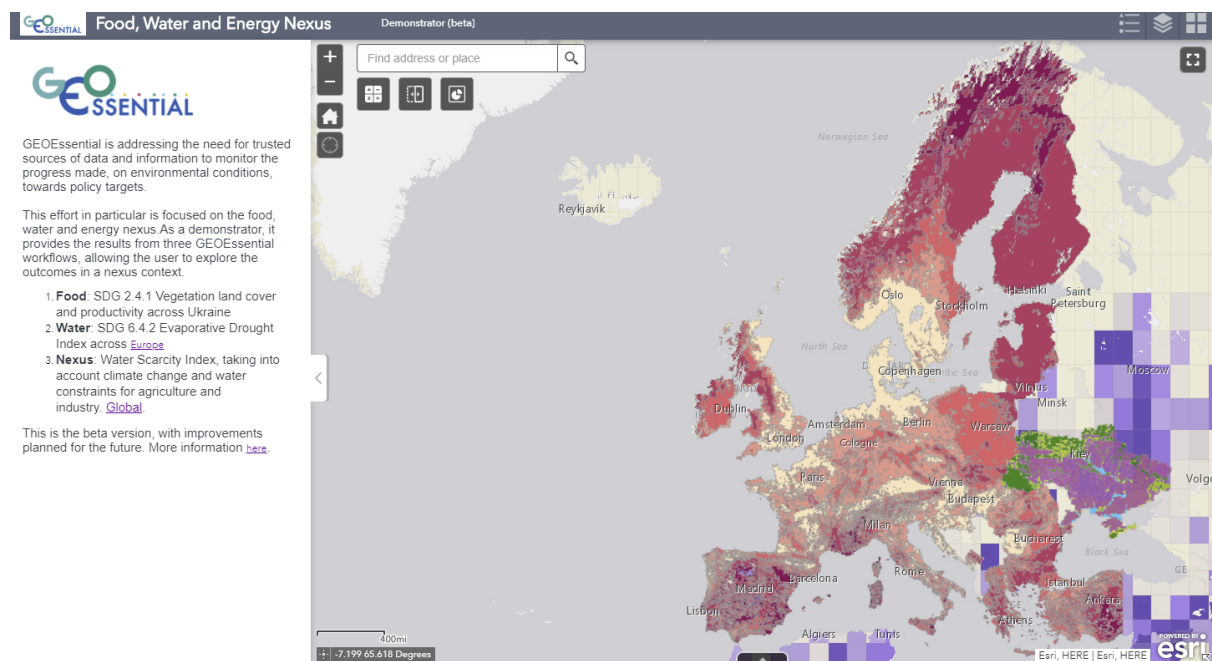


Figure 1. Landing page of the Food, Water and Energy Nexus Demonstrator.

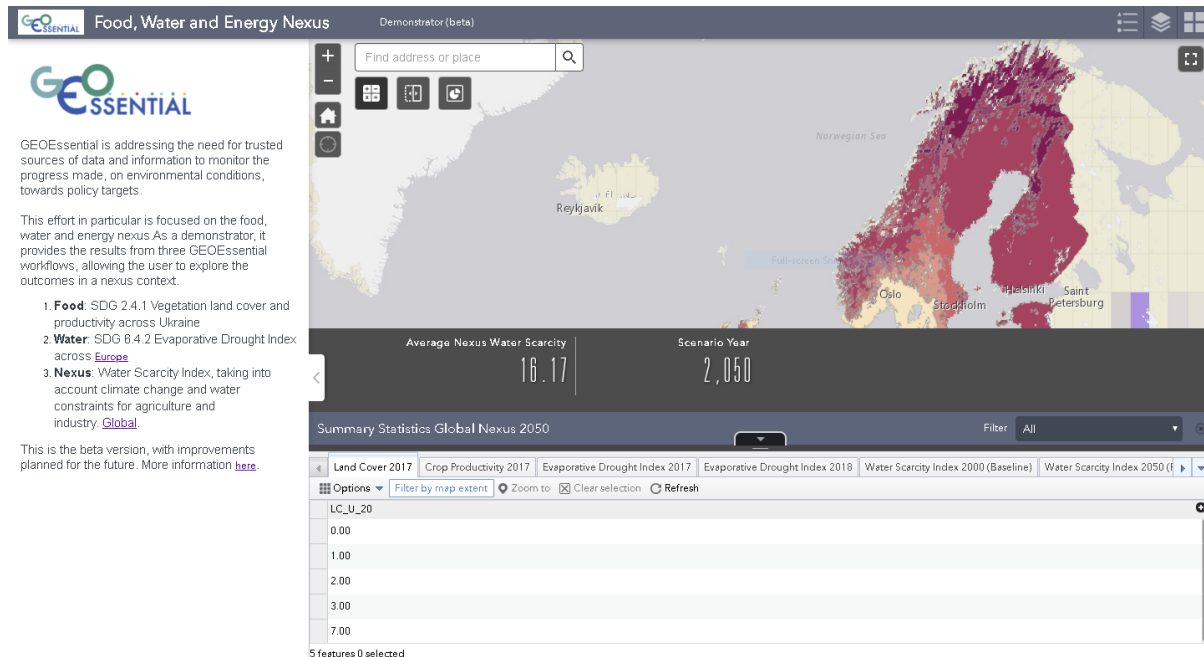


Figure 2. Nexus Demonstrator, showing related database and statistics.

## Summary

As described above, the beta version of the Food, Water and Energy Nexus Demonstrator is online. The Demonstrator presents several datasets produced by various workflows in WP6 in the Food, Water and Energy domains. Each of the workflows however produces data via different means, with differing spatial resolution, temporal resolution and priorities in terms of what they are addressing. Integrating this information is challenging, with this Demonstrator being the first step in this direction. With improvements planned over time, the Demonstrator can be updated as new information becomes available.

Integration of nexus related information is indeed a challenge particularly as we are using disparate models within GEO-Essential. These models were never designed to work together and hence address very different aspects of the environment and economy. Applying their outputs to a common problem is difficult, further hampered by the issues raised above (i.e. different spatial resolution, temporal resolution). Nevertheless, this Demonstrator gives a first impression of the potential for integration of nexus related information to address the food, water and energy nexus. Ongoing efforts such as the Integrated Solutions for Water, Energy, and Land Project ([ISWEL](#)) are helping to address these efforts.

## References

McCallum, I., C Montzka, B Bayat, S Kollet, A Kolotii, N Kussul, M Lavreniuk, A Lehmann, J Maso, P Mazzetti, A Mosnier, E Perracchione, M Putti, M Santoro, I Serral, L Shumilo, D Spengler & S Fritz (2019): Developing food, water and energy nexus workflows, International Journal of Digital Earth, DOI: 10.1080/17538947.2019.1626921

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