*Aljaž KUNČIČ**

PRIORITISING THE SUSTAINABLE DEVELOPMENT GOALS USING A NETWORK APPROACH: SDG LINKAGES AND GROUPS[1]

Abstract. *The Sustainable Development Goals (SDGs) are central to the operationalization of the 2030 Agenda for Sustainable Development. Both represent an ambitious developmental framework whose potential to focus on smart policies and prioritise measures that bring the maximum impact on the highest number of SDGs is crucial for achieving progress. We propose this can be accomplished using the criteria of efficiency in policy targeting of SDGs. In particular, by examining the links among SDGs, identifying positive and negative connections, and the core goals and tightly knit communities in the developmental networks of today and tomorrow. Utilising the SDGs' interconnected nature for developmental planning and comparing the characteristics of developmental networks may be the missing component in accelerating sustainable development.*
Keywords: *SDGs, Sustainable Development Goals, sustainable development, 2030 Agenda, linkages, interlinkages, priority setting, development planning*

Introduction

The world is in a greater state of flux than ever before, with changes occurring in the international balance of powers. Some developed countries show a palpable lack of willingness to continue to lead and their withering support for the current system of international organisations (or parts within). In this climate, the international community and sovereign states are faced with the challenge of achieving the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) by 2030.

Globalisation and the benefits of free trade and investment are in question, with rising protectionism, growing inequalities at the extremes of

----

* *Aljaž Kunčič, PhD, Economic Affairs Officer, Unit on 2030 Agenda, Social Development Division (SDD), United Nations Economic and Social Commission for Western Asia (UN ESCWA), Beirut, Lebanon*

distributions, marginalised groups' lack of access, and ever more complicated human interactions with the natural environment. The idea of accomplishing or even moving closer to accomplishing the SDGs, for developing countries in particular, justifiably attracts much doubt.

The challenges of sustainable development described in the 17 SDGs, 169 targets and 232 indicators are plentiful and vary depending on a country's context. It is today clear that the conventional unidimensional or even multidimensional policy recommendations in the toolbox relied on by international development experts will not do the job at hand (for instance, to reduce poverty and create decent jobs, while at the same time protecting the environment and wildlife, and not overlooking social protection and gender equality, while having energy, water and other constraints, etc.). The 2030 Agenda is simply too broad and too interconnected. There are no conventional and simple tools available to address it adequately.

This paper argues that it is precisely the 2030 Agenda's interconnectedness that, when explored in depth and developed as a policymaking tool, may be seen as an integral part of the riddle of how to support, assist and promote human development on the international and national scale with such a broad agenda and in a global system that is today less forgiving of development planning mistakes. This especially applies to developing countries and least-developed countries (LDCs) whose resources are the most limited and encounter the greatest trade-offs.

The aim of this paper is thus to present a framework for development planning, in other words, to suggest how to develop an action plan that is better suited to today's circumstances and the 2030 Agenda's holistic nature. The aim is to ensure the maximum of the 2030 Agenda and the SDGs can be achieved, keeping in mind that national-level resources are limited, while pursuing the most effective use of resources.

The outline of this paper is as follows. Section 2 overviews the literature and frames the topic of interest and our contribution. Section 3 introduces the framework for developmental planning in pursuit of the 2030 Agenda while always bearing in mind the SDG linkages/interlinkages. Section 4 illustrates the developmental planning action plan with data on SDGs on the global level. Section 5 discusses the empirical findings and policy implications. Finally, Section 6 summarises, presents some caveats and suggests the way forward.

Literature review

The Sustainable Development Goals (SDGs) were passed in 2015 after a long process of coordination and validation as part of para. 54 of United Nations Resolution A/RES/70/1 in the publication "Transforming our world:

the 2030 Agenda for Sustainable Development" (UN GA 2015). They cover three dimensions, economic, social and the environment, and based on 'the 5Ps' – people, prosperity, planet, peace and partnership (5P); the idea of leaving no one behind, and contain the 17 SDGs listed in Table 1 (UN GA 2015).

Table 1: THE SUSTAINABLE DEVELOPMENT GOALS

Goal 1. End poverty in all its forms everywhere
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3. Ensure healthy lives and promote well-being for all at all ages
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5. Achieve gender equality and empower all women and girls
Goal 6. Ensure availability and sustainable management of water and sanitation for all
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10. Reduce inequality within and among countries
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12. Ensure sustainable consumption and production patterns
Goal 13. Take urgent action to combat climate change and its impacts
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Source: UN GA, 2015.

420

The literature on the link ('the Nexus') between specific areas of the 2030 Agenda for Sustainable Development or specific SDGs as well as that literature on the interconnectedness of SDGs and targets as an integrated system is gaining momentum in both academic circles and among international organisations. Jungcurt (2016) provides a good overview of several publications on these topics.

The Nexus approach examines specific areas of Agenda 2030 characterised by interconnectedness and where an intervention in one goal or area affects other areas or goals. Examples include health, poverty, gender and education (Clancy et al., 2002), education, health and water (Kitamura et

al., 2014), education, health and food (Igutchi et al., 2014), water, energy and food security (UN, 2014), oceans, seas, marine resources and human well-being (UN, 2015), infrastructure, inequality and resilience (UN, 2016), water, soil and waste (2015 Dresden Nexus Conference) etc.

Similarly, the constraints one SDG imposes on another, more detailed on the level of targets, are examined by Nilsson et al. (2016a) and Nilsson et al. (2016b) who describe the relations between parts of the sustainable agenda on an ordinal scale from +3 to -3 in terms of their complementarity, and label the relations Indivisible, Reinforcing, Enabling, Consistent, Constraining, Counteracting, or Cancelling. This proves to be a very useful approach in the absence of data or when thinking about how the relationships between parts of the sustainable agenda should look like, as argued in section 4 of this paper. Coopman et al. (2016) similarly define relationships as Supporting, Enabling/disenabling, and Relying, using a combination of correlations and chronological, step-by-step sequencing. The most advanced is the Millennium Institute's (2016) structural macroeconomic model (a dynamic system of equations) covering all 17 SDGs and 78 underlying indicators, which allows for modelling and testing policy choices, and is most likely the most sophisticated tool available for planning the achievement of SDGs, albeit much more complicated and somewhat different in focus from what we propose in this paper.

The 2030 Agenda ('sustainable development agenda') and SDGs have already been considered by Social Network Analysis (SNA), which is also the empirical strategy this paper follows. Le Blanc (2015) examines SDGs and targets as a network using normative/political mapping, finding that the "SDGs as a whole are a more integrated system than the MDGs were, which may facilitate policy integration across sectors". He establishes links between SDGs based on targets that explicitly refer to multiple goals, using the wording below each target to link it with other SDGs. The most central SDGs in the network turn out to be SDG 12 on sustainable consumption and production and SDG 10 on inequality. Most links are found between gender and education (SDGs 4 and 5), and between poverty and inequality (SDGs 1 and 10), and to a lesser extent between SDG 10 and SDG 16. The study does not, however, consider in the analysis the more cross-cutting means of implementation under SDG or SDG 17 as the cross-cutting means of the implementation goal since it solely concentrates on thematic areas. Pedrosa-Garcia (2016) examines the SDGs as a network for Jordan in particular, based on 36 indicators, plots the SDG network based on a correlation matrix, and reports measures of centrality. Zhou and Moinuddin (2017) examine binary linkages between the 169 SDG targets using a literature review and assign a value of 1 to those pairs with a potential link, and 0 otherwise. They quantify the relationships based on correlations of 51 indicators with data available

421

for nine Asian countries (covering 108 targets), and plot the SDG network for each of these nine countries and report an array of centrality measures, then allowing them to identify the most pivotal targets for each country. Both Pedrosa-Garcia (2016) and Zhou and Moinuddin (2017) support the starting steps in planning for SDGs this paper suggests, but do not explore the network to the fullest and are missing subsequent steps.

Two papers aimed at helping to prioritise the development agenda objectives while under a limited budget and while keeping the interlinkages central, much as this paper is attempting, are by El-Maghrabi, Gable, Osorio-Rodarte and Verbeek (2018) and Allen, Metternicht, and Wiedmann (2018). The first presents a network-based methodology aimed at assisting policymakers in prioritising the targets of SDGs, while the second proposes a way to prioritise SDG targets by adopting a multi-criteria approach that evaluates and ranks the SDG targets by three criteria: their 'level of urgency', 'systemic impact' and 'policy gap', using the network methodology for the last of these. Both papers essentially research the same topic as this paper, with relevant differences and overlaps in approach (producing similar results regarding those overlaps, corroborating the robustness of this way of approaching such prioritisation).

The value added of this paper lies partly in its simplicity and the fact policymakers will find it easy to apply, but also in its new proposal to not only rely on mapping the Present development network (using existing interlinkages, as discussed below), as occurs in the rest of the literature, but to also try to link the identification of policy options with the difference between where we are as a developing society and where we wish to be once we are more developed. Ultimately, it is about identifying priorities with a limited budget and timeframe, and a country can apply various methodologies to do that, ranging from more straightforward to reasonably advanced ones, or integrating the SDGs into a fully-fledged dynamic macro model (like the Millennium Institute, 2016).

Developmental planning for the SDGs

When resources are limited, any nation state, particularly a developing country or a least developed country (LDC), must determine how to prioritise its goals and targets when trying to align and meet the developmental objectives found in the 2030 Agenda and the SDGs. In essence, this entails a question of prioritisation. Priorities can either be politically determined or determined by objective criteria, either needs -or effectiveness- based. The aim of this view of developing planning is to come up with a method for objective criteria based on the effectiveness of interventions, thereby reducing the 2030 Agenda down to a narrower, more manageable and affordable

422

set, and offering a novel way of deciding on potential policy interventions based on a comparison of two developmental levels.

The first step in forming an action plan for the prioritisation and implementation of SDGs through the lens of objectively determined areas of intervention is thus to build two 2030 developmental networks within the SDG framework. The second step is to ascertain where the policy interventions should be made in order to be able to move from the present developmental state to full realisation of the 2030 Agenda – by comparing the two networks.

Step 1

The 2030 Agenda or the SDG network should be explored to help answer two research questions crucial for policymakers that lead to the construction of two 2030 developmental networks:
a. what can we do to impact/move the existing 2030 Agenda network the most:
   build the *Present developmental network*
b. what can we do to get from the existing 2030 Agenda network to the desired one:
   build the *Future developmental network*

It is necessary to discuss the interconnectedness of the 2030 Agenda objectives or SDGs, namely the links between them. Interlinkages within 2030 Agenda can be examined at the 5P level (people, prosperity, planet, peace and partnership), 3-dimensional (economic, social and environmental), SDG, target, or indicator level. Yet, in all these cases, answering questions a) and b) above calls for them to be examined through the two lenses of the Present and Future developmental network.

The Present developmental network tells us, by looking at interlinkages existing today, what the current state of the links is, and can determine how a policy intervention in goal/target/indicator X relates to other parts of Agenda 2030, in the situation now. They can determine which, in the current and unchanged situations, policy interventions or development levers would move/improve the entire 2030 Agenda the most. In other words, in pursuing the agenda, 'where do you get the biggest bang for your buck'. Technically, the present developmental network must be constructed using existing data on the key indicators and sectors in the country. This can be accomplished within a formalised model such as a country CGE, structural VAR or a dynamic system of equations, with various methods such as structural equation modelling or social network analysis, structural equations modelling, and others. The Present developmental network essentially relies on the existing links between the indicators, targets and SDGs, either as correlations or partial coefficients, which enable the policymaker to plot

the network as a whole and track how a policy intervention in one part of the agenda ripples across the network, positively or negatively.

The Future developmental network instead includes interlinkages that are future-looking or identified according to what we want the 2030 Agenda network to look like at the 'finish line', and hence embody our developmental aspirations of what we want the interlinkages to be (e.g. having environmental indices positively covary with, for instance, economic growth and employment). They are not based on existing data, but on how we envisage the indicators, targets and goals should be connected to each other in a sustainable developmental model – in the realised state of the 2030 Agenda. One possible way of determining the end state of 2030 Agenda development is for a technical team to evaluate the linkages between the SDG targets, possibly based on the Nilsson, Griggs and Visbeck (2016, Nature) methodology. This methodology can incorporate a future-looking perspective through which a cross-impact matrix can be constructed, showing how every SDG indicator, target or goal (depending on the level of analysis) should ultimately relate to every other counterpart in the network. Another way may entail use of the actual wording of the SDGs to identify what the international consensus was concerning the connections between the SDGs, such as in Le Blanc (2015).

The combination of both the present and future-looking national SDG networks results in three identified characteristics of such a network, by:

1. *Mapping of the network:* identifying the most central (salient) connections, Goals, Targets and Indicators (those most connected to the rest of the network, the levers of development most suitable for quick and effective interventions)
2. *Determining the nature of the interlinkages:* identifying positive and negative connections within the Goals, Targets and Indicators (to be aware as a policymaker where the trade-offs exist and where policies can reinforce each other, as well as where interventions might counteract each other)
3. *Uncovering tightly knit subgroups:* identification of communities within the network – subparts of the network that are more connected to each other (those SDGs, targets and indicators, which should be addressed as a set all at once)

Step 2

In the second step, the three resulting characteristics of the both networks can be compared. For each characteristic, the places where the Future 2030 developmental network departs from the Present 2030 developmental network are noted and represent areas requiring a longer-term policy intervention, namely (by each characteristic):

1. Mapping of the network: Transition to relying on other parts of the 2030 Agenda as your economic, social and environmental engine: this could imply a transition from an economy based on heavy industry and pollutant energies to one based on a knowledge economy and renewables.
2. Determining the nature of the interlinkages: Reforming links among parts of the 2030 Agenda: given that the traditional economic development model includes trade-offs between economic growth and the environment, the move towards more sustainable development must include the economic, social and environmental dimension to be positively related and reinforce one another.
3. Uncovering tightly knit subgroups: With a long-term vision of development, the synergies between parts of the 2030 Agenda can be strategically targeted so as to increase the multiplication effect of a policy that touches on several interconnected issues.

In this step, the combined insights from the Present 2030 and the Future 2030 developmental networks are used. Policy interventions which aim to have the quickest effect should target the levers of development as identified by the most central parts of the network using the existing linkages, but should do so strategically, with the end goal in mind. The policies aimed at a longer-term effect and result, utilising future linkages, are those associated with redefining the centrality of parts of the network, and are those trying to reformulate how different parts of the network relate to each other. The policy work needed is thus both short and long term, and only the right combination adjusted to a country's specifics can bring the best result.

We continue describing the approach and benefits of constructing a developmental network using cross-sectional data and Social Network Analysis (SNA), as an example, in the next section.

Global SDG network

Social Network Analysis (SNA) is a methodology that can graphically show and mathematically calculate the effect of SDG interlinkages and determine which SDGs are most central (most embedded) in the entire network, determine communities of more connected SDGs etc. The data used in this paper are based on the UN Statistics Global SDG Indicators database (accessible at https://unstats.un.org/sdgs/) through the SDG Index & Dashboard (Sachs, 2016, 2017 and 2018) report data. These data are used to present how a national based Present 2030 developmental network could look according to the three characteristics identified above: mapping of the network, determining the nature of the interlinkages, and uncovering tightly knit subgroups.

425

Mapping of the network and identification of the most central parts

We start with the country-specific SDG scores (values) reported in Sachs et al. (2017). Table 1 in Appendix A shows Pearson's correlation matrix of those, where only correlations significant at the level of 5 percent are reported.

These linkages can be shown as a network in which the nodes are the SDGs, whereby the bigger the node, the higher the number of connections, and where the lines are (undirected) edges whose pattern depends on whether the connection is positive or negative (full line, dotted line), and whose thickness depends on the correlation's strength (De Nooy et al., 2018 for more details on Social Network Analysis). Figure 1 presents the Global SDG Network. The network is shown using the Kamada-Kawai algorithm which simulates the network as a physical system with the edges behaving like springs, and the nodes as charged particles. We use the values of the lines (whish are correlations) as a similarity measure (differentiating between positive and negative, and the strength). In addition, the sizes of nodes are proportionate to the weighted degree, which in this case is the summation of the absolute values of all correlations for a particular SDG. In this way, we can already holistically determine that SDG 17, since it has no correlations with the other SDGs, is completely out of the network. Also more remote within the network are SDG 15 and SDG 13.

Figure 1: GLOBAL SDG NETWORK ON THE LEVEL OF SDG SCORES
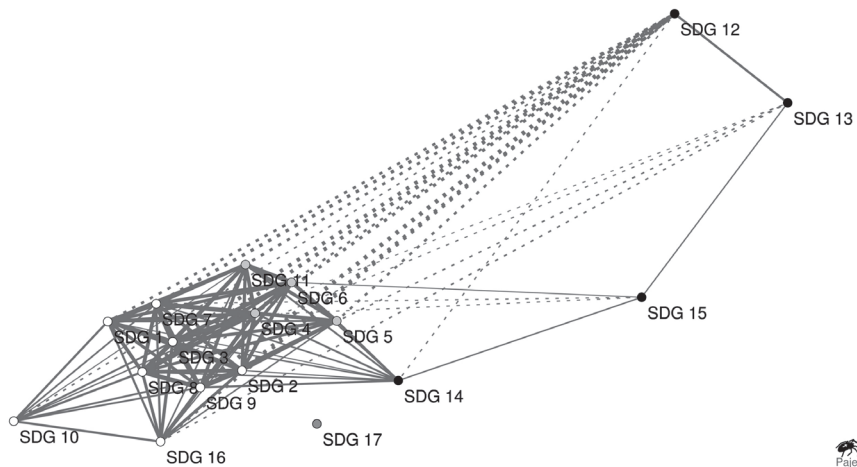
Note: Own calculations using Pajek.

There are 98 connections in our global SDG network, with Table 2 showing the 10 highest and lowest line values. We can see that in 6/10 cases the strongest positive correlations are between SDG 3 and the others, while the

strongest negative correlations in all 10 cases exist with SDG 12. As the one with almost exclusively negative links with the other SDGs, SDG 12 is also the most remote, followed by SDG 13, SDG 15 and SDG 14 (the most environmental ones).

Table 2: HIGHEST AND LOWEST VALUES OF CONNECTIONS BASED ON SDG SCORES

| Positive top 10	Value	Connection	Negative top 10	Value	Connection
1	0.874	SDG 3-SDG 7	1	-0.754	SDG 12-SDG 9
2	0.843	SDG 3-SDG 4	2	-0.678	SDG 12-SDG 3
3	0.817	SDG 3-SDG 8	3	-0.674	SDG 12-SDG 8
4	0.811	SDG 1-SDG 7	4	-0.587	SDG 12-SDG 2
5	0.792	SDG 4-SDG 7	5	-0.573	SDG 12-SDG 7
6	0.792	SDG 3-SDG 9	6	-0.563	SDG 12-SDG 4
7	0.788	SDG 8-SDG 9	7	-0.549	SDG 12-SDG 16
8	0.777	SDG 3-SDG 1	8	-0.474	SDG 12-SDG 11
9	0.776	SDG 2-SDG 9	9	-0.448	SDG 12-SDG 1
10	0.733	SDG 3-SDG 2	10	-0.427	SDG 12-SDG 5

Source: Own calculations.

427

The SDGs at the heart of the network and reinforcing each other are those more in line with the classic socio-economic development/human development paradigm, where sustainability and the environment, as well as governance, were not prominent. These SDGs are called a 12-clique (a special type of a core whereby every node in this subset is connected to at least 12 nodes from the same subset, and a subnetwork with maximum density), as every node from this subset is connected to all other nodes in this subset: SDG 1, SDG 2, SDG 3, SDG 4, SDG 6, SDG 7, SDG 8, SDG 9, SDG 10, SDG 11, SDG 12, SDG 16 (all but SDG 5, SDG 13, SDG 14, SDG 15 and SDG 17).

In trying to determine what are the most powerful levers for policymakers to target within the Present Agenda 2030 development network, we consider four measures of centrality of our SDG nodes:

- All Degree: number of all nodes connected to a particular node
- Weighted degree: correlation (value of connection) weighted number of all nodes connected to a particular node (for this calculation, the absolute value of negative correlations is taken)
- Closeness: how near a node is to all other nodes in a network, the number of other nodes divided by the sum of all distances between the node and all other nodes
- Betweenness: how important a node is as an intermediary in the network, calculated as the fraction of all paths between any two nodes that pass through a node

Figure 2 shows the centrality measures defined above. It shows that in terms of weighted degree centrality as well as closeness centrality SDG 3, SDG 9, SDG 8 and SDG 7 are the most central ones, in that order. From bottom up, the last ones are SDG 15, SDG 13, SDG 10 and SDG 14. The betweenness centrality paints a different picture and has three clusters. The most connected ones are SDG 7, SDG 1 and SDG 6, and the least connected are SDG 5, SDG 11, SDG 2 and SDG 4, with the others lying between the top and bottom groups.

*Figure 2: CENTRALITY MEASURES OF THE GLOBAL SDG NETWORK*
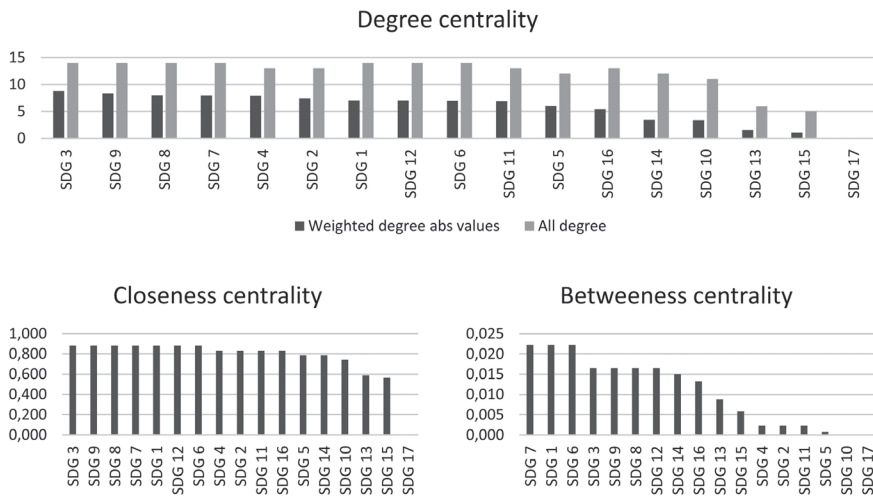
Source: Own calculations.

The All degree and Weighted all degree centrality measures shown above, however, only take account of the first-order effects, that is the direct correlation of a particular SDG to all others, and do not consider the indirect correlation of an SDG with other SDGs through each SDG. These second-order effects, although more suitable for an inferred causality network as in Weitz et al. (2017), can be calculated using Equation 1, where stands for first- and second-order influence, or cumulative first- and second-order weighted degree for an SDG *i*, calculated as total influence (first-order weighted degree) of SDG *i*, plus the summation of the multiplication term of weighted degree (correlation) from SDG *i* to each other SDG and that SDG's total influence (second-order weighted degree). Figure 3 shows the results.

$$I_{i2} = I_{i1} + \sum_{i \neq j}^{17} I_{i1,j}$$
Equation 1.

Figure 3: FIRST AND SECOND ORDER LINKAGES
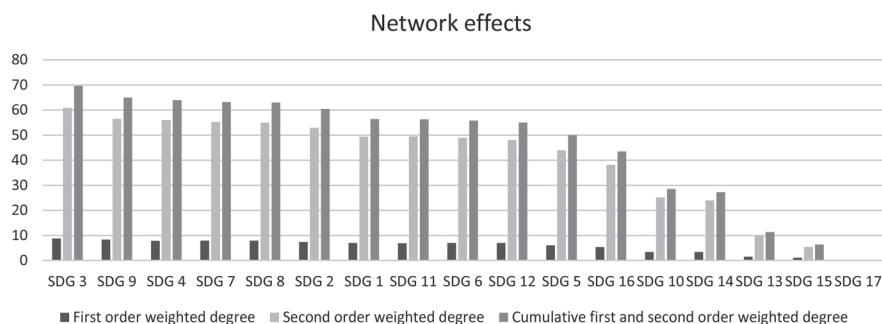
Source: Own calculations.

Clustering these according to both the first- and second-order effects produces four groups of SDGs in terms of cumulative direct – first-order, and indirect second-order – ripple effects. The highest group contains SDG 3, 9, 4, 7, 8 and 2, the middle-high one SDG 1, 11, 6 and 12, the middle-low one SDG 5 and SDG 16, and the low one SDG 10, 14, 13, 15 and 17.

429

Determining the nature of the interlinkages

Another way to look at the SDG network is to differentiate the nodes based on whether the connection between them is positive or negative. Figure 4 shows this solution, with SDG 15, SDG 13 and SDG 12 forming a cluster which is positively connected within, and predominantly negatively connected to other clusters. In the larger mainly positively connected cluster, we have 10 SDGs which form the closest group on the basis of line similarities, with three more SDGs on the outskirts of this group: SDG 14, SDG 16 and SDG 10.

Uncovering tightly knit subgroups

We also wish to move beyond the separation of clusters based on positive and negative linkages and thus explore community detection, which forms clusters in which there are more lines inside each cluster than among the clusters (when taking the values of lines into account). VOS (visualization of similarities) clustering applies an algorithm to the network whereby we gradually increase r – the resolution parameter, increasing the number of cluster solutions up to a point where (apart from SDG 17) we receive a solution with a single SDG cluster, which is uninformative and thus the end of the exploration. The solution with the highest quality of the VOS

Figure 4: GLOBAL SDG NETWORK, POSITIVELY AND NEGATIVELY CONNECTED SDGS
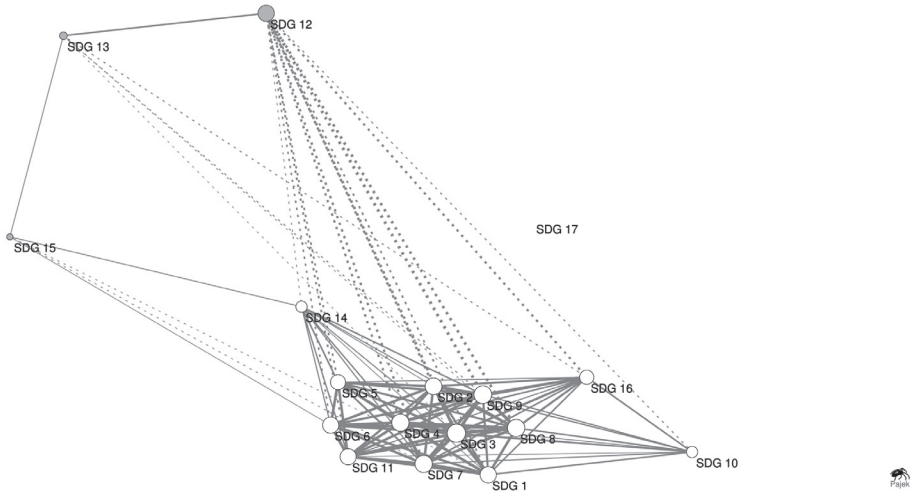
Source: Own calculations using Pajek.

Figure 5: GLOBAL SDG NETWORK, DETECTING COMMUNITIES
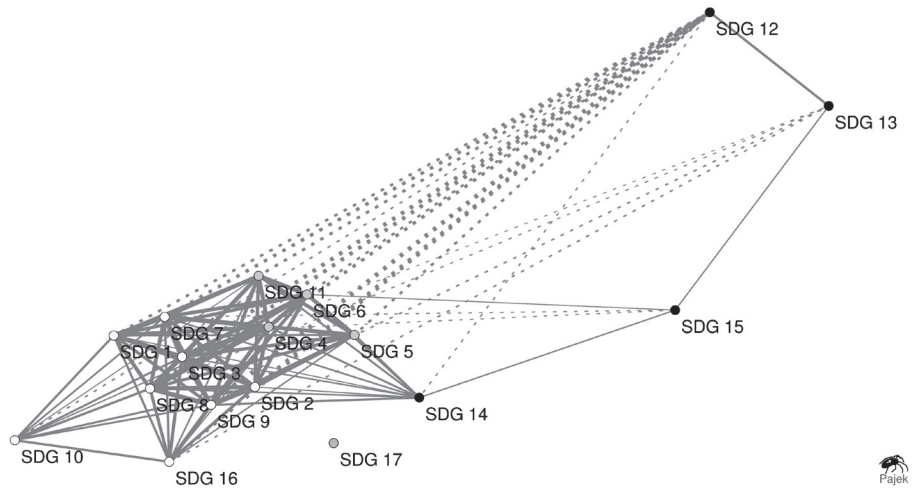
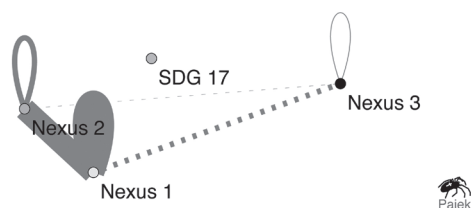Source: Own calculations using Pajek.

function amongst the explored ones is shown in Figure 5. There we can see three meaningful clusters or nexuses, also displayed as a shrunk network in Figure 6 with loops (representing within connections), and with a manual placement of nodes for better visibility (as opposed to the more usual energy outline). Nexus 3 is an environmental nexus of SDGs 12–15, which

is least connected within and weakly negatively connected to Nexus 2, but more strongly negatively connected to Nexus 1. Nexus 2 is a social nexus of SDGs 4–6 + SDG 11, moderately connected within and very strongly positively connected to Nexus 1. And Nexus 1 itself is an economic nexus of all the other SDGs (apart from SDG 17, which is unconnected), which corresponds to a more traditional view of economic development, and is the one most connected within.

Figure 6: SHRUNK GLOBAL SDG NETWORK, COMMUNITIES

Source: Own calculations using Pajek.

In each of the identified three nexuses, we can determine what the most connected/central SDGs are. We isolate every nexus and only look at the linkages within the nexuses. Nexus 1 has an average density (with no loops allowed) of 1.0 and 0.875 (with loops allowed), and an average degree of 7, all of the connections being positive. According to weighted degree, SDG 3 is the most central node (4.90), followed by SDG 9 (4.54) and SDG 8 (4.51), while the least central are by far SDG 10 (2.49) and SDG 16 (3.43). Nexus 2 has an average density (with no loops allowed) of 1.0 and 0.75 (with loops allowed), and average degree of 3, with all positive connections. According to weighted degree, all four SDGs are close together, with SDG 6 being the most central node (2.06) and SDG 5 the least central one (1.93). Nexus 3 has an average density (with no loops allowed) of 0.67 and 0.5 (with loops allowed), and average degree of 2. All but the connection between SDG 12 and SDG 14 are positive. According to the weighted degree (in absolute terms), SDGs 12 and 13 are more central (0.64 and 0.63, respectively), and SDGs 14 and 15 less central (0.47 for both).

Another interesting question is which SDGs serve as the strongest connectors between the clusters. In terms of weighted degree (in absolute values), the most important one for interlinkages in Nexus 3 is SDG 12, in Nexus 2 SDG 4, and in Nexus 1 SDG 3.

431

Discussion

The network analysis in Section 4 answers the three questions (according to the identified three characteristics of an example of a Present developmental network) in need of answering when thinking about using a developmental network for goal prioritisation: it maps the network and identifies the most central (salient) individual connections and Goals, it determines the nature of (inter)linkages, and it reveals tightly knit subgroups within the network. In all three cases elaborated below, the Present developmental network identified using global cross-sectional data in the preceding section can for illustration purposes also be juxtaposed against what a Future developmental network might look like (without going through with the exercise of an expert group to determine the nature of future interlinkages), indicating how areas of policy focus in the long term can quickly be determined.

First, mapping of the network reveals the strongest individual positive connections within the network are between SDG 3 (health) and the others, while the strongest individual negative connections exist between SDG 12 (responsible consumption and production) and the rest of the network. The goals that turn out to be most central, the levers of development for the Present development network, are especially SDG 3 and SDG 9 (industry), suggesting targeting them will have the biggest impact on the entire network (positive through positive linkages and negative through negative linkages) while those on the fringe are SDG 15 (life on land) and SDG 13 (climate action), representing the least effective entry points for interventions in the short term. If the national vision is, for instance, of a healthy, knowledge-based and equal society as the engine for development, then the Future developmental network would still have SDG 3 at its heart, accompanied by SDGs 4 (education) and 10 (equality). On the other hand, if the environment plays a bigger role in the national vision, then the SDGs currently at the tail of the centrality ranking should move towards the front. In every case, the most appropriate SDGs to focus on through policy interventions can be identified.

Second, further analysis of the positive and negative links and division of the SDG network highlights two groups. The smaller one, consisting of SDG 15, SDG 13 and SDG 12, which are all heavily environmentally charged goals, are positively connected to each another, and negatively connected to the other group. At the heart of the other group are 10 goals, also positively connected with each other, and they represent a more traditional view of economic development. This suggests policies aimed at improving the environmental goals will reinforce goals that are rooted in the environment, while they will possibly hinder more traditional economic progress,

and vice versa. If for instance a Future developmental network at the end of the 2030 Agenda were to emphasise that economic growth and climate change do not have to oppose each other but can positively reinforce each another, as opposed to the case now, then alternative policies that in the long term would alter the negative interlinkage between SDG 13 on one side, and SDG 8 and 9 on the other, could be identified and constitute the set of long-term policy changes to consider.

Third, identifying closely knit groups of SDGs may prove very practical, namely policymakers should design their policy interventions in packages, concentrating on the most central goal in each group, and think of the other most related goals (for instance, with policy planning groups including a representative of all affected ministries), and then also think about how to deal with the links to other groups of goals, and through which goal those links are manifested the most. The Present development network, not very surprisingly given that the same developmental model has been used for decades, identifies three communities of goals, which in terms of their substance are nexuses: an environment nexus, social nexus, and an economic nexus. All are connected positively within, and the social and economic nexus are also positively connected between, with the environmental nexus being negatively connected to the economic one in particular. As short-term policy interventions, same-cluster SDGs should be part of a coordinated package of policies, while being cognisant of the nature of the linkages between the clusters and knowing that the most salient inter-cluster spillover goals (expectedly those less characteristic of their cluster and with a more inter-cluster nature) are SDG 3 (economic nexus), SDG 4 (social nexus) and SDG 12 (environment nexus). Comparing the existing communities to what the communities in a Future developmental network might look like may lead the policymaker to design interventions to break down these traditional siloes, which are an outcome of very compartmentalised policymaking, and try to create a situation where the social, economic and environmental indicators or goals share the same community/cluster and reinforce each other, as well as other clusters.

433

Conclusion

The global economy's interconnectedness, disturbed by changes in the balance of powers and certain political leaders' erratic behaviour bringing real consequences for millions of people on the ground, render the traditional development model, planning and thinking unfit to answer the aspirations contained in the 2030 Agenda. Our analysis aimed to show how the complex nature of the 2030 Agenda and the Sustainable Development Goals can be harnessed to achieve more development across three dimensions

(economic, social, environment). With limited funds and competing political objectives, policy planners are challenged by how to tackle this vast development agenda, what to tackle first and how their policy interventions spill over onto other areas.

One possible strategy for achieving the SDGs is discussed in this paper, following the idea of the maximum effectiveness of policy interventions, and objectivity in determining which ones. We suggested that on the national level two developmental networks showing the (inter)linkages between SDGs, their targets or indicators, should be constructed and compared. Both must be able to show three characteristics of such a network: identify the most central (salient) connections, Goals, Targets and Indicators that are most central (most suitable for quick interventions – levers of development); determine the nature of the interlinkages (identify positive and negative connections, be aware where the trade-offs are and where policies can reinforce each other); and uncover tightly knit subgroups (identify parts of the 2030 Agenda that should be targeted by policies as a whole). Once the two developmental networks are mapped out, they can be compared and contrasted, leading to several policy recommendations. The Present developmental network (using interlinkages between SDGs as they exist today) tells us what we can do now to impact the existing 2030 Agenda network the most, while comparing with to the Future developmental agenda (using interlinkages as we want them to be in the future) reveals which areas should be targeted to move from the existing developmental mix to the desired one.

Our analysis presents one possible method for constructing such a network on the global level. The results for such a Present developmental network show that the most central goals are SDG 3 on health and SDG 9 on industry and infrastructure, that there are positive and negative linkages between goals, especially between economic and environmental ones, and that there are three communities/nexuses in the network that coincide with the three dimensions of the 2030 Agenda – economic, social and environmental – which do not all relate to each other in the same way.

These results indicate in which areas policies with short-term or long-term effects should be focused on. Yet they do not identify what those policies should be and only highlight a particular area of development and the connections between development areas in need of targeting using the effectiveness criteria (without considering the needs-based approach, as mentioned). Moreover, multiple methodological tools are available to map a developmental network and answer the questions concerning the linkages, especially for the Present developmental network, while the options are much more limited for mapping a Future developmental network (apart from an expert group to determine the nature of these future linkages or

analysing the wording of the 2030 Agenda). In both cases, however, the results can only be as good as the initial data input. For the network based on linkages as seen today, this depends on either indicators, targets or some type of index at the goal level which is selected, limited of course by data availability. Results can vary with the inclusion of new data or changes in the methodology, making robustness analysis and recalculations when newer and better data/methodologies become available advisable. The unimportance of a particular target or goal might simply be a consequence of poor and inadequate data coverage. With the network based on future linkages, some of the caveats remain the same, but mainly that repetition of the exercise is more likely to lead to the convergence of expert opinions and the repeated inclusion of new academic thinking, findings and methodologies will ensure the Future developmental network is up to date and uses the best information available.

Yet the most important point to take away is that simply thinking about development as an (inter)linked process, whether within the 2030 Agenda and the SDGs, or within another document or framework, should ultimately lead to better identification of the policy points of entry and ensure the greater effectiveness of interventions when and where they are made, and help with the prioritisation of the SDGs or development areas. With limited resources and ever broader developmental agendas, this may prove to be the accelerator of development that was largely missing in the past.

435

Appendix: PAIRWISE PEARSON CORRELATION COEFFICIENTS

SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1.0																
2	0.5	1.0															
3	0.8	0.7	1.0														
4	0.7	0.7	0.8	1.0													
5	0.3	0.6	0.6	0.7	1.0												
6	0.6	0.6	0.7	0.7	0.7	1.0											
7	0.8	0.6	0.9	0.8	0.4	0.6	1.0										
8	0.6	0.7	0.8	0.7	0.5	0.6	0.7	1.0									
9	0.5	0.8	0.8	0.7	0.6	0.6	0.7	0.8	1.0								
10	0.4	0.3	0.3	0.2		0.2	0.3	0.4	0.3	1.0							
11	0.5	0.6	0.7	0.7	0.6	0.7	0.7	0.5	0.6	0.2	1.0						
12	-0.4	-0.6	-0.7	-0.6	-0.4	-0.4	-0.6	-0.7	-0.8	-0.3	-0.5	1.0					
13			-0.2					-0.2	-0.3			0.4	1.0				
14	0.2	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.4		0.3	-0.2		1.0			
15	-0.2				0.2	-0.2							0.2	0.2	1.0		
16	0.4	0.5	0.6	0.4	0.3	0.2	0.4	0.5	0.7	0.4	0.3	-0.5	-0.3			1.0	
17																	1.0

Source: Own calculations.

BIBLIOGRAPHY

Allen, Cameron, Graciela Metternicht and Thomas Wiedmann (2018): Prioritising SDG Targets: Assessing Baselines, Gaps and Interlinkages. Sustainability Science 14 (2): 421–438.

Clancy, Joy S., Margaret Skutsch and Simon Batchelor (2002): The Gender–Energy–Poverty Nexus. Finding the Energy to Address Gender Concerns in Development. London: DFID.

Coopman, Anna, Derek Osborn, Farooq Ullah, Emily Aukland and Graham Long (2016): Seeing the Whole: Implementing SDGs in an Integrated and Coherent Way. London, UK: Stakeholder Forum.

De Nooy, Wouter, Andrej Mrvar and Vladimir Batagelj (2018): Exploratory Social Network Analysis with Pajek: Revised and Expanded Edition for Updated Software. Third Edition. (Structural Analysis in the Social Sciences). Cambridge: Cambridge University Press.

El-Maghrabi, Mariam Hoda, Susanna Gable, Israel Osorio-Rodarte and Jos Verbeek (2018): Sustainable Development Goals Diagnostics: An Application of Network Theory and Complexity Measures to Set Country Priorities. Policy Research Working Paper, No. 8481. Washington, DC: World Bank.

Iguchi, Masahiko, Tomoki Ehara, Eri Yamazaki, Tomohiro Tasaki, Naoya Abe, Seiji Hasimoto and Taro Yamamoto (2014): Ending the Double Burden of Malnutrition: Addressing the Food and Health Nexus in the Sustainable Development Goals. POST2015/UNU-IAS Policy Brief No. 6. Tokyo: UNU-IAS.

Jungcurt, Stefan (2016): Towards Integrated Implementation: Tools for Understanding Linkages and Developing Strategies for Policy Coherence. IISD.

Kitamura, Yuto, Eri Yamazaki, E., Norichika Kanie, D. Brent Edwards, Binaya Rai Shivakoty, Bijon Kumer Mitra, Naoya Abe, Andante Hadi Pandyaswargo and Casey Stevens (2014): Linking Education and Water in the Sustainable Development Goals. POST2015/UNI-IAS Policy Brief No. 2. Tokyo: UNU-IAS.

Nilsson, Måns, Dave Griggs, Martin Visbeck and Claudia Riegler (2016a): A Draft Framework for Understanding SDG Interactions. Paris, France: International Council for Science (ICSU).

Nilsson, Måns, Dave Griggs and Martin Visbeck (2016b): Map the Interactions between Sustainable Development Goals. Nature (534): 320–322.

Weitz, Nina, Henrik Carlsen, Måns Nilsson and Kristian Skånberg (2017): Towards Systemic and Contextual Priority Setting for Implementing the 2030 Agenda, Sustain Sci.13 (2): 531–548.

Zhou, Xin and Mustafa Moinuddin (2017): Sustainable Development Goals Interlinkages and Network Analysis: A Practical Tool for SDG Integration and Policy Coherence. Institute for Global Environmental Strategies (IGES).

SOURCES

Le Blanc, David (2015): Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. Sustainable Development 23: 176–187.

Millennium Institute (2016): Policy Coherence and Integration to Achieve the Sustainable Development Goals. Washington D.C.: Millennium Institute.

436

Pedrosa-Garcia, Jose Antonio (2016): Mapping Synergies and Tradeoffs in the Sustainable Development Goals Network: A Case Study from Jordan, UN ESCWA Working papers E/ESCWA/SDD/2017/WP.2, UN ESCWA.

UN (2014): Prototype Global Sustainable Development Report. New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development.

UN (2015): Global Sustainable Development Report: 2015 Edition. New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development.

UN (2016): Global Sustainable Development Report: 2016 Edition. New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development.

UN GA (2015): Transforming Our World: The 2030 Agenda for Sustainable Development. A/RES/70/1. New York: United Nations General Assembly.

437