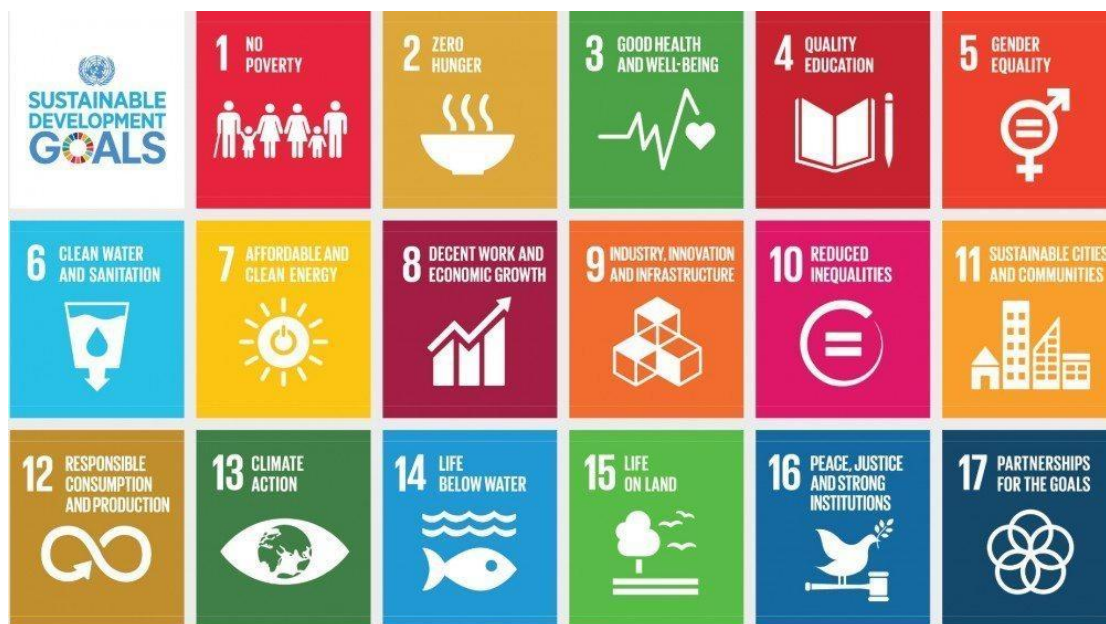# Systems Thinking, Scenarios and Indicators for SD (GEO4-2331)

2022-2023

Assignment 4:
Quantitative research on Sustainable Development Goals and Sustainability Indicators

Introduction

Outline

To determine how Sustainable Development Goals (SDGs) can be achieved, policy makers and sustainability professionals require what is called useable knowledge[1] on socio-economical, ecological and technological developments. This knowledge can be provided by scientific research. For this assignment groups of three, four or five students conduct a quantitative scientific research project focused on generating usable knowledge on a topic that involves sustainability indicators and their role in achieving a specific SDG. The assignment is designed to apply and integrate the knowledge and experience gained during the course Systems Thinking, Scenarios and Indicators (STSI) for sustainable development. A key objective of this assignment is to learn how to ask a suitable quantitative research question[2] in the context of research on indicators for sustainable development.

The outcomes of the research assignment are presented orally and in writing during the final week of the course. Two intermediate deadlines facilitate continuous progress with the research assignment. Quantitative analysis of data and/or system behaviour is an explicit part of this assignment. You are encouraged to use one of modelling platforms or quantitative methods of prior course assignments (Stella, Netlogo, Excel) for your own quantitative research on sustainability indicators. All prior course material should be considered as background knowledge for this assignment.

Assignment goals

By completing this assignment, you will be able to:
- Critically assess and compare indicators that are used in the UN SDG frame work;
- Develop comparative and/or relational research questions to study the behaviour of indicators in the context of sustainable development;
- Conduct quantitative research and generate usable knowledge on indicators for sustainable development;
- Present your research findings in oral and written format.

Deadlines

The assignment is introduced in the last week before the Christmas break and finishes with a presentation and final paper in the last week of the course. You are expected to integrate the knowledge and skills gained during the previous lectures and assignments of the course. Specific computer labs are scheduled to work on the assignment. During these moments teaching staff is available to answer questions and discuss your approach. You are also expected to allocate time to work on the assignment outside the scheduled computer labs.

In addition, the following feedback moments and deadlines have been set to warrant your continuous progress:
- Tuesday 20 December: Submit your group composition (https://edu.nl/erruu) and research proposal (via Blackboard) (**step 1**);
- Friday 23 December 17:00: Hand in conceptual framework and methodology (system overview and methods, including an overview of available data) (**step 2**);
- Monday 9 January: In-class feedback on conceptual framework and methodology;
- Thursday 19 (11:00-12:30): Q&A hour;
- Monday 23 January: Final oral presentations (**step 3**);
- Friday 27 January 17:00: Hand in final paper (including presentation slides) (**step 3**).

Grading

Both the oral presentation and the final paper will contribute to your grade in this assignment:
1. Presentation – we will follow the oral presentation assessment form (**Appendix A**). The presentation grade will account for 25% of the assignment grade.
2. Paper – we will follow the paper assessment form (**Appendix B**). The paper grade will account for 75% of the assignment grade.
3. In total, the assignment contributes for 30% to the overall course grade.

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[1] Clark WC, Kerkhoff L van, Lebel L, Gallopin GC. 2016. Crafting usable knowledge for sustainable development. Proceedings of the National Academy of Sciences 113: 4570–4578.

[2] See the document 'What is a 'good' scientific research question and hypothesis?' on Blackboard.

Assignment description

To guide you through the process of designing and conducting your own research, this assignment guide has broken down the process in the following steps.

1: The research proposal

Step 1.1: Form a group

The indicator research assignment is conducted with a group of three, four or five students. It is expected that students self organize the group composition and manage the collaboration process. The course guide contains suggestions on effective collaboration and discusses the system in place to prevent issues in the group collaboration. Keep in mind that all scheduled computer labs and tutorials are mandatory, so use these moments to meet in person and collaborate effectively. Additional time should be allocated to collaborate outside scheduled hours as well.

Step 1.2: Select your Sustainable Development Goal

In this assignment you are asked to pick an SDG to focus the research on, and read the associated targets.

→ *Go to the following link and explore the different SDGs as defined by the UN:*
http://www.un.org/sustainabledevelopment/sustainable-development-goals/

→ *Also take an in-depth look at the UN SDG indicator list linked here:*
https://unstats.un.org/sdgs/indicators/indicators-list/

Now select one SDG that your group finds most interesting and relevant to study in this project.

Step 1.3: Literature review on sustainable development goals and their targets

Most of the SDGs and their targets are already being studied in scientific research. Use the well-known search engines and UU library to search for relevant scientific literature on your SDG. Some of this research may involve specific indicators that could be useful for your project. Scientific research could, for example, highlight a new or better method to collect data, or an alternative method to quantify a specific indicator to reach an SDG. Or it could focus on the question whether or not we are in the trajectory of meeting a specific target, by measuring a given indicator at multiple points in time or modelling their behaviour. Your review of scientific literature should include a minimum of 5-10 relevant scientific papers.

→ *Search the literature and become aware of the pressing research questions related to your selected SDG and target, and the sustainability indicators used in this research. To structure your search, fill-out **Table 1**. Note that you are free to resize the cells to fit the required information, but keep it relatively short. The table helps you to keep an overview of the different papers and their content:*

Table 1: Overview of key research components

Author(s)	Title	Main SDG	Main Target	Set of Indicators and/or data	Gap in knowledge	Main findings and next steps

Step 1.4: Develop a causal loop diagram or conceptual framework reflecting your topic

At this point you should be aware of the scientific literature on your specific topic, and have identified the knowledge gap that you want to address. To develop a causal loop diagram or conceptual framework you should think critically about the components that are central to your research, and how they interact and relate to each other. Also it is wise to leave-out components that are not specifically relevant to your study. Keep the system as simple as it can be, but not simpler.

→ *Make a drawing or chart that describes the key components of your research, and indicate the relationships between these components. In your causal loop diagram or conceptual framework you could, for example, include the expected mechanistic links between the dependent (effect) and independent (cause) variables, note potential confounding variables (outside the controlled study, but important to consider), and outline the context of the study. The framework should clearly outline how the SDG and target are related to the indicator, and which variables are measured and may be included in the research question that you will develop later. During this phase of the study it is natural to go back and forth between the different parts of the proposal to create a coherent framework. Often this process involves revisiting the initial arguments regarding why certain variables were chosen, or why one aspect of the problem was selected, and not another. Note that there are many ways visualize your conceptual framework, and this may require some creativity (you may draw by hand or computer).*

Submit group composition (https://edu.nl/erruu) and hand-in research proposal for the research assignment via Blackboard on Tuesday 20 December

Here we expect you to hand-in a document which includes:

1. The members of the group, and optional team name (*catchy names help the teaching team to remember the different groups*);
2. The sustainable development goal that you choose, and the main target and set of indicators;
3. Filled out table 1, with approximately 5-10 relevant references. More references are allowed, less references not. If you struggle to find enough relevant literature, adjust topic or broaden scope;
4. Causal loop diagram or conceptual framework: the graph/diagram you produced that frames the research project and identifies which part of the gap in knowledge you will be addressing;
5. Reference list of all papers in the Table 1.

→ *Based on this research proposal you will be assigned to a project advisor. This is your go-to person when you have questions and want to discuss the progress of your research in detail. You will be informed about your assigned advisor before the first tutorial after the Christmas break.*

2: The research questions and research methods

Step 2.1: Define gap in knowledge

The literature will often indicate gaps in knowledge that provide interesting research topics for future study. In this step you are asked to select a gap in knowledge and define your own specific research aim, research question and hypothesis to narrow that gap.

→ *Review the literature on your topic with the intent to develop your research question, aim or hypothesis focused on a specific gap in knowledge. You can base yourself on the papers included in the table 1 that was part of the proposal, but you may also add other literature that could be relevant.*

Step 2.2: Develop a quantitative research question

As a hint for step 2.2 it is advised to make your research question as focussed and specific as possible, while being feasible, relevant and informative. For example, you could narrow-down your research question by looking at a local issue, or study the local implementation of monitoring progress towards a specific SDG. Further, it is preferred that you ask a **comparative** or **relational** type of research question. The **descriptive** and **causal** type of research questions are usually not suited for the indicator research. A more detailed explanation on research questions is given in the document '*What is a 'good' scientific research question and hypothesis?*'

→ *Write down your research question (multiple revisions and group discussions are likely needed)*

Step 2.3: Develop the analytical framework

After you have written down your research question, it is time to outline how exactly you will conduct the study to answer the question. This is done in the analytical framework. The analytical framework thus links your research question to the methods that you will apply to analyse the data or system behaviour (using a model). Please note that the analytical framework differs from the conceptual framework by more specifically indicating which steps are taken in the research to test the hypothesis and answer the research question. In short, the analytical framework outlines the step-by-step methods applied in the study and the data that will be used.

→ *Add a step-by-step analytical framework that describes how the relationships established in the conceptual framework will be measured, and studied to test the hypothesis and answer the research question.*

An important aspect of the indicator research is that you apply one of the modelling platforms taught in the course (Stella, Excel, or NetLogo). Moreover, you will likely need data in order the quantitatively answer your research question. For example, you can use Excel to calculate and compare the development of different indicators. A variety of data sources have been discussed in the lecture on data for sustainability science, but many more data sources can be found online.

→ *Outline which data sets are needed and the methodological approaches that will be applied. Clearly describe how your model framework and the data sets will be used.*

Hand-in your research questions and analytical framework for the indicator research project via Blackboard before Friday 23 December

We expect you to hand-in a document where in approximately 1500 words* you describe:
1. The (revised) sustainable development goal that you choose, and the main target and indicators;
2. The (revised) research aim, research question and (optionally) hypothesis;
3. The (revised) causal loop diagram or conceptual framework;
4. The analytical framework, *e.g.* the step-by-step method, including;
    * The modelling platform that you will use (Stella, Excel, NetLogo);
    * The data sets that will be used (make sure that you can actually access the data);
5. Reference list.

* Word counts do not include abstract, tables, reference list, and data appendices

→ *Based on your research questions and analytical framework the assigned advisor will provide specific feedback regarding your proposal and discuss the good points and the points of improvement for your research. The feedback will be based on the table shown in **Appendix C** and can be discussed during the tutorials or by appointment as arranged with your supervisor.*

3: The research

Step 3.1: Conduct your research

After finishing your research proposal you have time conduct the research. This will basically follow the steps that you have outlined in the analytical frame work. If any issues arise, you can discuss them with the assigned project advisor. Keep in mind that you are working towards presenting your research in the format of an oral presentation and a scientific paper.

Step 3.2: Communicate your research findings in an oral presentation

The indicator research is presented in the format of an oral presentation and a scientific paper. The oral presentations of the results are scheduled on Monday January 23 between 15:15 to 19:00. Each group is allowed to present for 4 minutes. A minimum of two students should actively contribute to the presentation. Given the short time available, it is crucial to manage your time effectively and only communicate your main message. See **appendix A** for the presentation assessment form. ***There will be prizes for the best presentation!!! These will be selected by popular vote and the instructors' assessment.***

The following points should be part of the oral presentation:
- Title slide, author names
- Title: describes the subject and what aspect of the subject was studied
- Introduction: what is the problem, why is it important and how do you plan to tackle it
- Methods: Your approach – very summarized but show the causal-loop diagram or conceptual framework if possible
- Results: Key findings of your research
- Discussion: Did you answer your research question? Do your findings match or not with your hypotheses? How do your findings compare to the published literature on the topic?
- Take home message: one key sentence that describes the findings

Step 3.3: Communicate your research findings in writing
The paper has a maximum length of 2500 words*. See **appendix B** for the paper assessment form.

Check the following page for more information and examples on writing scientific papers:
Emily Wortman-Wunder and Kate Kiefer (1994 - 2012). Writing the Scientific Paper. Writing@CSU. Colorado State University. Available at http://writing.colostate.edu/guides/guide.cfm?guideid=83.

The paper should have the following structure and content:
1. Title, author names
2. Abstract (max. 200 words). It contains the main reason for the study, the key findings and what those findings mean.
3. Introduction: explain <u>why</u> the study was conducted. Also include:
   - The causal-loop diagram or conceptual framework
   - The aim and research question, and (optionally) the hypothesis
4. Methods: describe <u>how</u> the study was conducted
5. Results: show the key quantitative results (graphs) and describe <u>what</u> was found
6. Discussion: explain <u>why</u> the results could be significant. Did you answer your research question? Do your findings match or not with your hypotheses? How do your findings compare to the published literature on the topic? What did we learn from your study?
7. Conclusion: write down your conclusion in one paragraph

* Word counts do not include abstract, tables, reference list, and data appendices

<u>Hand in your final paper and presentation slides via Blackboard before Friday 27 of January</u>

Appendix A: Presentation assessment form

Student names:		Date:		
Presentation title:				
Criteria	Good points / to be improved		Grade	
Content: - Clear aim, methods, results, conclusions - Informative text				60%
Layout / Design: - Not too much text (max 25%) - font readable from distance (not too small) - good use of slides				15%
Figures & illustrations: - Figures are informative - Figures are easy to interpret				10%
Presentation: - Within allocated time - Clear and to-the-point speaking - Contact with audience				15%
Specific attention points:				
Final grade:				

Appendix B: Paper assessment form

Student names:	Date:

Paper title:

Content (70%)

Introduction Problem definition Aim Research questions Hypotheses	
Methodology / Data analysis	
Results	
Discussion and conclusion	

Design (30%)

Structure of report	
Wording / readability / language	

Final remarks:

Final grade:

Appendix C: Feedback on research questions and analytical framework

Student names and IDs (group name):		
What is checked	**Ok**	**Additional comments**
There is a clear, concise and feasible research question and aim.		
The conceptual framework is complete and clearly connected to the research question and aim.		
The step-by-step method is complete and clearly connected to the research question and aim.		
Data sets are indicated and available. Data availably has been confirmed by the student.		
Modelling platform / method for data analysis has been indicated. The use of this modelling platform / method for data analysis is feasible and clearly connected to the research question and aim.		
Additional comments/suggestions:		