Inter- and Intra-Goal SDG Target Interactions in the Philippine Context: A Two-Method Approach

Bongolan, V., Soria, S., Rivera, R.

System Modelling and Simulation Laboratory
Department of Computer Science
University of the Philippines—Diliman

Abstract

In 2015, the United Nations developed 17 Sustainable Development Goals (SDGs) with 169 targets for a more sustainable future by 2030. This study seeks to evaluate and analyze intra- and inter-goal SDG target interactions within the Philippine context to determine what to mitigate and what to prioritize.

To evaluate all 14196 target interactions, two methods are employed. First, experts with over five years of SDG-related experience evaluated interactions using the 7-point scale. Second, official indicator data is run through a Spearman rank correlation, with resulting coefficients serving as interaction scores. Interaction scores are then interpreted to be indivisible, cancelling, or consistent. Targets are modelled as nodes and interactions as edges.

With 1256 evaluated interactions under expert evaluation and 1914 under official indicator data, results were integrated to formulate recommendations for concerned parties. This includes the mitigation of self-conflicting target interactions under SDG 3 “Good Health and Well-Being” with an emphasis on targets 3.6 “Halve traffic accident deaths” and 3.9 “Reduce pollution-related deaths”. These targets as well as 8.2 “Economic productivity”, and 16.1 “Reduce violence” also have multiple negative interactions that need to be mitigated.

Targets that reinforce their corresponding SDGs should be prioritized, including 1.1 “Eradicate extreme poverty”, 1.2 “Halve poverty proportions”, 3.2 “End preventable deaths”, 3.5 “Prevent substance abuse”, 3.9 “Reduce pollution-related deaths”, 3.9 “EW risk reduction”, 4.2 “Early education”, 4.B “Higher education scholarships”, and 6.2 “Sanitation and hygiene”. “Beautiful” targets (no negative interactions) should also be prioritized by score, namely, 3.D “Early warning systems for health risks”, 8.A “Trade support aid”, 15.B “Sustainable forest management”, and 17.1 “Domestic revenue collection”.
I. Introduction

1.1. Background of the Problem

In 2015, the countries which took part in the United Nations General Assembly agreed to adopt the 2030 Agenda for Sustainable Development. This agenda, often referred to as Agenda 2030, endeavors to be a framework through which a better future can be secured for the global community. This is to be accomplished by addressing issues of health, education, inequality, and environmental preservation, all in a concerted effort towards sustainability. These global issues will be addressed by focusing on the 17 Sustainable Development Goals, commonly referred to as SDGs, with 169 specific targets that all involved countries should strive to realize by the year 2030.

1.2. Statement of the Problem

At present, the Philippines is still considered to be a third world country. Plagued with corruption in the government, a lack of quality education, and poor access to healthcare, the country continues to struggle in its overall development. The 17 Sustainable Development Goals of Agenda 2030 were designed by the United Nations to be a model through which all countries regardless of development status can work towards a better and more sustainable future. The goal of the study is to identify what priorities should be made to achieve this agenda. To this end, the study seeks to identify which targets have conflicting interests and which ones positively reinforce each other, both inter-goal and intra-goal.

In order to do this, the study approaches the problem via two methods, viz: a) by panel of experts (ISC, 2017) and b) analyzing official indicator data (Pradhan, 2021). The respondents for the first method will provide an evaluation on the inter- and intra-goal interactions between the 169 targets underneath the 17 SDGs. They are also to provide professional insight regarding those interactions that considered negative (cancelling). These insights can guide policy makers on how these conflicts can be mitigated for the country to carry out the 2030 Agenda.

1.3. Scope and Limitations

Experts who have contributed to the study hail mostly from (1) the University of the Philippines College of Social Work and Community Development and (2) the UP National College of Public Administration and Governance in the University of the Philippines—Diliman. Their responses, in the form of SDG interaction scores dated up until February 2022, will be analyzed herein.
For the goal interactions, data has been retrieved from a study conducted by Anderson (2021) wherein a Spearman rank correlation was run on publicly available UN indicator data from 2018.

With the implementation of the system required for the study already in place, this paper will focus more on improvements made on the existing implementation and the results and discussion based on current data.

Results of the study are limited to the Philippine setting although the methodology may be adapted to other contexts.

1.4. Significance of the Study

An analysis of SDG target interactions can assist in directing the country’s efforts to achieve the 2030 Agenda by taking advantage of positive target interactions as well as pointing out negative interactions that need to be further investigated and mitigated. By limiting analysis to the Philippine context, insight on performance in terms of the 2030 Agenda would be better suited to the country’s status.

II. Research Design and Methodology

Previous studies have employed two main methods to evaluate SDG interactions namely: expert evaluation (ISC, 2017) and official indicator data (Pradhan, 2021). Both methods have been used in this study in order to get insight from both and draw an integrated conclusion.

In order to gather data for the first method and display the results for both methods, a web application was developed and deployed to Heroku at the address http://sdg-interactions.herokuapp.com/. This application is divided into two main components which will be discussed hereafter:

1. Front-end (user interface and design): ReactJS, a JavaScript framework
2. Back-end (data management): API (Application Programming Interface) developed using Flask, a Python framework.

The front and back-end components of the system have been developed separately, both deployed to Heroku, with the front end serving as the home of the main website.

2.1. Web Application
2.1.1. Front-End Development: React

React was used for the front-end development of the project. It is a JavaScript library used for making user interfaces on mobile and web applications. It was used to manufacture and design user views, administrator views, and functionalities to be used for the study. Some functionalities involve submitting survey answers, reviewing answers, and choosing goals, depending on whether the person is an administrator or a user. Privacy measures have been taken to limit viewing of certain pages to administrator privileges. Figure 1 shows the different capabilities of users and administrators.

![Figure 1. Admin and User privileges](image)

The developers also made use of Reactstrap to integrate needed components from Bootstrap. Axios, a Promise-based HTTP client widely used by React developers, was also utilized in order to connect to the database.

The most significant tool used for the application was the react-d3-graph library, which makes possible the creation and design of the graphs needed to analyze the results of the study.

2.1.2. Back-end Development: Flask

The back-end of the system serves up a RESTful API that collects, saves, and processes the data and was developed on top of Flask. The API requests handle user creation and data gathering.
PostgreSQL is the database management system used, interfaced with the Python SQL toolkit, SQLAlchemy. Four models are used in the system: the User model, the SDG model, the User to SDG model, and the Survey Answers model.

All necessary information in relation to the users are stored in the User model. Besides their login credentials, it also contains information to check if they are qualified to participate in the study such as educational attainment and years of experience. A user may only start answering the survey upon approval of an administrator. Their corresponding curator, stored in the database as their contact person, will be notified of their sign-up via email and on their dashboard so that they can be approved to proceed with the survey. Other information stored include the users’ affiliations and their preferences on whether they would like to be acknowledged in the study.

SDG target descriptions are stored in the SDG model to serve as reference for the users while taking the survey or viewing the graphs and other result features.

The User to SDG model stores the users’ chosen SDGs based on their expertise. From the chosen SDGs, SDG target interaction pairs are generated and linked to the user, which are then stored in the Survey Answers model as the users evaluate the interactions. The APIs created handle the processes to be discussed in Data Gathering.

2.2. Data Gathering

2.2.1. First Method: Expert Evaluation

For the first method, using expert evaluation, in order to ensure the credibility of the SDG target interaction scores, the respondents are screened by the study’s curators and through the sign-up page of the web application. Qualified respondents are required to have at least five years of experience in their respective fields related to the advancement of the SDGs. Having mostly been recruited by the study’s curators, each viable respondent was invited to apply for an account on the web application. Figure 2 shows the sign-up interface where all the necessary information required from the respondents are shown. Their selected contact person/curator will then be notified via email as well as on their administrator dashboard of a pending request to be approved in order for the respondents to be able to proceed with taking the survey for the purposes of data gathering.
Once the respondent’s account has been approved, they will then be able to log into the website wherein they will be asked to choose a minimum of two SDGs that are best aligned with their areas of expertise, an example of which is shown on Figure 3. From their selected SDGs, the system will then generate a series of SDG target pairs for them to evaluate.
Each SDG target pair generated by the system represents an interaction between two SDG targets, and the users will then have to score each pair positive or negative by a qualitative approach using the same 7-point scale used by the International Science Council (2017). The seven points on the scale are as follows: -3 for cancelling, -2 for counteracting, -1 for constraining, 0 for consistent, +1 for enabling, +2 for reinforcing, and +3 for indivisible.

For each evaluation given, the respondent also has the option to provide an explanation for their response, especially for those for which a negative score was given, in which case such an explanation is required. These explanations are meant to provide insight into the nature of the target interactions as well as what factors may have caused them to merit such an interaction. For negative interactions, an explanation for the respondents may also provide ideas on how the trade-offs can be mitigated. Users have the option to skip certain SDG target interactions that they do not wish to answer at the moment which allows for flexibility. As long as they have not finalized their answers by submitting them, they can come back at a later time to provide their scoring.
SDG target pairs are bound to their user and will not be reassigned to a different respondent. Thus, all respondents will be required to answer all target pairs given to them, underscoring the importance of thoroughly screening and briefing the survey respondents since the assumption is that all the respondents have sufficient experience to provide a reliable evaluation. Figure 4 shows an example of an SDG target interaction pair to be scored.

Each SDG target pair is to be scored only once, which means that the score given by the respondents will be deemed final. Provisions are made to allow users to review and edit their answers. However, once they submit their answers, the responses and thus the target interaction scores will be saved to the database and immediately reflected in the results pages of the web application, including all related graphs.

2.2.2. Second Method: Official UN Indicator Data

For the second method, official indicator data publicly available on the United Nations SDG website was used. This data has then been passed through a Spearman rank correlation. For the purposes of this study, the results provided by Anderson (2021) have been used which
takes official indicator data from 2018 and provides the different correlation coefficients for interactions at the indicator level.

Since this is a newer venture within the study and for the sake of uniformity with the existing system used for the first method, these correlation coefficients were averaged at the target level to provide a scoring for target interactions similar to the scores given by respondents. A similar threshold as Anderson (2021) has been used in interpreting the resulting correlation coefficients. That is, for coefficients less than or equal to -0.6, the interaction is considered to be a trade-off (at the goal level) or cancelling (at the target level). For coefficients greater than or equal to 0.6, the interaction is considered to be a synergy (at the goal level) or indivisible (at the target level). Values in between -0.6 and 0.6 are considered to be neutral (at the goal level) or consistent (at the target level). Target level labels have been adapted from the 7-point scale used by ISC (2017).

2.3. Graph Views

The current progress of the study, based on how much data has been gathered so far, can be viewed by the public on the website. That is, one does not need to have an account in order to view the graphs and other results of the study.

A graphical representation is used by the study in order to capture the nature of different target interactions whether they be positive (indivisible), negative (cancelling), or neutral (consistent). The graphs portray SDG targets as the nodes or vertices while the edges or links that connect all the nodes with each other represent the target interactions.

Nodes in the different graphs are color-coded based on the color of their corresponding SDG as displayed in the official UN SDG website and in Figure 5. The nodes are also labeled with their SDG and target number. Target interactions that have been evaluated to be positive (indivisible) correspond to the blue edges, negative (cancelling) interactions correspond to the red edges, and neutral (consistent) interactions are represented by black edges.
For the resulting graph for the first method, different shades of blue or red are used for the links corresponding to positive or negative interactions respectively. That is, the more positive or the more negative the interaction is, the darker the shade of the color used for the link. For the results of the first method, target interactions that have not yet been evaluated and still need to be colored by future respondents are represented by gray edges.

On the other hand, for the results of the second method, links for either indivisible, cancelling, and consistent interactions are simply colored blue, red, and black respectively. For interaction scores that have insufficient data, that is, there is no indicator data available, the links are colored a light purple.

Both nodes and edges can be clicked to display details about the chosen target and interaction respectively. The graph may also be resized and moved around for ease of use.

The different graphs used in the web application are discussed hereafter.

2.3.1. Graph Query

A graph query interface has been provided to display the results of both data gathering methods used. In a graph query page, users can select two SDGs to generate a graph for. The
system will then display a graph showing the interactions, represented as links or edges in the graph, between the targets of the selected SDGs, represented as nodes or vertices. A sample of the network of SDG target interactions can be seen on Figure 6.

![Graph Query Interface]

**Figure 6. Graph Query Interface**

2.3.2. Goal Interactions Graph

Two versions of a graph of goal interactions have been created for the second method results.

The first version, as shown in Figure 7, is a complete goal interactions graph which display an interaction network at the goal level instead of the target level. For this graph to be generated, the target interaction scores derived from indicator level Spearman rank coefficients are further cascaded upward to the goal level and averaged to result in goal interaction scores. This graph is similar to previously discussed ones. We refer to goal interactions evaluated 0.6 and greater as synergies, -0.6 and lesser as trade-offs, and everything in between as neutral. We also portray “perfect” goals to have a green halo, signifying that the goal is synergistic with itself based on its intra-goal interaction score.
The second version, as shown in Figure 8, is just a simplified view of the former where neutral and unevaluated goal interactions are eliminated, giving us a graph of only synergies and trade-offs between goals.

2.4. Other Featured Pages

Other featured pages display the current results of the study in text or tabular form for readability.

For both methods, a page listing all target pairs with negative (cancelling) interactions is provided as well as a page for positive (indivisible) interactions. Another page displays a list of all targets with their descriptions, color-coded to show whether they are beautiful or ugly. Beautiful targets, those that do not have any negative interactions, are colored blue while ugly targets are colored red. Those that do not have an evaluation yet are colored black.

For the second method, a page called “Synergies and Trade-offs” is also provided wherein a list of all goal pairs is given arranged in ascending order based on their corresponding mean Spearman rank correlation coefficients. The pairs are color-coded based on whether they are synergies, trade-offs, neutral, or have insufficient data. Synergies are colored blue, trade-offs are red, neutrals are black, and those with insufficient data are colored light purple. This is the same color-coding system used in the graph edges.
III. Results and Discussion

Since two methods for data gathering have been used, results from both methods will first be discussed separately then integrated together in order to draw conclusions.

3.1. First Method: Expert Elicitation Process

Of the 14196 (=169*168/2) edges (target interactions), 1256 (8.85%) edges have been colored so far; of which 36 (2.87%) are negative, 981 (78.11%) are positive, and 239 (19.03%) are neutral.

3.1.1. Intra-goal Target Interactions

3.1.1.1. Negative

From the list of negative interactions, 12 are intra-goal interactions as listed below. These interactions fall under SDG 3 “Health”, SDG 4 “Education”, SDG 5 “Gender Equality”, SDG 8 “Decent Work”, SDG 10 “Reduced Inequalities”, SDG 12 “Consumption and Production”, and SDG 16 “Peace”, with SDG 16 having the most, totaling to four.

- SDG 3
  - 3.6 – 3.1, 3.9
  - 3.7 – 3.9
- SDG 4
  - 4.7 – 4.8
- SDG 5
  - 5.2 – 5.8
- SDG 8
  - 8.2 – 8.6
- SDG 10
  - 10.5 – 10.C
- SDG 12
  - 12.1 – 12.4
- SDG 16
  - 16.1 – 16.5, 16.6
  - 16.4 – 16.7
  - 16.A – 16.B

3.1.1.2. Positive

From the list of positive interactions, 315 are intra-goal interactions as listed in Appendix A. These interactions are distributed across all SDGs, with the top five being SDG 3 “Health” having 35, SDG 8 “Decent Work” having 33, SDG 16 “Peace” having 29, SDG 5 “Gender Equality” having 28, and SDG 4 “Education” having 27.
3.1.2. Ugly and beautiful targets

Currently, 116 of the 169 targets (68.7%) are “beautiful”, 51 (30.2%) are “ugly”, and two (1.1%) do not have any evaluated target interactions.

3.1.2.1. Ugly

Among the ugly targets, 15 have more than one negative interaction, listed below with the number of negative interactions that they have:

- 3.6 (2)
- 3.7 (2)
- 3.9 (2)
- 3.Ａ (2)
- 5.A (2)
- 5.B (3)
- 8.2 (3)
- 10.C (2)
- 11.6 (2)
- 12.4 (3)
- 13.1 (4)
- 16.1 (3)
- 16.2 (2)
- 16.7 (2)
- 16.A (2)

Note that target 13.1 “Resilience to climate-related hazards” has the largest number of negative interactions with other targets.

3.1.2.2. Beautiful

Among the beautiful targets, 108 have more than one positive interaction, listed in Appendix B with the number of positive interactions that they have. Note that target 7.1 “Universal access to affordable energy” has the largest number, 65 to be exact, of positive interactions with other targets. It is followed by targets 1.3 “Social protection systems” and 5.5 “Full-participation in leadership” having 31 each, then target 12.8 “Understanding of sustainable lifestyles” having 28, and target 1.B “Pro-poor and gender-sensitive policy frameworks” having 27.

3.2. Second Method: Official UN Indicator Data

Of the 14196 edges that need to be colored, 1914 target interactions have available data to score them which comprises 13.5% of all target interactions. Of the 1914 colored edges, 196 are negative comprising 10.24% of all colored edges. 280 are positive, comprising 14.63%. 1438 are neutral, comprising 75.13%.

3.2.1. Intra-goal Target Interactions
3.2.1.1. Negative

From the list of negative interactions, 20 are intra-goal interactions as listed below. These interactions fall under SDG 1 “Poverty”, SDG 2 “Hunger”, SDG 3 “Health”, SDG 7 “Clean Energy”, SDG 9 “Industry”, SDG 15 “Land Life”, and SDG 17 “Partnership”, with SDG 3 having the most, totaling to eight.

- SDG 1
  - 1.1 – 1.A
- SDG 2
  - 2.1 – 2.5
- SDG 3
  - 3.4 – 3.2, 3.6, 3.9
  - 3.5 – 3.2, 3.6
  - 3.8 – 3.2, 3.6, 3.B
- SDG 7
  - 7.2 – 7.1, 7.3
- SDG 9
  - 9.3 – 9.5, 9.C
- SDG 15
  - 15.5 – 15.1, 15.4
- SDG 17
  - 17.6 – 17.3, 17.4
  - 17.4 – 17.8, 17.9

3.2.1.2. Positive

From the list of positive interactions, 16 are intra-goal interactions as listed below. These interactions fall under SDG 1 “Poverty”, SDG 3 “Health”, SDG 4 “Education”, SDG 6 “Clean Water”, SDG 7 “Clean Energy”, SDG 8 “Decent Work”, SDG 15 “Land Life”, and SDG 17 “Partnership”, with SDG 3 having the most, totaling to five.

- SDG 1
  - 1.1 – 1.2
- SDG 3
  - 3.9 – 3.2, 3.6, 3.D
  - 3.5 – 3.4, 3.D
- SDG 4
  - 4.2 – 4.B
- SDG 6
  - 6.2 – 6.6
- SDG 7
  - 7.1 – 7.3
- SDG 8
  - 8.2 – 8.1, 8.10
  - 8.6 – 8.10
- SDG 15
  - 15.A – 15.B
- SDG 17
  - 17.6 – 17.8, 17.9
  - 17.8 – 17.9

3.2.2. Ugly and beautiful targets

Currently, 12 of the 169 targets (7.1%) are “beautiful”, 55 (32.54%) are “ugly”. There are 102 targets that do not have any evaluated target interactions, comprising 60.36%.

3.2.2.1. Ugly
Among the ugly targets, 45 have more than one negative interaction, listed in Appendix C with the number of negative interactions that they have. Note that target 3.8 “Universal health coverage” has the largest number, 27 to be exact, of negative interactions with other targets. It is followed by target 15.5 “Biodiversity and natural habitats” having 23, target 7.2 “Increase global renewable energy percentage” having 21, and targets 2.5 “Genetic diversity in food production” and 3.4 “Reduce non-communicable disease-caused deaths” having 17 each.

3.2.2.2. Beautiful

Among the beautiful targets, five have more than one positive interaction, listed below with the number of positive interactions that they have:

- 3.D. (2)
- 8.A. (2)
- 15.A. (5)
- 15.B. (5)
- 17.1. (4)

Note that target 15.A “Mobilize finances for biodiversity” and 15.B “Mobilize finances for forestation” have the largest number of positive interactions with other targets.

3.2.3. Goal Interactions

Looking at the simplified view of goal interactions, shown on Figure 8, we obtain a low confidence answer as to the nature of goal interactions. The low confidence is due to the fact that at the target level, only 13.5% of interactions have been evaluated. That is, there is very little data to draw reliable conclusions at the goal level.

![Figure 8. Goal Interactions Graph (Simplified View)](image)

From this graph we note the following observations:

- SDG 1 “Poverty” and SDG 4 “Education” are good goals to focus on since they are not negatively linked with any goals with negative interactions. We call their branches “safe branches”.

3.3. Integration of Results

Currently, results for both methods do not cover all 14196 target interactions; we still have a long way to go to fully color both graphs. More respondents still need to be recruited to provide expert evaluations for the first method, and because updates to official indicator data are not conducted wholly, that is only select indicators are updated at a time, the data that has been used needs to be filled in and updated.

The information obtained thus far is insufficient for a comprehensive analysis. However, the information that we do have can already provide policy makers with possible directions and working solutions, since we are already able to identify some negative interactions that need to be mitigated within the Philippine setting.

One insight that can be gained from the results so far is that most target interactions are either positive or neutral. This is a good sign that supports the 2030 Agenda in that it is largely applicable to the Philippine context. This also means that there are relatively few negative interactions that need to be mitigated.

Integrated results across both methods are divided into a negative answer, discussing problematic goals or targets and interactions that need to be mitigated, and a positive answer, discussing which goals, targets, or interactions to be prioritized.

3.3.1. Negative Answer

It can be observed that SDG 3 “Health” is the only common goal between the two data-gathering methods that has negative intra-goal interactions with three under the first method and eight under the second method. While none of the target pairs are common, we can narrow down as a focus for mitigation the commonly involved targets 3.6 “Halve traffic accident deaths” and 3.9 “Reduce pollution-related deaths”. Target 3.6 in particular is problematic, having conflict with five other SDG 3 targets: 3.1, 3.4, 3.5, 3.8, and 3.9.
Among the ugly targets that have more than one negative interaction, the following targets are common among the two methods: 3.6, 3.9, 8.2 “Economic productivity”, and 16.1 “Reduce violence”.

3.3.2. Positive Answer

In terms of positive intra-goal target interactions, the common SDGs across both methods are SDG 1 “Poverty”, SDG 3 “Health”, SDG 4 “Education”, SDG 6 “Clean Water”, SDG 7 “Clean Energy”, SDG 8 “Decent Work”, SDG 15 “Land Life”, and SDG 17 “Partnership”. Under these SDGs, the following target pairs are also common:

- 1.1 – 1.2
- 3.2 – 3.9
- 3.5 – 3.D
- 4.2 – 4.B
- 6.2 – 6.6

On the other hand, among the beautiful targets with multiple positive target interactions, the following were common across both methods: 3.D “Early warning systems for health risks”, 8.A “Trade support aid”, 15.B “Sustainable forest management”, and 17.1 “Domestic revenue collection”.

IV. Recommendation and Conclusion

4.1. Implementation of SDGs

Since the ultimate goal of the study is to provide a guide towards sustainable development in the Philippines, results of the study from the initial data should be considered. Recommendations based on the results translate to problematic goals or targets whose interactions need to be mitigated and which ones need to be prioritized.

4.1.1. Mitigation of Negatives

It appears that there should be an effort to mitigate self-conflicting target interactions under SDG 3 “Good Health and Well-Being” with a particular emphasis on targets 3.6 “Halve traffic accident deaths” and 3.9 “Reduce pollution-related deaths”.

Common ugly targets with multiple negative interactions should also be investigated, namely, 3.6, 3.9, 8.2 “Economic productivity”, and 16.1 “Reduce violence”.

Even though they may not be common across methods, efforts should also be made to investigate the ugly targets that have an unusually high number of negative interactions such as targets 3.8 “Universal health coverage”, 15.5 “Biodiversity and natural habitats”, 7.2 “Increase global renewable energy percentage”, 2.5 “Genetic diversity in food production”, and 3.4 “Reduce non-communicable disease-caused deaths”. The higher the number of negative interactions, the more their involved interactions need to be prioritized for mitigation.

4.1.2. Prioritization of Positives

An insight from the results so far is that most target interactions are either positive/indivisible or zero/consistent. This is a good sign that the 2030 Agenda is, for the most part, applicable to the Philippine context. Since for the most part, target interactions are positive, focus should thus be narrowed down to targets that reinforce their corresponding SDGs. These targets include 1.1 “Eradicate extreme poverty”, 1.2 “Halve poverty proportions”, 3.2 “End preventable deaths”, 3.5 “Prevent substance abuse”, 3.9 “Reduce pollution-related deaths”, 3.D “EW risk reduction”, 4.2 “Early education”, 4.B “Higher education scholarships”, 6.2 “Sanitation and hygiene”, and 6.6 “Eco-systems”.

Common beautiful targets with multiple positive interactions should also be prioritized, namely, 3.D “Early warning systems for health risks”, 8.A “Trade support aid”, 15.B “Sustainable forest management”, and 17.1 “Domestic revenue collection”. Note that target 3.D both reinforces other targets under SDG 3 and is also a beautiful target with multiple positive interactions. Thus, among these common targets, target 3.D should be given special interest.

Focus should also be given to beautiful targets with an unusually high number of positive interactions from either method such as 7.1 “Universal access to affordable energy”, 1.3 “Social protection systems”, 5.5 “Full-participation in leadership”, 15.A “Mobilize finances for biodiversity”, and 15.B “Mobilize finances for forestation”.

It would be important to note that target 3.9 ”Reduce pollution-related deaths” straddles the line between a self-reinforcing and self-conflicting target. Therefore, further investigation needs to be conducted with regards to the trade-offs it may cause.

4.2. Further study on SDG target interactions

Future pursuits of this study should be focused on gathering more data for both data gathering methods in order to have a more complete analysis. Since the general framework of the study can also be adapted to fit more focused regional groups in the country, others who wish may do so at risk of difficulty in data gathering for both methods.
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Appendices

Appendix A: Positive Intra-Goal Target Interactions under Expert Evaluation Method. *See section 3.1.1.2.*

- **SDG 1** (19)
  - 1.2 – 1.1, 1.3, 1.4, 1.5, 1.A, 1.B
  - 1.A – 1.1, 1.3, 1.4, 1.5, 1.B
  - 1.B – 1.1, 1.3, 1.4, 1.5
  - 1.1 – 1.4, 1.5
  - 1.3 – 1.4, 1.5
- **SDG 2** (18)
  - 2.A – 2.1, 2.2, 2.3, 2.5, 2.B, 2.C
- SDG 3 (35)
  - 3.5 – 3.1, 3.2, 3.3, 3.6, 3.9, 3.A, 3.B, 3.C, 3.D
  - 3.D – 3.1, 3.2, 3.3, 3.8, 3.A, 3.B, 3.C
  - 3.A – 3.4, 3.8, 3.9, 3.B, 3.C
  - 3.7 – 3.1, 3.2, 3.8, 3.B
  - 3.3 – 3.1, 3.8, 3.9
  - 3.6 – 3.2, 3.4, 3.B
  - 3.8 – 3.9, 3.C
  - 3.2 – 3.9
  - 3.4 – 3.9

- SDG 4 (27)
  - 4.2 – 4.1, 4.3, 4.4, 4.6, 4.7, 4.A, 4.B
  - 4.3 – 4.4, 4.5, 4.6, 4.7, 4.B, 4.C
  - 4.A – 4.4, 4.6, 4.7, 4.B, 4.C
  - 4.C – 4.4, 4.5, 4.6, 4.B
  - 4.1 – 4.4, 4.5, 4.B
  - 4.4 – 4.6
  - 4.5 – 4.7

- SDG 5 (28)
  - 5.A – 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.B, 5.C
  - 5.C – 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.B
  - 5.4 – 5.1, 5.2, 5.3, 5.5, 5.6
  - 5.1 – 5.2, 5.3, 5.5
  - 5.6 – 5.3, 5.5, 5.B
  - 5.2 – 5.5
  - 5.3 – 5.B

- SDG 6 (15)
  - 6.1 – 6.2, 6.3, 6.4, 6.5, 6.6, 6.A
  - 6.6 – 6.2, 6.3, 6.4, 6.A, 6.B
  - 6.4 – 6.2, 6.B
  - 6.5 – 6.3, 6.B

- SDG 7 (2)
  - 7.A – 7.1, 7.3

- SDG 8 (33)
  - 8.5 – 8.1, 8.2, 8.3, 8.4, 8.6, 8.10, 8.A, 8.B
  - 8.9 – 8.1, 8.2, 8.3, 8.4, 8.6, 8.7, 8.8
  - 8.A – 8.1, 8.3, 8.4, 8.6, 8.7, 8.10
  - 8.1 – 8.4, 8.7, 8.8, 8.10
  - 8.3 – 8.7, 8.8, 8.10, 8.B
  - 8.2 – 8.8, 8.B
  - 8.7 – 8.4, 8.6
- SDG 9 (11)
  - 9.1 – 9.2, 9.3, 9.5, 9.C
  - 9.3 – 9.5, 9.A, 9.C
  - 9.2 – 9.A, 9.B
  - 9.4 – 9.5, 9.B
- SDG 10 (17)
  - 10.4 – 10.2, 10.3, 10.5, 10.7, 10.B, 10.C
  - 10.1 – 10.2, 10.5, 10.B
  - 10.3 – 10.6, 10.A, 10.C
  - 10.6 – 10.5, 10.B
  - 10.7 – 10.2, 10.A
  - 10.A – 10.C
- SDG 11 (22)
  - 11.5 – 11.1, 11.2, 11.3, 11.4, 11.6, 11.A, 11.C
  - 11.2 – 11.1, 11.6, 11.7, 11.A, 11.B
  - 11.3 – 11.1, 11.4, 11.7, 11.A
  - 11.1 – 11.6, 11.A
  - 11.7 – 11.6, 11.C
  - 11.4 – 11.A
  - 11.B – 11.C
- SDG 12 (26)
  - 12.6 – 12.1, 12.2, 12.3, 12.4, 12.8, 12.A
  - 12.5 – 12.3, 12.4, 12.8, 12.B, 12.C
  - 12.1 – 12.2, 12.7, 12.A, 12.C
  - 12.8 – 12.4, 12.A, 12.B, 12.C
  - 12.3 – 12.7, 12.A, 12.C
  - 12.2 – 12.A, 12.B
  - 12.C – 12.7, 12.B
- SDG 13 (5)
  - 13.B – 13.1, 13.3, 13.A
  - 13.2 – 13.1, 13.3
- SDG 14 (12)
  - 14.1 – 14.2, 14.3, 14.4, 14.5, 14.A, 14.B
  - 14.5 – 14.3, 14.7, 14.A, 14.B
  - 14.6 – 14.B
  - 14.7 – 14.A
- SDG 15 (2)
  - 15.6 – 15.1, 15.2
- SDG 16 (29)
  - 16.2 – 16.3, 16.5, 16.6, 16.8, 16.10, 16.A
  - 16.7 – 16.5, 16.6, 16.8, 16.9, 16.10, 16.B
  - 16.B – 16.1, 16.3, 16.5, 16.8, 16.10
  - 16.4 – 16.1, 16.3, 16.9, 16.A
  - 16.5 – 16.3, 16.8, 16.A
  - 16.10 – 16.3, 16.6, 16.8
Appendix B: Beautiful Targets with Multiple Positive Interactions under Expert Evaluation Method. See section 3.1.2.2.

- 1.1 (26)
- 1.2 (25)
- 1.3 (31)
- 1.4 (22)
- 1.5 (27)
- 2.1 (9)
- 2.2 (7)
- 2.3 (15)
- 2.4 (12)
- 2.5 (10)
- 2.A (16)
- 2.B (16)
- 2.C (13)
- 3.2 (10)
- 3.3 (11)
- 3.4 (11)
- 3.5 (15)
- 3.8 (17)
- 3.B (18)
- 3.C (11)
- 3.D (17)
- 4.1 (9)
- 4.2 (13)
- 4.3 (14)
- 4.4 (10)
- 4.5 (20)
- 4.6 (10)
- 4.A (11)
- 9.1 (14)
- 9.2 (7)
- 9.3 (14)
- 9.4 (6)
- 9.5 (13)
- 9.A (6)
- 9.B (8)
- 9.C (11)
- 10.2 (10)
- 10.3 (13)
- 10.4 (19)
- 10.5 (10)
- 10.6 (10)
- 10.7 (7)
- 10.8 (2)
- 10.9 (3)
- 10.A (8)
- 10.B (7)
- 11.1 (11)
- 11.2 (20)
- 11.5 (18)
- 11.6 (9)
- 11.7 (16)
- 11.8 (17)
- 11.9 (11)
- 11.A (17)
- 11.B (9)
- 11.C (9)
- 12.1 (15)
- 12.2 (10)
- 12.3 (12)
- 12.4 (19)
- 12.5 (10)
- 12.6 (12)
- 12.7 (7)
- 12.8 (28)
- 12.9 (2)
- 12.A (15)
- 12.B (15)
- 13.1 (13)
- 13.2 (9)
- 13.3 (13)
- 13.4 (17)
- 13.A (7)
- 13.B (8)
- 14.1 (7)
- 14.2 (2)
- 14.3 (5)
- 14.4 (5)
- 14.5 (14)
- 14.6 (5)
- 14.A (6)
- 14.B (6)
- 15.1 (4)
- 15.2 (2)
- 15.3 (3)
- 15.4 (2)
- 15.5 (2)
- 16.1 (22)
- 16.2 (20)
- 16.3 (12)
- 16.4 (11)
- 16.5 (10)
- 16.6 (10)
- 16.7 (7)
- 16.8 (2)
- 16.9 (11)
- 16.10 (14)
- 17.1 (4)
- 17.2 (2)
- 17.3 (2)
- 17.4 (5)
- 17.5 (5)
- 17.6 (4)
- 17.7 (4)
- 17.8 (2)
- 17.9 (3)
- 17.10 (4)
- 17.11 (8)
- 17.12 (8)
- 17.13 (5)
- 17.14 (9)
- 17.15 (7)
- 17.16 (3)
- 17.17 (8)
- 17.18 (6)
- 17.19 (7)
Appendix C: Ugly Targets with Multiple Negative Interactions under Official Indicator Data Method. See section 3.2.2.1.

|   |   |   |   |
|---|---|---|---|
| 1.1 (6) | 4.5 (5) | 8.10 (6) | 15.5 (23) |
| 1.3 (3) | 4.B (5) | 9.3 (16) | 16.1 (11) |
| 1.A (6) | 6.2 (10) | 9.B (7) | 16.8 (5) |
| 2.1 (8) | 6.6 (6) | 9.C (4) | 17.3 (5) |
| 2.5 (17) | 6.A (4) | 10.4 (4) | 17.4 (16) |
| 3.2 (9) | 7.1 (8) | 10.6 (5) | 17.6 (9) |
| 3.4 (17) | 7.2 (21) | 10.B (4) | 17.8 (9) |
| 3.5 (16) | 7.3 (10) | 11.1 (9) | 17.9 (8) |
| 3.6 (7) | 8.1 (4) | 14.5 (7) | 17.19 (3) |
| 3.8 (27) | 8.2 (2) | 15.1 (6) |
| 3.9 (5) | 8.6 (4) | 15.2 (2) |
| 4.2 (6) | 8.8 (8) | 15.4 (9) |