Analytical Framework for Integration of Water and Sanitation SDGs and Targets Using Systems Thinking Approach

Working Paper

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The Director

Environment and Development Division
United Nations Economic and Social Commission for Asia and the Pacific
United Nations Building
Radjadamnern Nok Avenue
Bangkok, 10200, Thailand

Electronic version available at www.unescap.org/esd and www.sustdev.unescap.org

Publication team: ESCAP team of experts led by Stefanos Fotiou, including Katinka Weinberger, Aneta Nikolova, Aida Karazhanova and Zulfiya Suleimenova and Robert Steele, Sustainability Asia/ AtKisson Group,

Peer Review: Dr. LeHuu Ti, Mr. Keizrul bin Abdullah, Dr. Sonali Senaratna Sellamuttu, Prof. Lawrence Surendra, Prof. Xiaoliu Yang, Dr. Lai Choo Malone-Lee, Mr. Batu Krishna Uprety, Ms. Banashree Banerjee, Ms. Nguyen Minh Tan, Mr. Rhonda Robinson, Mr. Thierry Facon, Dr. Oyeshola Kofoworola

Design/Layout: Jeff Williams

List of Abbreviations

APUF	Asia-Pacific Urban Forum
CLD	Causal Loop Diagram
GDP	Gross Domestic Product
IRBM	Integrated River Basin Management
IUWM	Integrated Urban Water Management
IWRM	Integrated Water Resources Management
MDGs	Millennium Development Goals
SDG	Sustainable Development Goals
SEI	Stockholm Environment Institute
UN	United Nations
UNEP	United Nations Environment Programme
UNOSD	United Nations Office for Sustainable Development
UNU-INWEH	United Nations University – Institute for Water Environment and Health

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Sustainable Development Goals

End poverty in all its forms everywhere

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

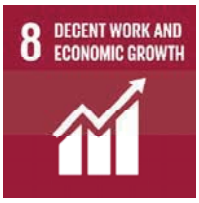
Ensure healthy lives and promote well-being for all at all ages

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Achieve gender equality and empower all women and girls

Ensure availability and sustainable management of water and sanitation for all

Ensure access to affordable, reliable, sustainable and modern energy for all



Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Reduce inequality within and among countries

Make cities and human settlements inclusive, safe, resilient and sustainable

Ensure sustainable consumption and production patterns

Take urgent action to combat climate change and its impacts

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Strengthen the means of implementation and revitalize the global partnership for sustainable development

Executive Summary

Success in achieving targets under SDG 6 on Water and Sanitation will to a large extent depend on understanding of the interdependencies with the other SDGs.

This publication presents a systems-thinking-based framework for integration of the SDG 6 targets with the 16 other Sustainable Development Goals (SDGs) and their 161 targets.

The framework was developed by a team comprised of leading water experts in the Asia-Pacific region, including an Expert Advisory Group. The framework aims to assist policy makers in designing integrated and holistic strategies and roadmaps for the implementation of the 2030 Agenda for Sustainable Development and the SDGs by applying tools and methods based on systems thinking.

Policy making for implementation of the 2030 Agenda for Sustainable Development is a complex and intricate process and systems thinking approaches provide policy makers with the means for long-term sustainability change. Traditional linear planning does not allow taking into account linkages and interactions of different factors. Deepest changes in systems, however, can be achieved by understanding which interactions result in most desired outcomes, thus supporting transitions beyond 'silo' approaches. Good leaders will look for and recognize effective "leverage points" in the system's dynamics for triggering long and short term impacts and interventions, and for making the most of scarce resources.

One of the most significant benefits in taking a systems thinking[1] approach in complex policy making is that it can assist policy makers to anticipate and prevent unintended consequences of proposed policies and turn trade-offs into opportunities for the benefit of the whole system. By identifying and visualizing how policy solutions to a given problem are interlinked with other elements in a system through a causal and a 'non-linear' approach, policy makers can identify better means to address these problems and to avoid adverse multiplication of problems in the long run.

In the development of the framework presented in this publication, the authors viewed all the 17 SDGs and their targets as one indivisible and holistic system, while placing the SDG 6 and its eight targets at its core. Three primary systems tools were utilized to analyse the system's elements behaviour:

1) an SDG goal/target relationship matrix which is used to identify 'direct' and 'indirect' interlinkages across all goals and their targets;

1. Systems Thinking utilizes multiple disciplines and critical thinking skills such as dynamic thinking, system-as-cause thinking, and 'big picture' holistic thinking, to see how things fit together so as to better understand, for example: what depends on what; what is causing what; where are the information flows; where control decisions are made; what information flows are most critical; and how best to manage or intervene in the system for desired results.

2) an online web-based systems diagramming tool (www.kumu.io) that allows visualization of the linkages between the targets; and

3) the Donella Meadows' framework (Meadows, 2009) of 12 leverage points for system change, which provides guidance in identifying and classifying the targets as leverage points.

The eight targets of the SDG 6 on water and sanitation and the targets of the other 16 SDGs were first analysed through a comparative Sustainable Development Goals/targets matrix, to assess their relationship.

This assessment focused on four key questions:

1) Is there a cause-and-effect relationship between the two intersecting targets within 1-2 degrees of causal influence?

2) If there is a causal relationship within these criteria: Is the relationship a 'direct' causal relationship (immediate and direct causal influence) or an 'indirect' causal relationship (not direct one-to-one, but must pass through other factors first)?

3) What is the directional characteristic of the two related targets? Is the indicator directional movement 'parallel' (in the same direction) or 'inverse' (in the opposite directions)?; and

4) Is the particular water and sanitation target for each causal relationship being 'driven' or influenced by the other target, or the water target is a 'driver' or influencer of the other target?

The results of this study confirm that the 17 of the SDGs are interconnected in one indivisible system, and that attaining many of the targets will rely on access to water resources and sanitation. On the other hand, successful implementation of the SDG 6 on Water and Sanitation will depend on effectively managing waste water and sanitation, water efficiency, and harnessing the interdependencies with the other SDGs. Understanding these complementarities and interlinkages, using integrated management and a systems based analytical approach, will assist countries to devise SDG implementation strategies that harness and eliminate trade-offs between the different SDGs. In addition, defining leverage points for high impact action will assist governments to attract the required investments for implementing the 2030 Agenda for Sustainable Development and the SDGs.

Though this analytical framework provides a macro-level perspective, when applied in country context and circumstances, it can aid decision planning and efficient implementation.

Key recommendations of the study[2] from the analysis of the leverage points for effective interventions to strengthen implementation of the 2030 Agenda for Sustainable Development and the SDGs include the following areas:

1. Law and Governance: Law, at both the domestic and international levels, and good governance can create the foundation for cooperation at all levels, as both aspects form a foundation for future policy actions. ESCAP has an important role to play for promotion of effective and strong, regional and national, legal and governance frameworks.

2. Data Gathering and Sharing: Frameworks of law and governance ought to incorporate data gathering, sharing and monitoring as legal provisions and best practices. ESCAP can foster regional cooperation for developing a regional data collection and sharing system and cross-fertilization of best practices.

3. Environmental degradation and Pollution: SDG 6 targets include strong linkages and concerns for the environment, thus highlighting environmental limits. Through addressing SDG 6 on water and sanitation, ESCAP can provide a platform for integrating the environmental dimension into the implementation of the 2030 Agenda for Sustainable Development in partnership with UNEP and other UN agencies.

4. Human and Institutional Capacity Building: Increasing knowledge and capacity on water related issues is required to support effective implementation of SDG 6 targets. ESCAP and other UN agencies need to identify knowledge gaps and provide capacity building to developing countries for integrated water resources management to address challenges of sustainable water for all.

5. Mobilisation of Financial Resources: Ultimately, to close the gap between promise and practice in the management of global water resources, enabling environments and innovative solutions for financing and implementation of SDG 6, including through water use-fees and tariffs, public–private partnerships and public–public partnerships need to be established. ESCAP has the potential to foster an enabling environment at the subregional and regional levels for overcoming the financial gaps and development of water markets.

6. Transboundary water cooperation: ESCAP has an important role to play to support effective integrated water resource management (IWRM), Integrated River Basin Management (IRWM) and Integrated Urban Water Management (IUWM), which require increasingly shared knowledge on river basins and shared water cycle dynamis, as well as resilience, including urban water resilience, and technologies for monitoring and early warning.

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2. More details are provided in Chapter 8 of this publication.

Table of Contents

1.	**Water for Life and Development in Asia-Pacific**	**11**
2.	**Rationale for Using a Systems Thinking Based Approach to Implementation of the SDGs**	**15**
3.	**Assessment methodology**	**17**
4.	**A Baseline Systems Storyline of Sustainable Water for All**	**20**
	Water – a critical factor for Sustainable Development	20
	Baseline Systems Mapping of Sustainable Water and Sanitation	22
5.	**Integrated SDG Systems Analysis with SDG 6 (water and sanitation) at the Core**	**27**
	Scope of the systems-based analysis	27
	Summary of the assessment of the interlinkages between SDG 6 targets with the other SDG targets	27
6.	**Leverage points analysis - opportunities for integrated high impact interventions**	**45**
	What is a Leverage Point?	45
	SDG 6 Leverage Points Assessment	47
7.	**Recommendations for integrated high-impact interventions**	**89**
8.	**Conclusion**	**92**
	REFERENCES	**93**
	Annex I: Full Matrix of Analysis of Direct and Indirect Linkages Between the SDG Targets and the Targets of Other SDGs	95
	Annex II: Box on Water Security / Sustainable Water	95
	Annex III: Water Security in Five Dimensions	96
	Annex IV: Glossary	97

List of Tables

Table 1:
Donella Meadows' 12 Leverage Points for System Intervention 48

Table 2:
SDG Target Leverage Points High Impact Ranking on SDG 6 Targets 83

List of Figures

Table 1:
Freshwater Withdrawals per Agriculture Value Added 11

Figure 2:
SDG 6 Water and Sanitation is a Core Prerequisite Goal for Sustainable Development 14

Figure 3:
SDG 6 Causal Loop System Diagrams – Overall and Individual SDG 6 Targets Mapped 19

Figure 4:
SDG targets that rely on access to water resources 21

Figure 5:
Causal Loop Diagram of Baseline System Model for Water Security 26

Figure 6:
SDG 6 Target 6.1 Achieve Universal and equitable access to safe and affordable drinking water for all: Drivers and Responses Map 30

Figure 7:
SDG 6 Target 6.2 Achieve access to adequate and equitable sanitation and hygiene and end open defecation, (special attention to the needs of women and girls): Drivers and Responses Map 32

Figure 8:
SDG 6 Target 6.3- Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally: Drivers and Responses Map 34

Figure 9:
SDG 6 Target 6.4 - Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity: Drivers and Responses Map 36

Figure 10:
SDG 6 Target 6.5 - Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate: Drivers and Responses Map 38

List of Figures

Figure 11:
SDG 6 Target 6.6 - Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. Drivers and Responses Map 40

Figure 12:
Target 6.a - Expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies: Drivers and Responses Map 42

Figure 13:
SDG 6 Target 6.b - Support and strengthen the participation of local communities in improving water and sanitation management: Drivers and Responses Map 44

Figure 14:
System Iceberg and Leverage 46

Figure 15:
SDG 6 Target 6.1 - Potential High Impact Leverage Points 55

Figure 16:
SDG 6 Target 6.2 - Potential High Impact Leverage Points 59

Figure 17:
SDG 6 Target 6.3 - Potential High Impact Leverage Points 63

Figure 18:
SDG 6 Target 6.4 - Potential High Impact Leverage Points 67

Figure 19:
SDG 6 Target 6.5 - Potential High Impact Leverage Points 70

Figure 20:
SDG 6 Target 6.6 - Potential High Impact Leverage Points 74

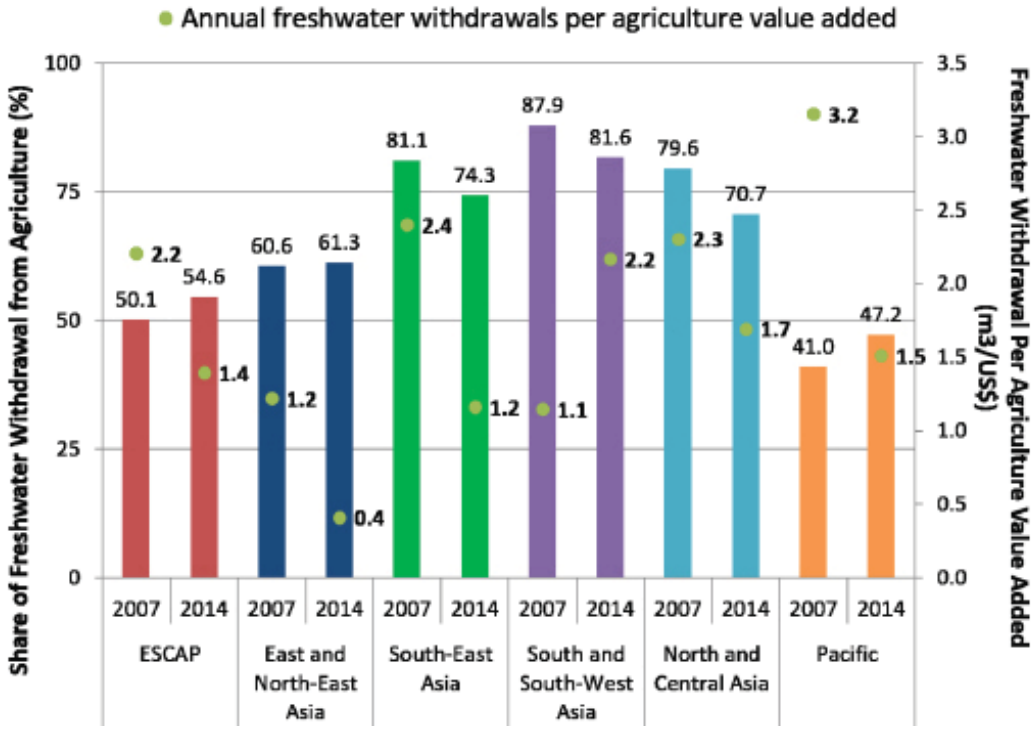
Figure 21:
SDG 6 Target 6.a – Potential High Impact Leverage Points 77

Figure 22:
SDG 6 Target 6.b – Potential High Impact Leverage Points 80

1. Water for Life and Development in Asia-Pacific

As the Asia-Pacific region hosts two-thirds of the world population, and with the commitment of member states to ending hunger in the region, where still 490 million[3] undernourished people of the world live, the importance of water for food production is essential. About 40 per cent of the land in the region is used for agriculture and another 30 per cent is forested[4]. A significant proportion of the available fresh-water resources, at around 70 per cent of the freshwater withdrawals worldwide[5] are being used for irrigated agriculture for food production (Figure 1). The region is the biggest producer in the world of cereals, vegetables, fruits, meat and fish with strong growth in all areas, and yet, water resources endowment per capita in Asia-Pacific is the lowest of all world's regions[6].

Figure 1: Freshwater Withdrawals per Agriculture Value Added



Source: ESCAP Analytical Work on Water Efficiency in the Agricultural Sector

However, the regional water and sanitation landscape is quickly changing with increasing urbanization and industrialization, and growing energy demands coupled with new and emerging conflicting water supply needs that are intertwined in a complex water-energy-food nexus relationship. Over-extraction of water to meet these needs in many countries of the Asia-Pacific region is compounded by continued deforestation and the impacts of climate change, which together, are magnifying recurrent

3. ESCAP Statistical Yearbook, 2015
4. FAO, 2015
5. FAO, 2014 and 2015
6. In 2015 the available water resources were 5,224 cubic meters/per capita, way below the world's average of 7,568 cubic meters (ESCAP Statistical Yearbook, 2015)

droughts alternating severe flood events that are significantly changing the flow and replenishment of the water cycle.

A distinct feature of rapid urbanization and industrialization is that as much as 70 to 90 per cent of household and industrial waste waters, are discharged untreated in existing fresh water bodies (lakes, rivers, reservoirs, wetlands) and the ocean, further reducing the availability of scarce fresh water resources[7].

Although Asia-Pacific is progressing well in improving access to drinking water for its people, significant challenges still remain. Today, 277 million[8] people still lack access to safe drinking water. While access to improved water sources in urban settings of the Asia-Pacific region is nearly universal, one in every ten rural residents still lives without access to clean drinking water[9]. Another important disparity in terms of provision of access to basic sanitation, and wastewater treatment is between the sub-regions, with South-West and South-Asia lagging behind the others.

Application of integrated water resources management, which takes into account the dynamics of the natural water cycle, and utilizes water efficient techniques, in particular in agriculture, is important to support vibrant rural communities' development and agricultural labour productivity growth. Modernization of irrigation systems in the region is most desired, since irrigation expansion in most of Asia has nearly reached its limits.

Water is a vital and irreplaceable resource for life and therefore underpins all sustainable development. This is well recognized through Sustainable Development Goal 6 of the recently agreed 2030 Agenda for Sustainable Development. SDG 6, aiming to "Ensure availability and sustainable management of water and sanitation for all", and its 8 targets form one important sub-set of the 17 SDGs and 169 targets (Figure 1). With water at the very core of sustainable development, SDG 6 is inextricably linked with all the other 16 SDGs; and is one of the key prerequisites for achieving sustainable development. An integrated approach to implementation of SDG 6 would significantly boost the opportunities for achieving long-term sustainable development.

This analytical study on the integration of the water and sanitation targets of Sustainable Development Goal (SDG) 6 with the other 16 SDGs was initiated based on the recommendations of the Parallel Session 8 on Integrated Urban Water Solutions for Sustainable Cities of the 6th Asia-Pacific Urban Forum (APUF—6, 19-21 October 2015, Jakarta, Indonesia) as a Regional Preparatory Meeting to Habitat III[10] and the UN-Water Regional Expert Consultation on Water Security in Asia-Pacific[11], which was organised by UNESCAP in partnership with the United Nations University – Institute for Water, Environment and Health (UNU-INWEH, 9 - 10 November 2015, Bangkok, Thailand). These meetings recommended to ESCAP to undertake a study on tracking the interrelated nature of water and sanitation related targets across the 17 SDGs.

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7. ESCAP, UN-Habitat, AIT; 2015. Policy Guidance Manual on Wastewater Management
8. ESCAP Statistical Yearbook, 2015
9. ESCAP Statistical Yearbook, 2014 and 2015

A systems thinking approach was considered highly beneficial for assisting policy making in individual countries in the region to prioritise their work on SDGs, including SDG 6 to create a conducive environment for cross-sectorial cooperation and collaboration, attract investment and identify more effective long-term leverage points for sustainable outcomes.

Systems thinking focuses on recognizing the interconnections between the parts of a system in understanding the whole. This is a way of understanding complex systems by examining the relationships among the system's parts, rather than the parts themselves. It is also concerned about the interrelationships among parts and their relationship to a functioning whole[12]. The aim of systems thinking is to understand system behaviour by identifying the underlying patterns, systemic structures and mental models that influence the patterns of behaviour and repeated outcomes so that more sustainable long-term decisions and interventions can be implemented[13].

The study was conceived as a desk-based research and analysis on the water and sanitation related targets of all SDGs with the aim to assess cross-sectoral inter-linkages between SDG 6 and the other SDGs at the target level. Figure 1 describes the base premise with water and sanitation at the core which defined one group of SDGs (SDG 2, 3, 7, 8, 9, 11, 12, 13, 14 and 15) for which water and sanitation were viewed as the means for development and preservation of natural processes, while for the other group (SDG 1, 5, 4, 10, 16 and 17) the availability of water and sanitation was considered as an enabler of sustainable development and human wellbeing.

For this purpose, the 17 SDGs were considered as one whole, indivisible and holistic system with complex interactions between its targets, with direct and indirect linkages and causal influences. Further deeper analysis of these relationships allowed to identify the opportunities for high impact and integrated interventions to support effective implementation of the 2030 Agenda for Sustainable Development and the SDGs.

Further, the study integrated the analysis of the inter-target relationship matrix with the kumu.io causal diagram to identify the 'high impact leverage points' using the Meadows' 12 leverage points framework. The approach and analysis are described in more detail in Section 6 to provide an understanding of where the best opportunities emerge for integrated high impact interventions.

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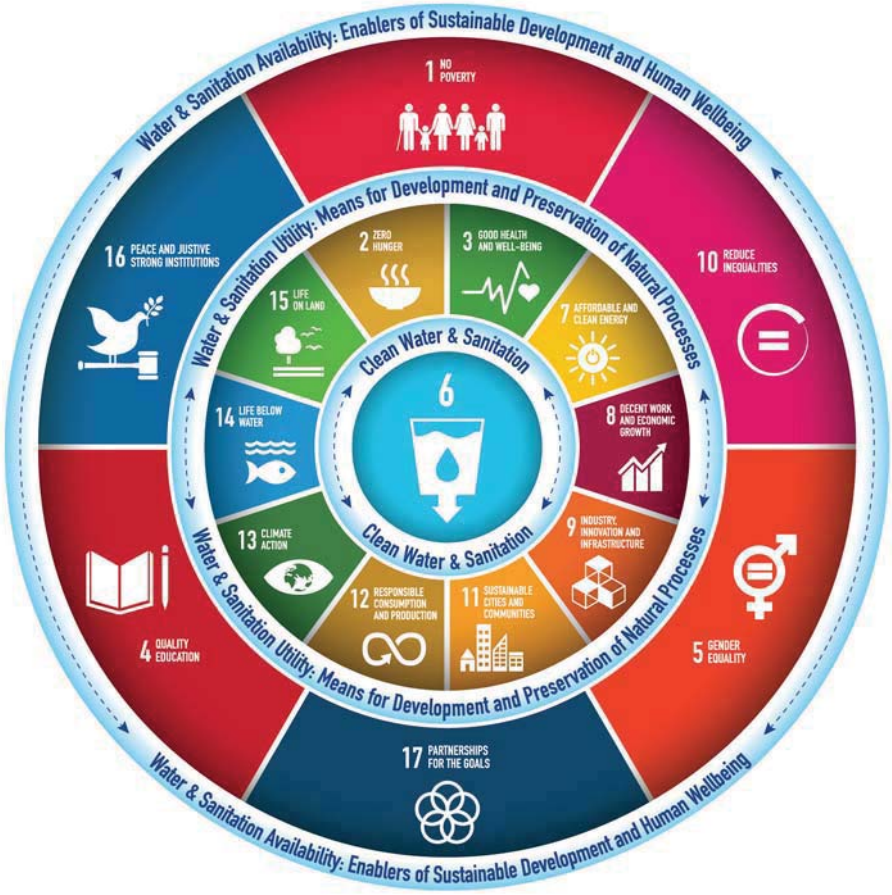
10. Implementation of water and sanitation-related development goals requires the adoption of system-based framework on integrated urban water management, inclusive of policy regulations, diverse technologies, financing sources, water and sanitation markets and community participation.
11. The regional consultation deliberated on the regional perspectives on water security in the 5 thematic areas: 1) on household water security; 2) on economic water security; 3) on environmental water security; 4) on urban water security; 5) on extreme events and water security; and an additional session on the integration aspects of all 5 of water security themes together.
12. Richmond 2010, AtKisson, 2011
13. Ferencik, Soderquist, Minyard, 2014

This assessment study was conducted at the regional level and does not take into account situational differences between individual countries. Therefore, findings and recommendations from this study are still to be further tested and verified by pilots in individual countries, using country-specific indicators and data to map out the relationships of the SDG targets at the national level, with the aim to utilize this framework in identifying high impact interventions that will help national government and stakeholders to tackle their Water and Sanitation SDG targets in a strategic and efficient manner.

Figure 2: SDG 6 Water and Sanitation is a Core Prerequisite Goal for Sustainable Development



Source: ESCAP, 2015 UN-Water Regional Expert Consultation on Water and Security in Asia-Pacific, 9-10 November 2015.

2. Rationale for Using a Systems Thinking Based Approach to assess the Implementation of the SDGs

The progression of global priorities from the Millennium Development Goals (MDG) to the SDGs of the 2030 Agenda for Sustainable Development shows that the challenge of sustainable development cannot be seen as achieving isolated goals and targets at the national, subregional and regional levels. What is required is an integrated approach to the interlinked sustainable development goals and targets, and by all countries. Only then will we see long-term sustainability in any area, such as water and sanitation. Building on the lessons from the MDGs, the current and emerging global sustainability challenges captured in the 17 SDGs require action that embraces interdisciplinary and inter-sectoral approaches to development that acknowledge both path-dependence and context-dependence implementation. In addition, the 17 SDGs and their targets comprise a whole system with high degree of complementarity between the various targets.

The approach of systems thinking is fundamentally different from that of traditional forms of analysis. Traditional analytical approaches tend to deep dive into the individual elements or components of a problem, and focus attention on the solutions to relatively fragmented or "siloed" 'cause and effect' dynamics in a linear progression (i.e. a process of thought following known cycles or step-by-step progression where a response to a step must be elicited before another step is taken). This is often referred to as a logical 'reductionist' approach (e.g. logical framework approach). The disadvantage of relying too heavily on a linear logic approach is in the determination of the starting point. Once a starting point is chosen, there are a limited number of logical conclusions to a problem. The advantage of a linear logic approach, is that it allows us to reach an answer from a given starting point. However, starting from one point and progressing to a solution is limiting because the world itself is complex and non-linear and thus the most logical answer may not be the best answer.

Systems thinking, in contrast, focuses on how the problem being analysed interacts with other elements of a bounded system (i.e. a set of elements that interact to produce behaviour, of which it is a part). This means that instead of isolating smaller and smaller parts of the system being studied, a systems thinking approach works by expanding the view to take into account larger and larger numbers of interactions, which often results in sometimes strikingly different conclusions than those generated by traditional forms of analysis, especially when what is being studied is dynamically complex or has a great deal of feedback from other sources, internal or external (Aronson, 1996-1998).

Systems thinking, which is based on non-linearity logic, can help to expand the problem solving lens to take in multiple directions with multiple starting points, which can be applied logically to find solutions. The character of systems thinking makes it extremely effective on the most difficult types of problems to solve: those involving complex issues, those that depend a great deal on the past or on the actions and decisions of others, and those stemming from ineffective coordination among the different decision makers and parties involved.

Systems thinking utilizes habits, tools and concepts to develop an understanding of the interdependent structures of dynamic systems. When individuals have a better understanding of systems, they are better able to identify the leverage points that lead to desired outcomes.

Systems thinking encompasses a wide range of constructs, including complex adaptive systems, systems dynamics, and cybernetics, to name a few. Its advocates and recognises the dynamic and sometimes unpredictable interactions among actors (such as policy makers, providers, organisations, and communities) in complex systems such as water and sanitation, health, or rule of law and social justice for example. In contrast with selective, reductionist approaches, systems thinking is based on understanding relationships, a commitment to multiple perspectives, and an awareness of boundaries.

Whether at the stage of developing collaborative action, planning implementation, or assessing the effects of existing or new programming, systems thinking offers a theoretical perspective and a suite of concrete and accessible strategies to create long-term sustainable solutions at multiple levels. Perhaps more importantly, systems thinking requires a change in mindset, recognising that the whole is greater than the sum of its parts, which contrasts with a traditional, reductionist approach. According to Nguyen and Bosch (2012) systems thinking is a way for development practitioners to conceptualise, make decisions, and take action that supports the integration of social, environmental and economic dimensions of sustainability. This, in turn, supports people to address the challenges of improving both human and ecosystem wellbeing. Bosch et al. (2013) agree that, the use of systems thinking approach indeed helps to leverage management complexity relative to other approaches. The challenges of sustainability are complex and evolving and require the development of effective “mental models” to effectively deal with the rapid social, political, economic and technological changes that support an adaptive transition, and in some cases radical transformation, to sustainability. How different people “see and understand” the global market, the environment and of course, what sustainable development is and how to achieve it, all underpin the systems that are designed to address current and emerging issues and the strategies and actions employed (Soderquist & Overakker 2010). A systems perspective is a new mental model, which particularly supports policy makers in their strategic analysis and planning for the 2030 Agenda for Sustainable Development and SDGs.

3. Assessment Methodology

The methodology employed for this assessment is grounded in a systems thinking based approach. A systems based analysis approach provides a framework within which complex systems can be understood. It also offers structure and methods to describe and analyse parts within their context and systems as wholes. There are three primary systems tools utilized in this assessment: 1) an SDG Goal/target relationship inter-target linkage matrix which is used to identify 'direct' and 'indirect' cross-goal inter-target linkages; 2) an online web-based systems diagramming tool (www.kumu.io) that allows us to visually lay out the linkages between targets; and 3) Donella Meadows' 12 leverage points for system change framework (Meadows, 2009), which provides the guidance in identifying and classifying leverage point targets.

As a foundation for the analytical work undertaken under this study, a complex SDG Goal/targets matrix was developed and is presented in Annex I of this report. The eight targets of SDG 6 were first analysed through a comparison matrix with all of the targets of the other 16 SDGs, and within SDG 6 itself. For each cell of intersecting targets in the matrix, four questions were asked:

1) Is there a cause-and-effect relationship between the two intersecting targets within 1-2 degrees of causal influence[14]?

2) If there is a causal relationship within these criteria: "Is the relationship a 'direct' causal relationship (immediate and direct causal influence) or an 'indirect' causal relationship (not direct one-to-one, but must pass through at least 2-3 other targets first)?

3) Is the selected or specific water and sanitation target for each causal relationship being 'driven' (an effect) or influenced by the other target, or is the water target a causal 'driver' (a cause) or influencer of the other target?

4) What is the directional characteristic of the two causally related targets? A parallel relationship indicates that the directional influence between two indicators is in the same direction. For example, if water use efficiency will increase (target SDG 6.4), then sustainable agriculture productivity (target SDG 2.4) will also increase due to significant importance of water withdrawals for the agricultural activities in the region. In contrast, an inverse relationship is one in which the causal influence between two indicators is in the opposite direction. For example, with increase of number of waste water treatment facilities in a country, the levels of waste water discharges and pollution of fresh water bodies will decrease.

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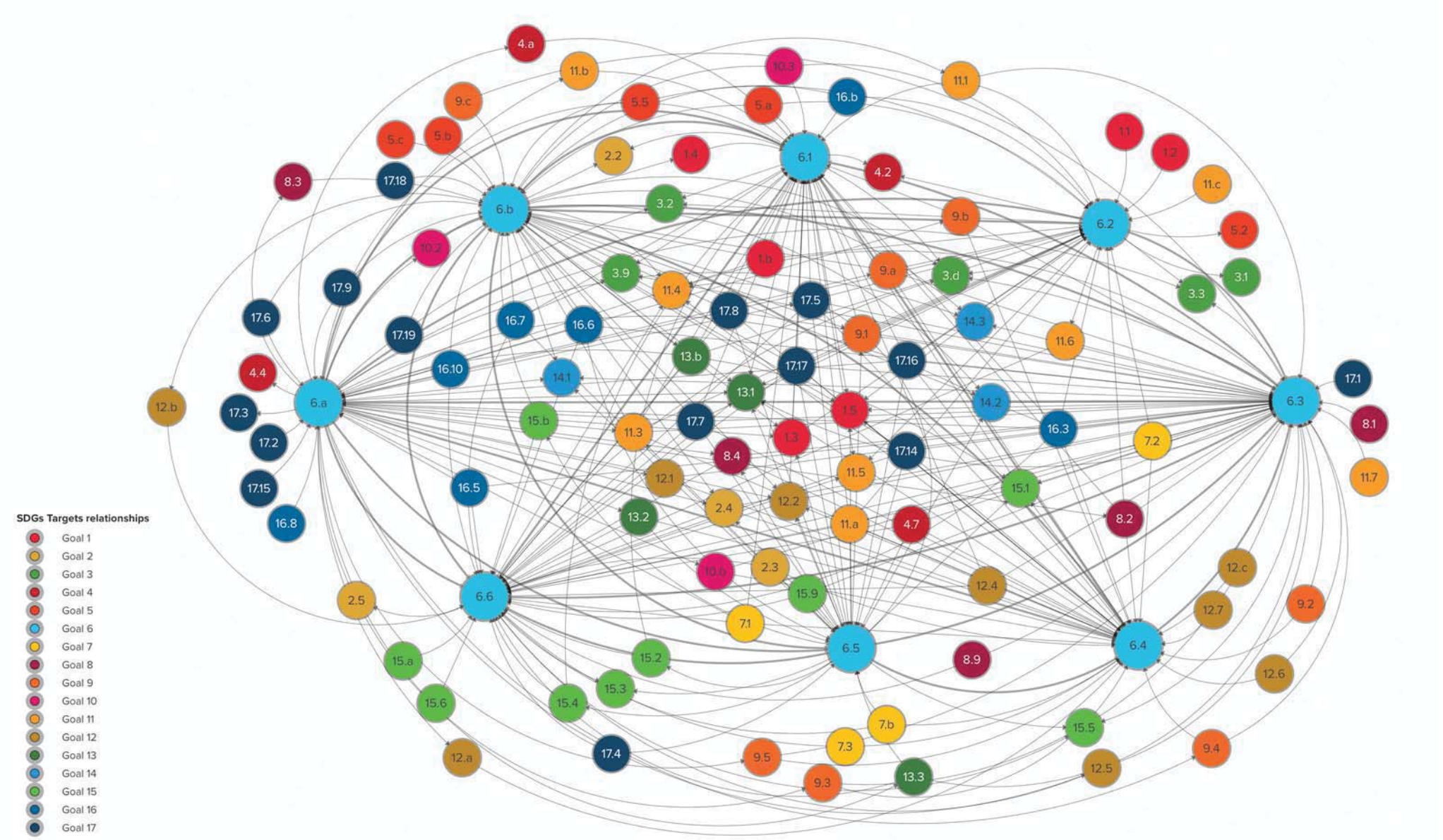
14. The reason we focus on the targets that are within 1-2 degrees of causal influence to a selected SDG 6 target, is based on research in complexity and decision-control influence (Berlow, 2010). Essentially we ask three questions in progression: "what causes this to change? Then what causes this to change, and once more, what causes this to change? Answers are cognitively related to the specific target of focus, and applied to the "driver' targets that we have identified having a causal relationship with our focus target."

To develop the inter-linkages SDG Goal / targets systems diagram, an online web-based software tool (www.kumu.io) was used to visualise the direct causal relationships between all of the SDG 6 water and sanitation targets and the other 16 SDGs targets identified in the relationship matrix analysis. Kumu is a powerful visualization platform for mapping systems and better understanding relationships. The 8 water and sanitation targets of SDG 6 were first mapped amongst themselves. From there on, the targets with direct linkages with the other 16 goals were further mapped out, resulting in an overall systems causal diagram presented on Figure 3 Overall Map below.

The Kumu is a diagram-mapping tool, which provides a spatial relationship map consisting of two distinct parts. One part provides a narrative description for each one-to-one inter-target causal relationship as described in the relationship matrix. The other part shows visually the system relationship diagram, which can be manipulated to zoom in and focus on any part of the overall diagram for analytical purposes. For this report, a link to the KUMU site is provided in the Integrated Systems Analysis section (Section 6), which will present the summary of the analytical study in a Kumu format.

Further, the study integrated the analysis of the inter-target relationship matrix with the kumu.io causal diagram to identify the 'high impact leverage points' using the Meadows' 12 leverage points framework. The approach and analysis are described in more detail in Section 6 to provide an understanding of where the best opportunities emerge for integrated high impact interventions.

Figure 3: SDG 6 Causal Loop System Diagrams – Overall and Individual SDG 6 Targets Mapped



Source: https://nonglala.kumu.io/sdg-6-targets-systems-analysis

4. A Baseline Systems Storyline for Sustainable Water for All

The threat of a global water crisis is often mischaracterised as a lack of enough water to immediately meet all of humanity's diverse needs. The crisis is not that there is not enough water on Earth to meet all needs; it is a crisis of there not being enough water where we want it, when we want it, of sufficient quality to meet these needs.

From – UNU-INWEH, Water in the World We Want

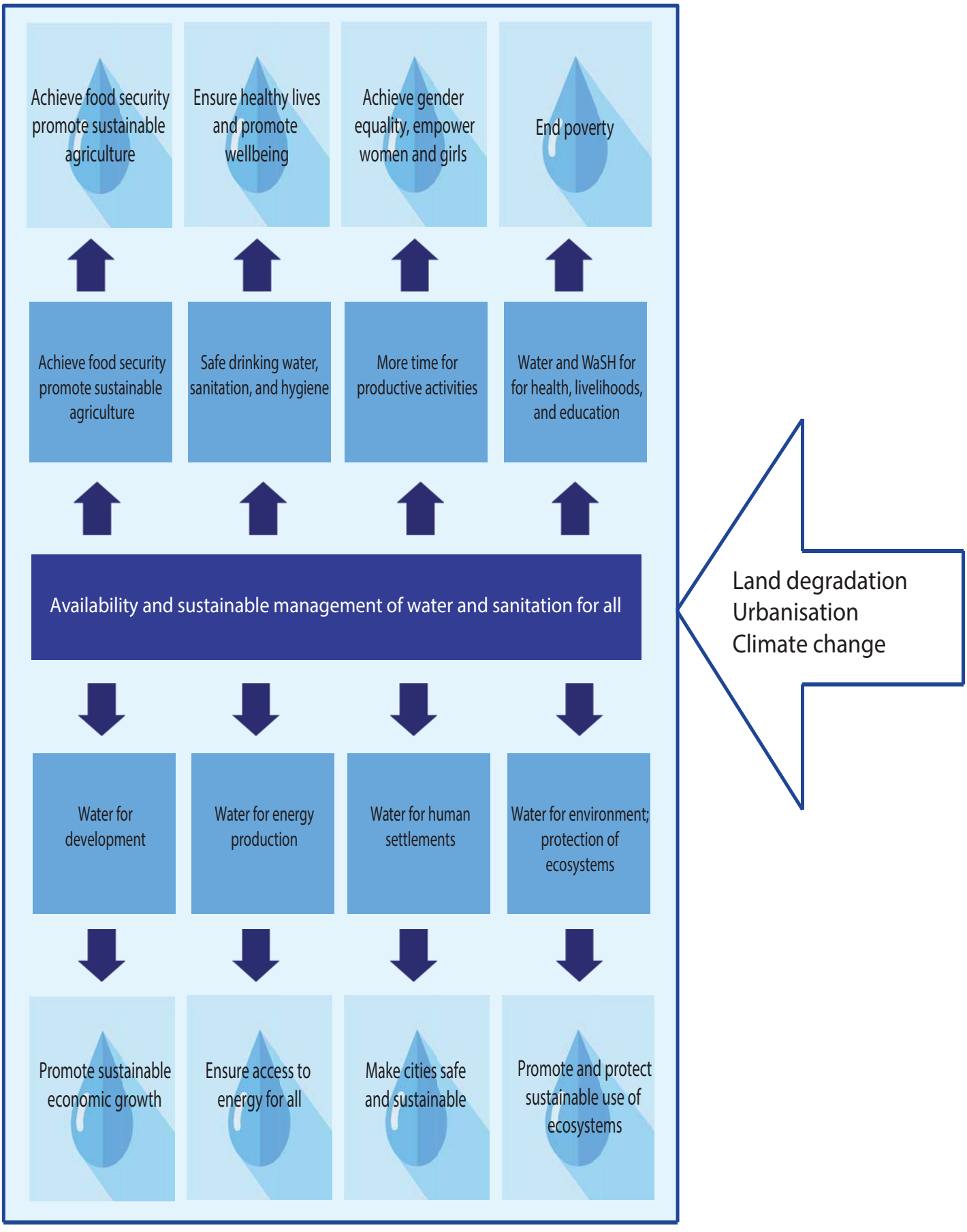
Water – a Critical Factor for Sustainable Development

Water is an essential element for human life and wellbeing, and is a key element of all human economic sustainability, particularly in relation to energy production, resource extraction (e.g. mining), manufacturing, agriculture, transportation, construction and the service sector. It is central to the production and preservation of a host of benefits and services for people. Water is integral to many religious rites and rituals in most if not all of the world's major religions and is vital for social development. It plays an integral role in reducing the global burden of disease and improving the health, welfare and productivity of people (UNU-INWEH, UNOSD and SEI. 2013). Water is also a crucial component of healthy ecosystems via the water cycle, which in turn provides an ecological service benefit back to humans in the form of clean water.

The Earth's ecosystems are linked and maintained by water, as it drives plant growth and provides a permanent habitat for many species. Water is also at the heart of adaptation to climate change, serving as the crucial link between the climate system, human society and the environment. Wise management of water is therefore a pre-condition of sustainability, whether we are talking strictly about environmental sustainability or human sustainability. Changing circumstances with respect to water availability tend to cascade through every sector of the economy, and through all social and political systems around the world (Schuster-Wallace and Sandford, 2015).

The UNU-INWEH, UNOSD and SEI 2013 report - Water in the World We Want: Catalysing Water for Sustainable Development and Growth highlights the strong linkages that exist between water resources development and economic development. In doing so, it also identifies the dual role of water as a resource and a sector in its own right. As such, it is a right and a commodity, a core necessity for human health and wellbeing and a primary ingredient for economic productivity. As this report shows in Figure 4, sensitivity to external pressures coupled with increasing scarcity and competition for its use puts water governance and management at a critical intersection and point of leverage.

Figure 4: SDG targets that rely on access to water resources



Source: UNU-INWEH, UNOSD and SEI 2013 report - Water in the World We Want: Catalysing Water for Sustainable Development and Growth

The inclusion of SDG 6 on Water and Sanitation for All in the overall framework of SDGs is an important step in recognising the fundamental and implicit role of water in sustainable development. As shown in Figure 2, water is directly linked to a range of targets of other SDGs, i.e. to some as an essential means for development and preservation of natural processes, and to others as an important enabler of human wellbeing. Furthermore, many more targets of the other SDGs are directly and indirectly impacting the achievement of the water and sanitation SDG 6.

Baseline Systems Mapping of Sustainable Water and Sanitation

Given the role of water as a key natural resource underpinning social wellbeing, economic prosperity, and environmental integrity, water is central to sustainable development and therefore must be placed at the centre of the post-2015 process (Figure 2). Following from this premise, a baseline systems story of sustainable water (conceptualized in terms of water quantity and quality) was built, illustrated by a causal loop diagram (CLD) model as shown in Figure 5. A key aspect of this systems' model is the mapping of cause and effect relationships between topical nodes (e.g. national policy setting) along with the highlighting of key feedback loops[15].

For the purposes of this study, the baseline system model identified five primary drivers, referred to as D1 drivers. These drivers have the most immediate causal influence on sustainable water quality and quantity (e.g. total available renewable water resources) regionally, nationally and locally. These primary drivers include:

1) Water Governance (Policy and Management);
2) Technology and Infrastructure Development and Utilization;
3) Emission and Pollutants;
4) Environmental Health and Ecosystem Services;
5) Climate Change.

The five primary drivers described previously are in their turn directly influenced by three other intermediate (D2) drivers (underlying causes). This include:

1) Production & Consumption Practice from Industry, Agriculture, Energy and Service Sector;
2) Evidence-based Scientific Research (data and information); and
3) Financial Investments and Markets.

15. Feedback occurs when outputs of a system are routed back as inputs as part of a chain of cause-and-effect that forms a circuit or loop. Note on feedback in systems analysis: Simple causal reasoning about a feedback system is difficult because the first system influences the second and second system influences the first, leading to a circular argument. This makes reasoning based upon cause and effect tricky, and it is necessary to analyze the system as a whole.

The D1 driver (Emission of Pollutants and Drawdown) and the D2 driver (Production & Consumption Practice) are further directly influenced by the responses (effects) to the state or situation of water quantity and quality through a system feedback. This feedback loop we have named "consumption and utilization" responses. These include: 1) Human Settlement Development; 2) Human Health and Wellbeing; and 3) Energy Production.

These three primary responses further influence the D2 driver Production and Consumption practice and Emission of Pollutants and Drawdown as described, which in turn influence the D1 drivers of Climate Change and Environment Health and Ecosystem Services. The dynamic series of reinforcing feedback loops we call the "Environmental Impact Loop."

The final pieces forming the model are the factors seen as driving the entire system. There are four root cause factors (D3), which are that are driving the current behaviour of our baseline sustainable water and sanitation model. The D3 drivers are: 1) National Economic Performance (GDP); 2); and 3) National Governance and Policy Setting; and 4) Local Participation and Capacity for Knowledge Management (i.e. collection, monitoring, analysis and sharing of data / information). The D3 drivers are what influence the D2 drivers, and are themselves reciprocally influenced by the D2 drivers and other companion D3 drivers through balancing (negative) feedback loops. Names have been given to each smaller feedback loops and include: Water Management, Economic Productivity, Economic Growth, Global Laws and Governance, National Laws and Governance, Knowledge Management, and Policy Formulation.

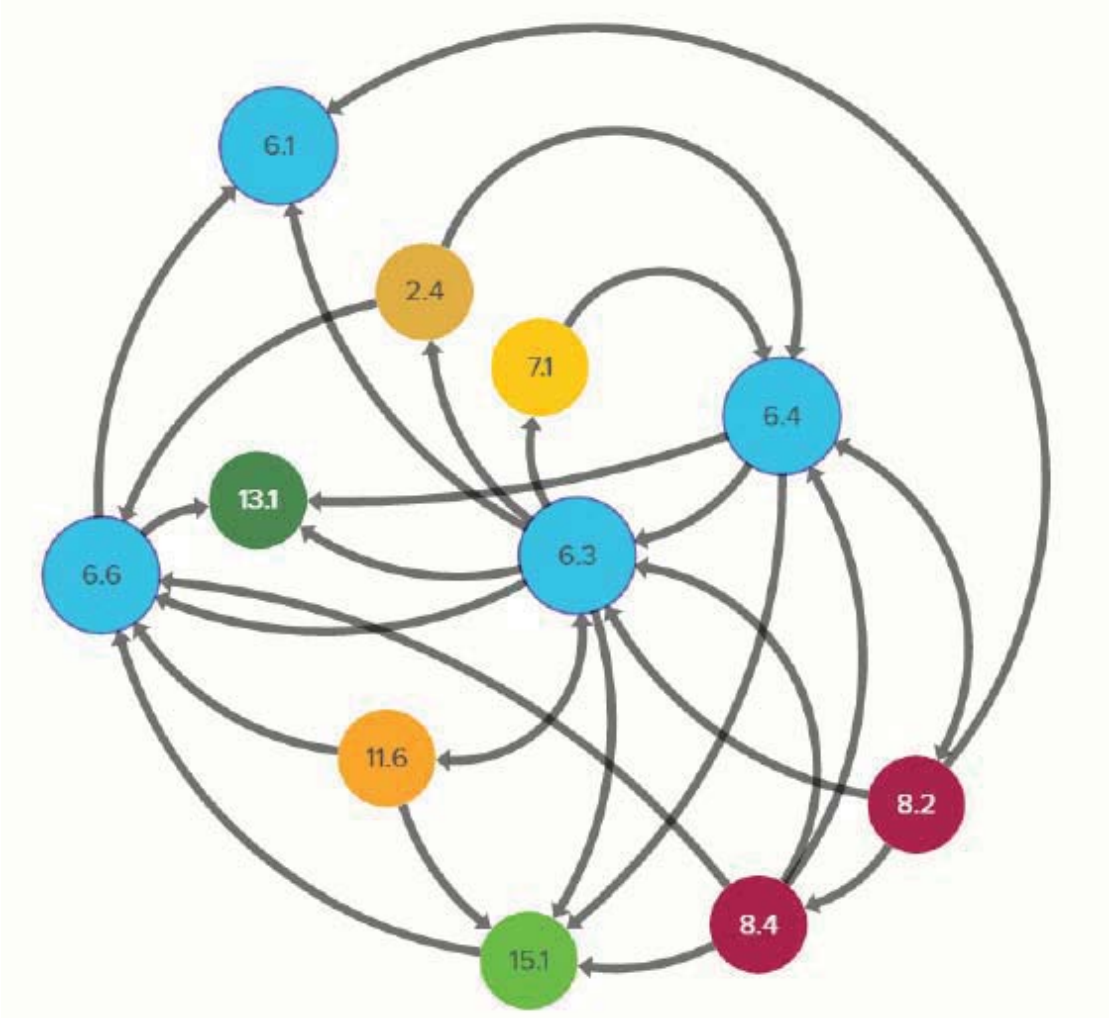
Four important observations can be derived from this baseline systems analysis of Sustainable Water and Sanitation. The first is there is a clear evidence for a strong link between. water quantity and quality, with economic activity and performance, human development, and human health and wellbeing. As such, water is both a human right and a commodity; a necessity for human health and wellbeing and a key ingredient for economic productivity. Water is also a critical ingredient in sustaining the natural environment and as a critical factor driving many of the systems that produce the various ecological services that humans directly benefit from in terms of basic needs, economic activity and human wellbeing. Thirdly, without proper water governance (policy and management), there is likely to be increased competition for water between sectors and an escalation of water crises of various kinds, triggering emergencies in a range of water-dependent sectors (UN-Water, 2014). Finally, the access to and use of scientific data and information for policy formulation, along with the participation of all citizens in the sustainable development process are core drivers for achieving the water and sanitation targets and thus the Goal of SDG 6 – water and sanitation for all.

Figure 5 on page 24 visualizes the baseline causal relationships through a systems model described previously. The systems model diagram is also available online at the Kumu website: https://nonglala.kumu.io/sdg-6-water-and-sanitation-for-all with an interactive presentation of the baseline systems storyline of sustainable water for all as a causal loop diagram.

Box 1: Vertical agriculture [SDG2] and water [SDG6]

A case study of 2016 analysed some of the benefits of vertical farming, which is a method to produce food within urban limits in specially constructed buildings. The concept of vertical farming is being developed under pilot projects in various places around the Asia and the Pacific, such as Australia, China, Japan, or the Republic of Korea. The Seoul Metropolitan Government, for example, has reformed an apartment complex in the Yangcheon district of Seoul to test new types of growing techniques.

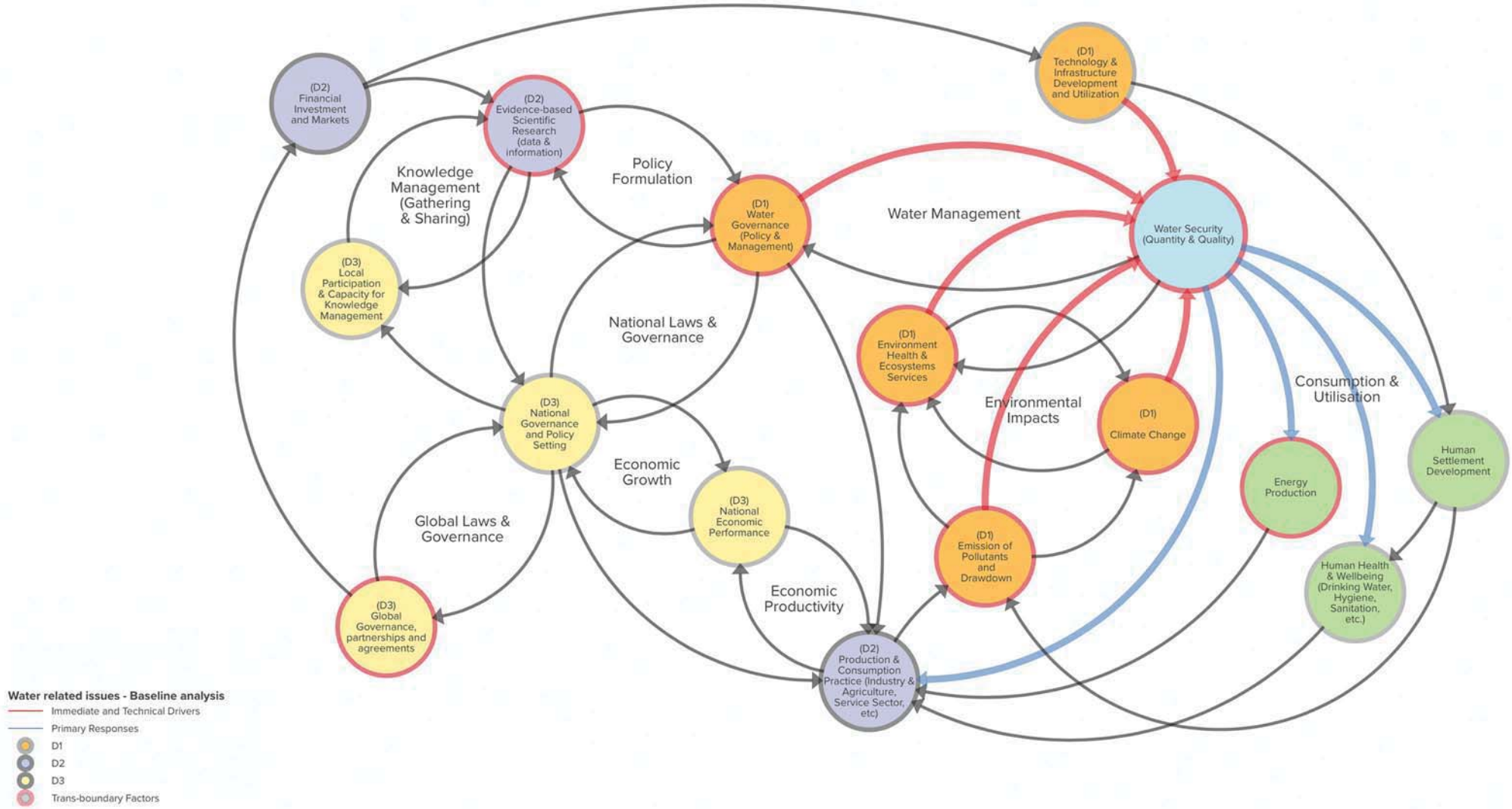
The basic purpose of this method is to reduce soil use, and to protect crops from extreme weather events. That is to say, to achieve a resilient and sustainable food production system [2.4]. Some of the insights of the case study revealed that SDG target 2.4 can perform as a high impact driver leverage of SDG targets 6.3, 6.4 and 6.6. For example, vertical farms could help to improve water [6.3] quality by using a closed loop system to convert safe-to-use grey water into drinking water through transpiration. Wastewater issues could be additionally corrected by the incorporation of waste-to-energy strategies [7.1]. Furthermore, the use of aeroponics and aquaponics would reduce water consumption, ensuring thus water-use efficiency and increasing the volume of available fresh water [6.4]. Finally, the reduced impact on ecosystems of agricultural runoff laden [11.6] would contribute to the safety of water-related ecosystems [6.6, 15.1].



A secondary scope for vertical farming is to contribute to achieve greater levels of economic productivity in line with SDG target 8.2, by making use of the possibilities of innovation and new types of technologies. Improved economic productivity can directly influence SDGs target 6.1, 6.3 and 6.4. In case of vertical farming, the economic outcome of higher productivity could incentivize the use of more efficient and clean methods of water use, particularly through the practises we've mentioned. Decreased environmental degradation [8.4] is also one of the main outputs of vertical farming; since environmental degradation associated with agricultural grow would be reduced. Again, target 8.4 is also one of the main influencers for targets 6.3, 6.4, and 6.6; given that a lesser environmental degradation would entail lower water pollution, greater availability of water sources that facilitate water-use efficiency and a smaller damage over water-related ecosystems. In sum, targets 6.3, 6.4 and 6.6 are the specific central components influenced by vertical farming under the field of SDG 6 on water availability and sustainable management, which in turn is one of the main areas affected by this method. At the same time, these targets can provide a critical impact over some of the targets addressed by vertical farming, as for example over resilience and adaptive capacity to climate change-related disasters [13.1]. An enhanced status of clean freshwater sources [6.3, 6.4] will ensure greater resilience in terms of water availability in front of climate change-related risks, which can additionally be relieved through the natural protection offered by water ecosystems.

Source: Barnes, I. (2016). Case Study: Vertical Farming. e-Module 2: Shifting Towards Water-Resilient Sustainable Cities. pp.1-3.

Figure 5: Causal Loop Diagram of Baseline System Model for Water Security



Source: https://nonglala.kumu.io/sdg-6-water-and-sanitation-for-all

5. Integrated SDG Systems Analysis with SDG 6 (Water and Sanitation) at the Core

This section describes the results of the integrated SDG target analysis for SDG 6.

Scope of the Systems-Based Analysis

Sustainable Development Goal 6 (Water and Sanitation for All) is the focus of the systems analysis of this report, with the scope including all 169 targets that make up the 17 goals of the 2030 Agenda for Sustainable Development. The analysis identifies both 'direct' and 'indirect' causal relationship linkages between all 169 SDG targets with the eight targets of SDG 6, within three degrees of influence. Particular attention is given to the 'direct' causal linkages identified through the inter-target linkage analysis (Annex 1) and systems relationship mapping exercise (kumu.io) to find the highest impact leverage points for intervention from ESCAP. It must be pointed out that this analysis is conducted at the macro level using a global and Asia-Pacific regional lens. The relationships between the SDGs and their targets may be perceived differently when applied at the country specific situation and context.

Summary of the assessment of the interlinkages between SDG 6 targets with the other SDG targets

The eight targets of SDG 6 were first analysed through an inter-linkage relationship matrix with all 169 targets of the other 16 SDGs, and between themselves. Direct and indirect linkages were identified based on degree of influence from the specific water target of focus . Additionally, the influence direction was identified for each linkage as either parallel (both targets' indicators would move in the same direction) or inverse (target indicators would move in opposite direction to one another). Those targets separated with 1-2 degrees of causal influence were identified as **direct linkages** and the corresponding cells of the matrix were marked with green shading. The targets that were perceived as **indirect linkage** targets were those that were within 1-2 degrees of influence in their causal influence to the respective SDG 6 target. These targets were marked in the matrix cells with yellow shading. Targets, at the global scale, that were not perceived to be within three degrees of causal influence were left blank. All targets can be either a 'driver' (causal influencer) for another target, or be a 'driven" (be causally influenced) by the respective SDG 6 target. Targets with indirect linkages, that were identified in the inter-target linkage analysis matrix, were not included in the inter-linkage leverage points assessment.

17. Identified linkages were perceived to be with three degrees of causal influence.

However, it is important to noted that this macro/global scale analysis framework does not preclude that the inter-linkages causal relationship between the SDGs targets at the national and sub-national level may differ and national specific circumstances and context may change the direct and indirect drivers and responses relationship to a certain degree. As mentioned in the UNU-INWEH, UNOSD and SEI 2013 report, the linkages between water, the environment, people, and the economy highly depend upon the level of national development and the water demands of priority sectors of the economy (UNU-INWEH, UNOSD, SEI, 2013).

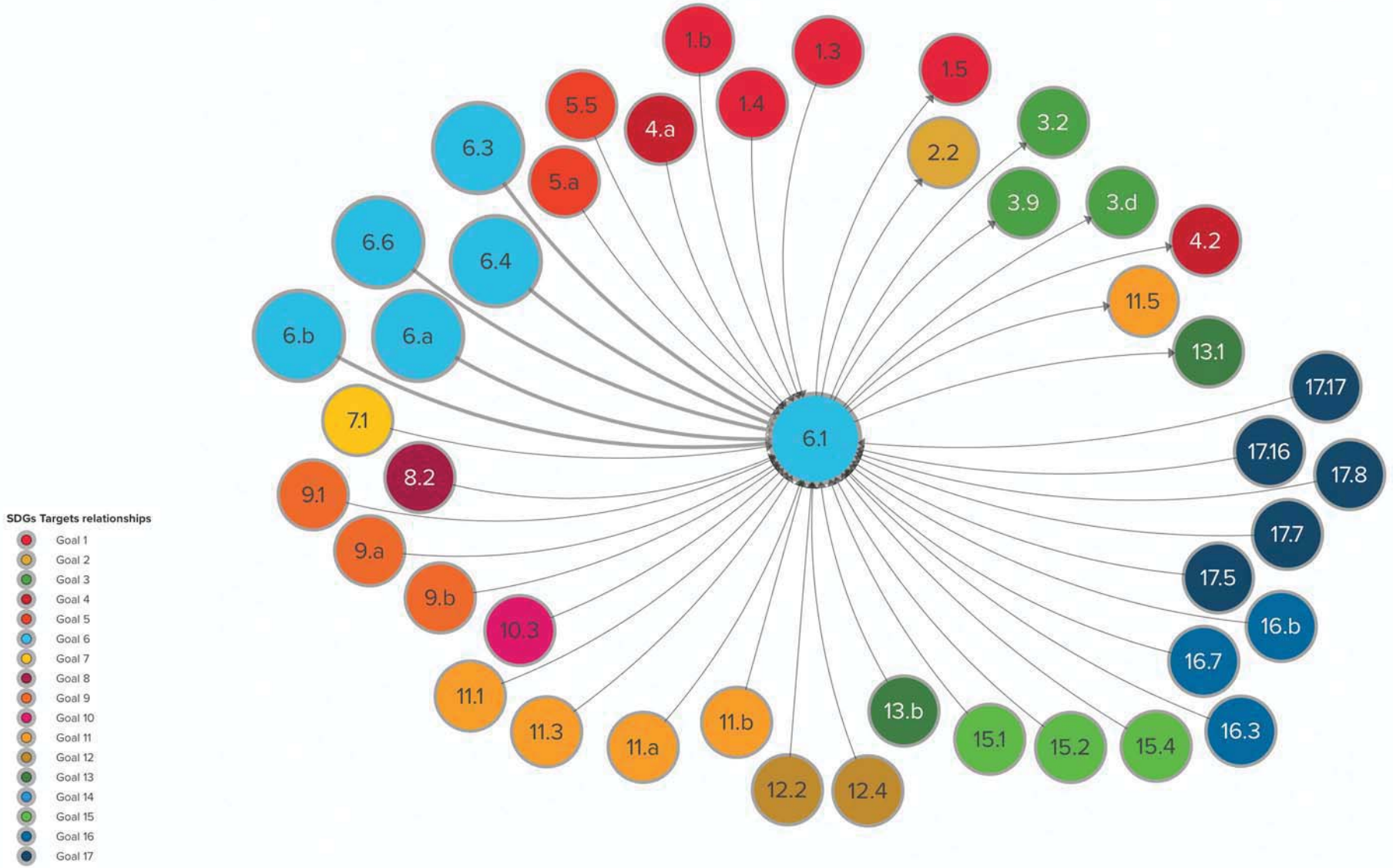
The summary results of the interlinkages analysis[18] of the SDG 6 targets with all 169 SDG targets of the 17 SDGs are presented in tabular format further below. The first column of each table for each of the eight SDG 6 targets represents the total number of direct and indirect inter-target linkages. The second (middle) column represents all the SDGs' targets, for which the SDG 6 target is considered as the primary causal 'direct driver'. The far right-hand column identifies all of the SDG targets that have direct causal influence on the respective SDG 6 target. As noted in the scope of this project, the assessment of the interlinkages of the SDG 6 targets provides only the assessment of the direct linkages and did not cover the indirect linkages that are identified in full in the relationship matrix of the SDG targets in the Annex 1 to this report.

18. The matrix describing in full the interlinkage analysis of all SDGs' targets is included in Annex 1 to this report.

Target 6.1 - Achieve universal and equitable access to safe and affordable drinking water for all. This is the third most inter-linked of the eight water and sanitation targets. Target 6.1 has direct causal interlinkages with 42 other targets from 16 of the 17 SDGs. It is indirectly linked with another 38 targets. Target 6.1 is directly driven / influenced by 35 other targets and is a key driver / influencer of 7 other targets. Considering the total number of direct inter-target linkages found, Target 6.1 is most strongly influenced by SDG 1 (Poverty Eradication); SDG 6 (Water & Sanitation); SDG 9 (Infrastructure & Industrialization); SDG 11 (Cities and Human Settlements); SDG 15 (Sustainable Use of Terrestrial Ecosystems); SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions); and SDG 17 (Means of Implementation). Target 6.1 has the most direct influence on SDG 3 (Human Health and Wellbeing).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.1 Achieve universal and equitable access to safe and affordable drinking water for all. **Total No. of direct links to other SDG targets = 42** **Total No. of indirect links = 38**	**Total Direct 'Driver' linkages deriving from 6.1: (8)** **SDG 1: 1.5** **SDG 2: 2.2** **SDG 3: 3.2, 3.9, 3d** **SDG 4: 4.2** **SDG 11: 11.5** **SDG 13: 13.1**	**Total Direct 'Response' linkages going to 6.1: (35)** **SDG 1: 1.3, 1.4, 1.b** **SDG 4: 4.a** **SDG 5: 5.5, 5.a** **SDG 6: 6.3, 6.4 6.6, 6a, 6.b** **SDG 7: 7.1** **SDG 8: 8.2** **SDG 9: 9.1, 9.a, 9.b** **SDG 10: 10.3** **SDG 11: 11.1, 11.3, 11.a, 11.b** **SDG 12: 12.2, 12.4** **SDG 13: 13.b** **SDG 15: 15.1, 15.2, 15.4** **SDG 16: 16.3, 16.7, 16.b** **SDG 17: 17.5, 17.7, 17.8, 17.16, 17.17**

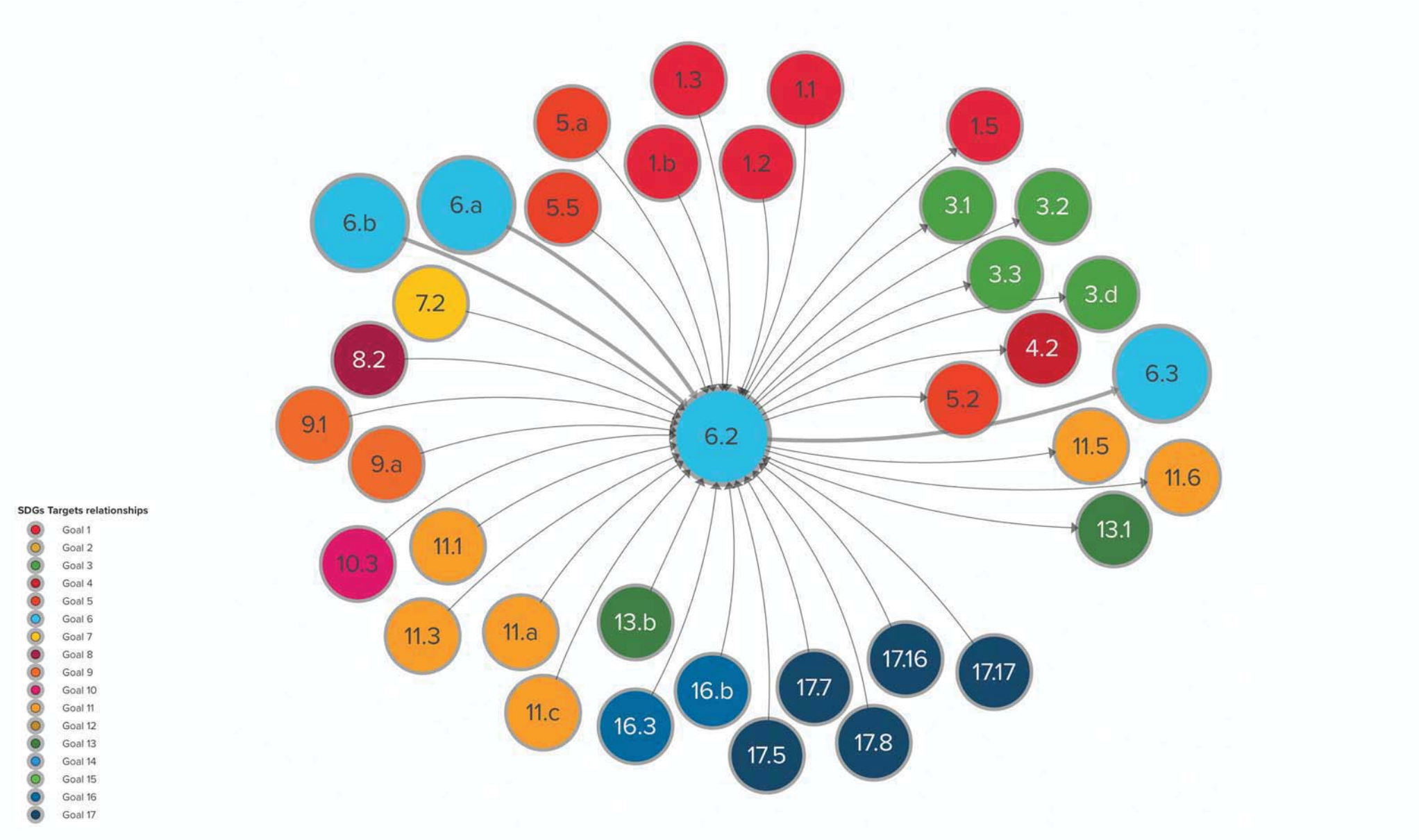
Figure 6: SDG 6 Target 6.1 Achieve Universal and equitable access to safe and affordable drinking water for all: Drivers and Responses Map



Target 6.2 - Achieve access to adequate and equitable sanitation and hygiene and end open defecation, (special attention to the needs of women and girls). Target 6.2 has direct causal linkages with 35 other targets from 13 of the 17 SDGs. It is indirectly linked with another 26 targets. Target 6.2 is directly driven / influenced by 25 other targets and is a key driver / influencer of 10 other targets. Considering the total number of direct inter-target linkages found, Target 6.2 is most strongly influenced by SDG 1 (Poverty Eradication); SDG 6 (Water & Sanitation); SDG 9 (Infrastructure & Industrialization); SDG 11 (Cities and Human Settlements); and SDG 17 (Means of Implementation). Target 6.2 has the most direct influence on SDG 3 (Human Health and Wellbeing) and SDG 11 (Cities and Human Settlements).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.2 Achieve access to adequate and equitable sanitation and hygiene and end open defecation, (special attention to the needs of women and girls). **Total No. of direct links to other SDG targets = 35** **Total No. of indirect links = 26**	**Total Direct 'Driver' linkages from 6.2: (11)** **SDG 1: 1.5** **SDG 3: 3.1, 3.2, 3.3, 3.d** **SDG 4: 4.2** **SDG 5: 5.2** **SDG 6: 6.3** **SDG 11: 11.5, 11.6** **SDG 13: 13.1**	**Total Direct 'Response' linkages going to 6.2: (25)** **SDG 1: 1.1, 1.2, 1.3, 1.b** **SDG 5: 5.5, 5.a** **SDG 6: 6.a, 6.b** **SDG 7: 7.2** **SDG 8: 8.2** **SDG 9: 9.1, 9.a** **SDG 10: 10.3** **SDG 11: 11.1, 11.3, 11.a, 11.c** **SDG 13: 13.b** **SDG 16: 16.3, 16.b** **SDG 17: 17.5, 17.7, 17.8, 17.16, 17.17**

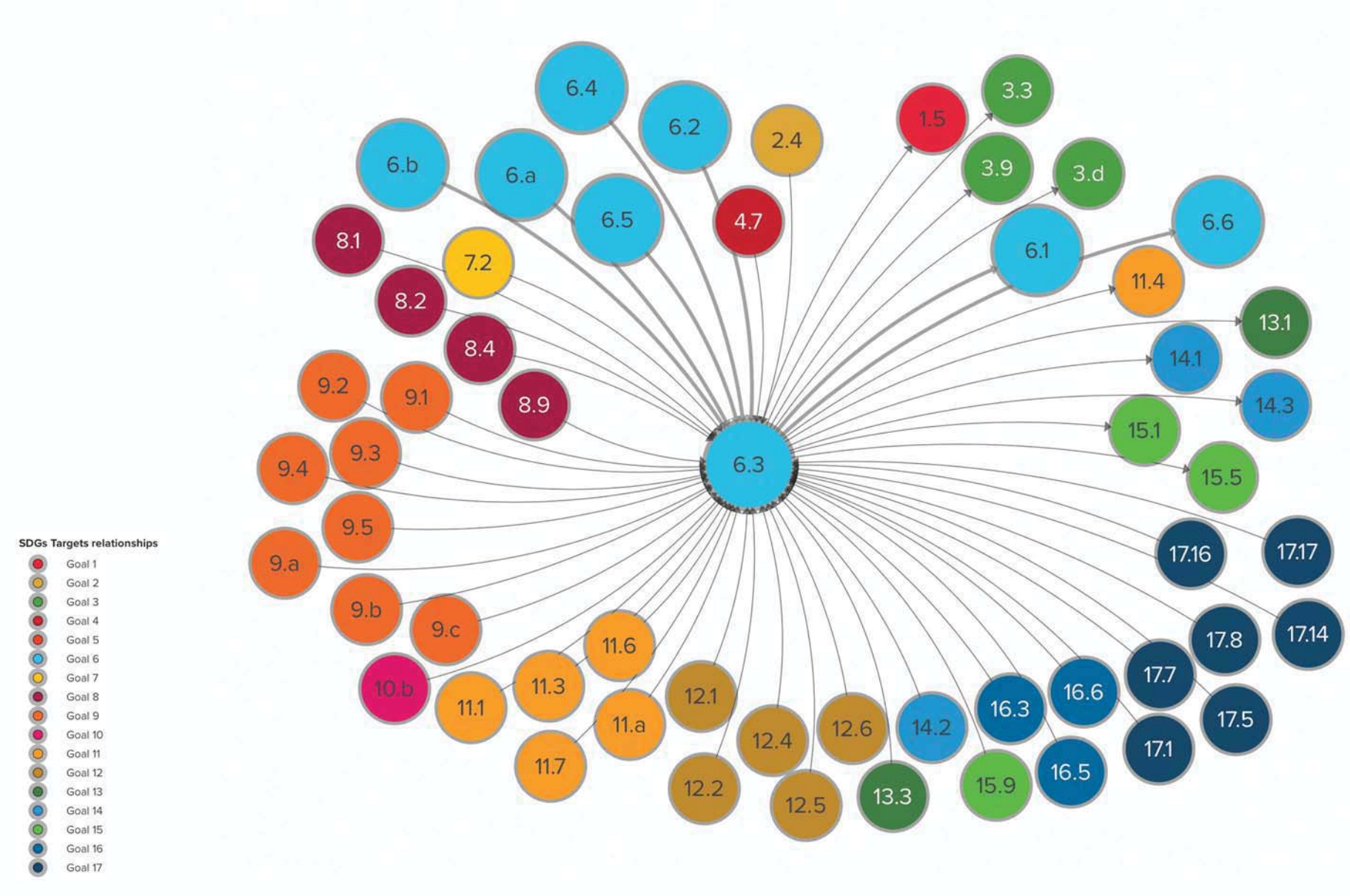
Figure 7: SDG 6 Target 6.2 Achieve access to adequate and equitable sanitation and hygiene and end open defecation, (special attention to the needs of women and girls): Drivers and Responses Map



Target 6.3 - Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. This is the second most inter-linked of the eight water and sanitation targets. Target 6.3 has direct causal linkages with 55 other targets from 16 of the 17 SDGs. It is indirectly linked with another 31 targets. Target 6.3 is directly driven / influenced by 44 other targets and is a key driver / influencer of 11 other targets. Considering the total number of direct inter-target linkages found, Target 6.3 is most strongly influenced by SDG 6 (Water & Sanitation); SDG 8 (Inclusive and Sustainable Economic Growth); SDG 9 (Infrastructure & Industrialization); SDG 11 (Cities and Human Settlements); SDG 12 (Sustainable Consumption and Production); SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions); and SDG 17 (Means of Implementation). Target 6.3 has the most direct influence on SDG 3 (Human Health and Wellbeing); SDG 6 (Water & Sanitation); SDG 14 (Sustainable Use of Oceans, Seas And Marine Resources); and SDG 15 (Sustainable Use of Terrestrial Ecosystems).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets (Identified by Target)**	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.3 Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally **Total of 56 direct links to other SDG targets** **Total No. of indirect links = 31**	**Total Direct 'Driver' linkages deriving from 6.3: (12)** **SDG 1: 1.5** **SDG 3: 3.3, 3.9, 3.d** **SDG 6: 6.1, 6.6** **SDG 11: 11.4,** **SDG 13: 13.1** **SDG 14: 14.1, 14.3** **SDG 15: 15.1, 15.5**	**Total Direct 'Response' linkages going to 6.3: (44)** **SDG 2: 2.4** **SDG 4: 4.7** **SDG 6: 6.2, 6.4, 6.5, 6.a, 6.b** **SDG 7: 7.2** **SDG 8: 8.1, 8.2, 8.4, 8.9** **SDG 9: 9.1, 9.2, 9.3, 9.4, 9,5, 9.a, 9.b, 9.c** **SDG 10: 10.b** **SDG 11: 11.1, 11.3, 11.6, 11.7, 11.a** **SDG 12: 12.1, 12.2, 12.4, 12.5, 12.6** **SDG 13: 13.3** **SDG 14: 14.2** **SDG 15: 15.9** **SDG 16: 16.3, 16.5, 16.6** **SDG 17: 17.1, 17.5, 17.7, 17.8, 17.14, 17.16, 17.17**

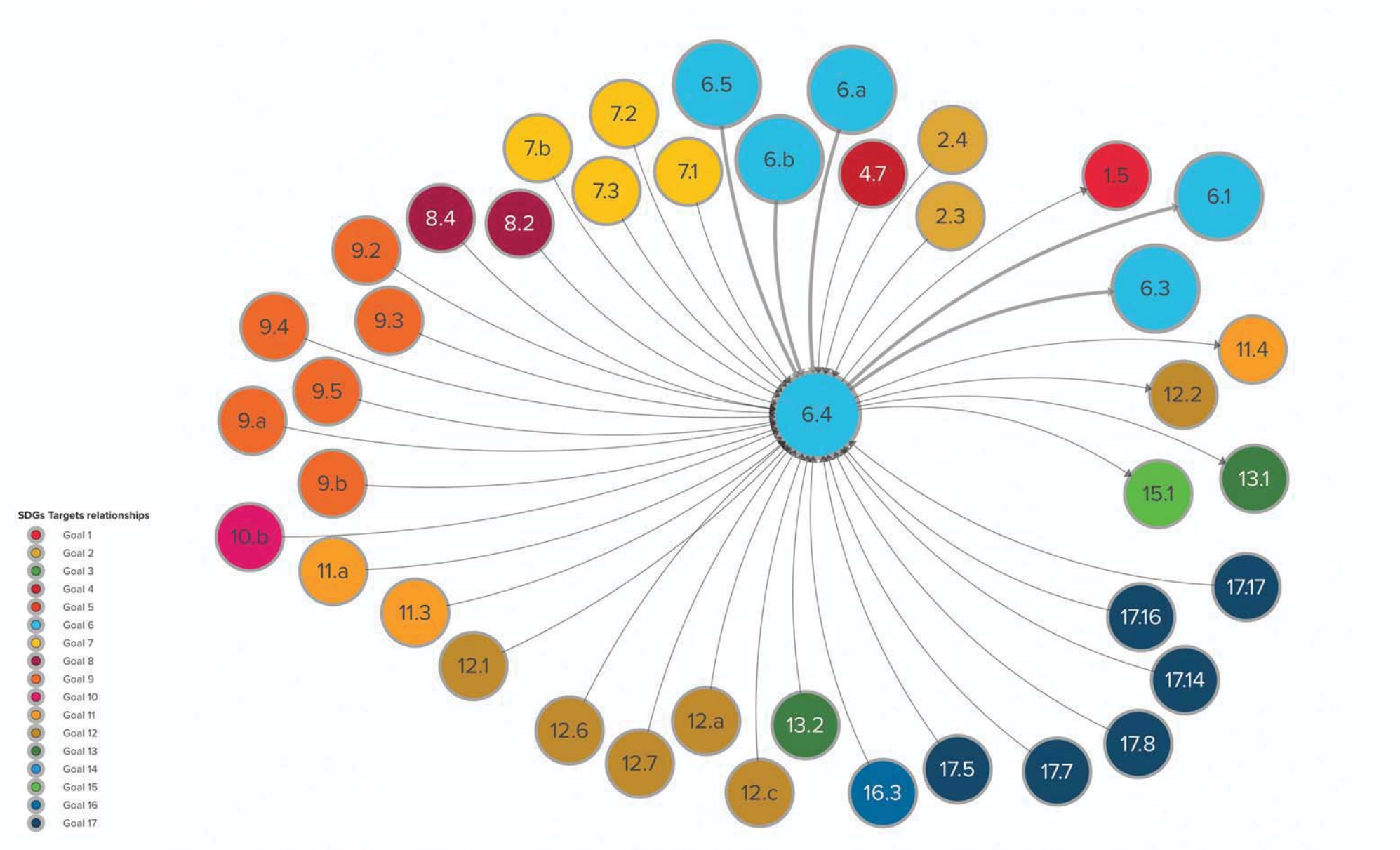
Figure 8: SDG 6 Target 6.3- Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally: Drivers and Responses Map



Target 6.4 - Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. Target 6.4 has direct causal linkages with 41 other targets from 14 of the 17 SDGs. It is indirectly linked with another 31 targets. Target 6.4 is directly driven / influenced by 34 other targets and is a key driver / influencer of 7 other targets. Considering the total number of direct inter-target linkages found, Target 6.4 is most strongly influenced by SDG 6 (Water & Sanitation); SDG 7 (Sustainable and Modern Energy); SDG 9 (Infrastructure & Industrialization); SDG 12 (Sustainable Consumption and Production); and SDG 17 (Means of Implementation). Target 6.4 has the most direct influence on SDG 6 (Water & Sanitation).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.4 Increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity **Total of 41 direct links to other SDG targets** **Total No. of indirect links = 32**	**Total Direct 'Driver' linkages deriving from 6.4: (7)** **SDG 1: 1.5** **SDG 6: 6.1, 6.3** **SDG 11: 11.4** **SDG 12: 12.2** **SDG 13: 13.1** **SDG 15: 15.1**	**Total Direct 'Response' linkages going to 6.4: (34)** **SDG 2: 2.3, 2.4** **SDG 4: 4.7** **SDG 6: 6.5, 6.a, 6.b** **SDG 7: 7.1, 7.2, 7.3, 7.b** **SDG 8: 8.2, 8.4** **SDG 9: 9.2, 9.3, 9.4, 9.5, 9.a, 9.b** **SDG 10: 10.b** **SDG 11: 11.3, 11.a** **SDG 12: 12.1, 12.6, 12.7, 12.a, 12.c** **SDG 13: 13.2** **SDG 16: 16.3** **SDG 17: 17.5, 17.7, 17.8, 17.14, 17.16, 17.17**

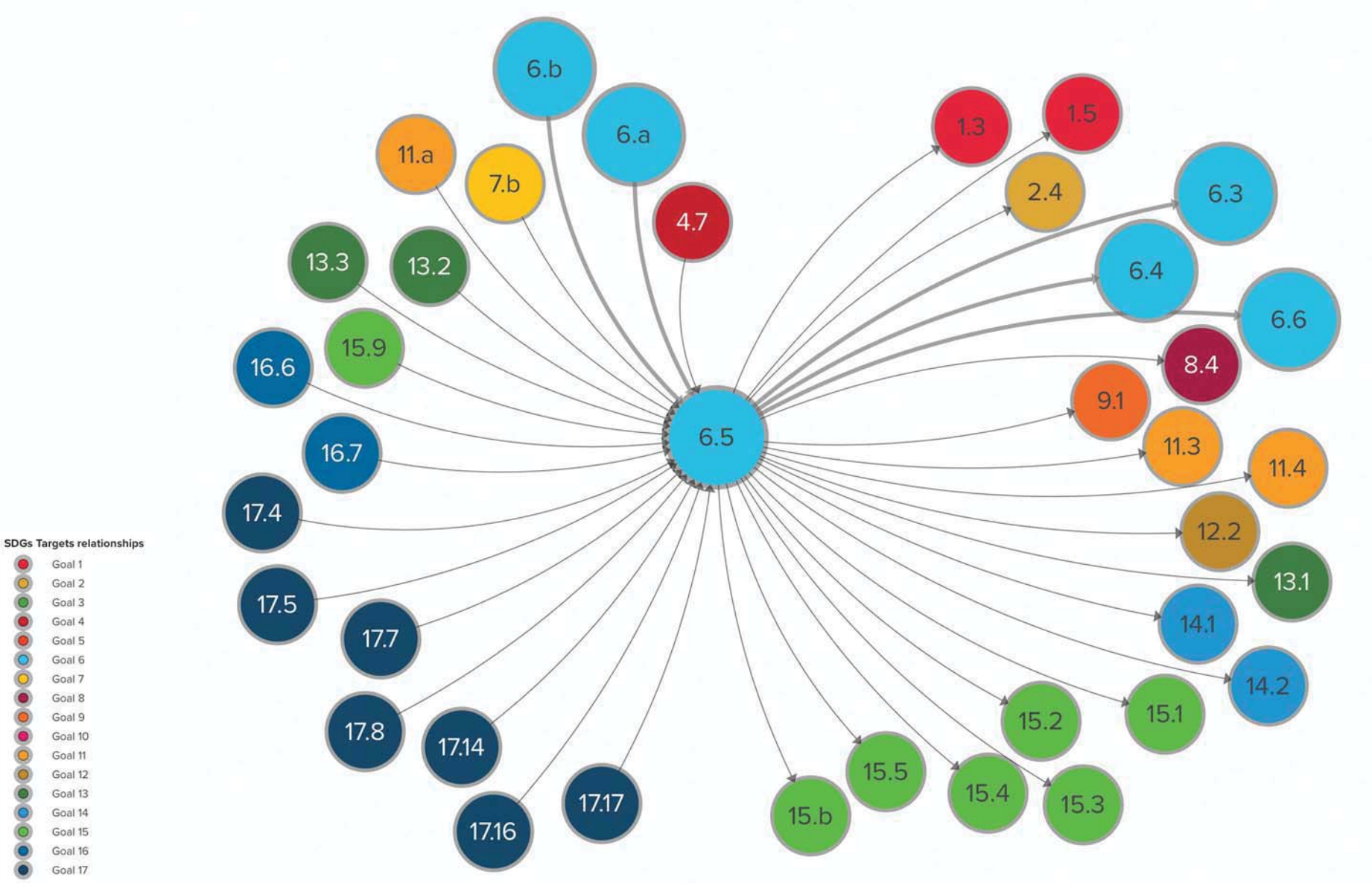
Figure 9: SDG 6 Target 6.4 - Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity: Drivers and Responses Map



Target 6.5 - Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate. Target 6.5 has 37 direct causal linkages with other targets from 14 of the 17 SDGs. It is indirectly linked with another 28 targets. Target 6.5 is directly driven / influenced by 17 other targets and is a key driver / influencer of 20 other targets. Considering the total number of direct inter-target linkages found, Target 6.5, is most strongly influenced by SDG 6 (Water & Sanitation); SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions); and SDG 17 (Means of Implementation). On the other hand, Target 6.5 has the most direct influence on SDG 6 (Water & Sanitation); SDG 11 (Cities and Human Settlements); SDG 14 (Sustainable Use of Oceans, Seas And Marine Resources); and SDG 15 (Sustainable Use of Terrestrial Ecosystems).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.5 Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate. **Total of 37 direct links to other SDG targets** **Total No. of indirect links = 29**	**Total Direct 'Driver' linkages from 6.5: (20)** **SDG 1: 1.3, 1.5** **SDG 2: 2.4** **SDG 6: 6.3, 6.4, 6.6** **SDG 8: 8.4** **SDG 9: 9.1** **SDG 11: 11.3, 11.4** **SDG 12: 12.2** **SDG 13: 13.1** **SDG 14: 14.1, 14.2** **SDG 15: 15.1, 15.2, 15.3, 15.4, 15.5, 15.b**	**Total Direct 'Response' linkages going to 6.5: (17)** **SDG 4: 4.7** **SDG 6: 6.a, 6.b** **SDG 7: 7.b** **SDG 11: 11.a** **SDG 13: 13.2, 13.3** **SDG 15: 15.9** **SDG 16: 16.6, 16.7** **SDG 17: 17.4, 17.5, 17.7, 17.8, 17.14, 17.16, 17.17**

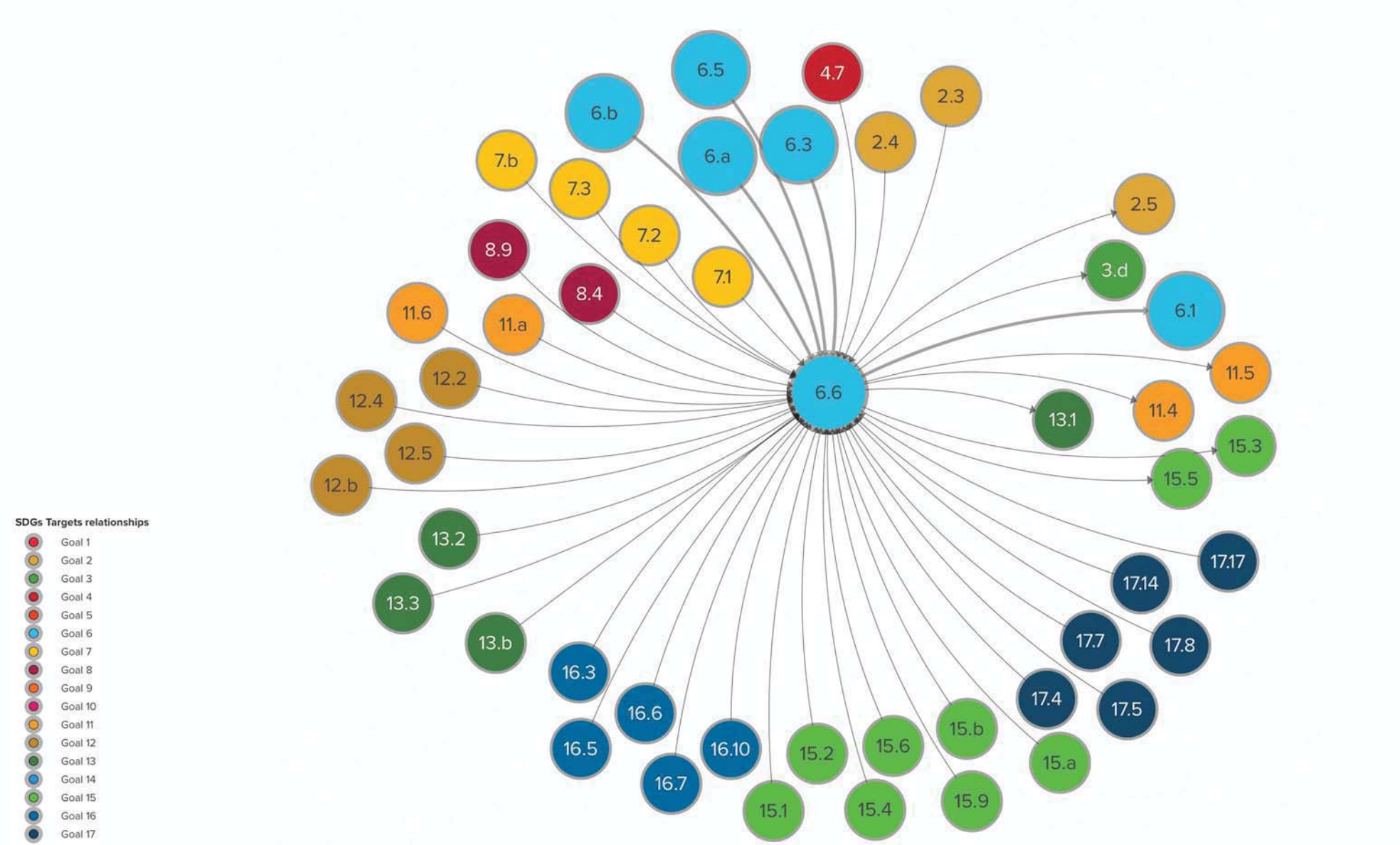
Figure 10: SDG 6 Target 6.5 - Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate: Drivers and Responses Map



Target 6.6 - Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. This is the most inter-linked of the eight water and sanitation targets. Target 6.6 has direct causal linkages with 47 other targets from 11 of the 17 SDGs. It is indirectly linked with another 36 targets. Target 6.6 is directly driven / influenced by 40 other targets and is a key driver / influencer of 7 other targets. Considering the total number of direct inter-target linkages found, Target 6.6 is most strongly influenced by SDG 6 (Water & Sanitation); SDG 7 (Sustainable and Modern Energy); SDG 12 (Sustainable Consumption and Production); SDG 13 (Climate Change); SDG 15 (Sustainable Use of Terrestrial Ecosystems); SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions); and SDG 17 (Means of Implementation). Target 6.6 has the most direct influence on SDG 11 (Cities and Human Settlements) and SDG 15 (Sustainable Use of Terrestrial Ecosystems).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.6 Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. **Total of 48 direct links to other SDG targets** **Total No. of indirect links = 36**	**Total Direct 'Driver' linkages deriving from 6.6: (8)** **SDG 2: 2.5** **SDG 3: 3.d** **SDG 6: 6.1** **SDG 11: 11.4, 11.5** **SDG 13: 13.1** **SDG 15: 15.3, 15.5**	**Total Direct 'Response' linkages going to 6.6: (40)** **SDG 2: 2.3, 2.4,** **SDG 4: 4.7** **SDG 6: 6.3, 6.5, 6.a, 6.b** **SDG 7: 7.1, 7.2, 7.3, 7.b** **SDG 8: 8.4, 8.9** **SDG 11: 11.6, 11a** **SDG 12: 12.2, 12.4, 12.5, 12.b** **SDG 13: 13.2, 13.3, 13.b** **SDG 15: 15.1, 15.2, 15.4, 15.6, 15.9, 15.a, 15.b** **SDG 16: 16.3, 16.5, 16.6, 16.7, 16.10** **SDG 17: 17.4, 17.5, 17.7, 17.8, 17.14, 17.17**

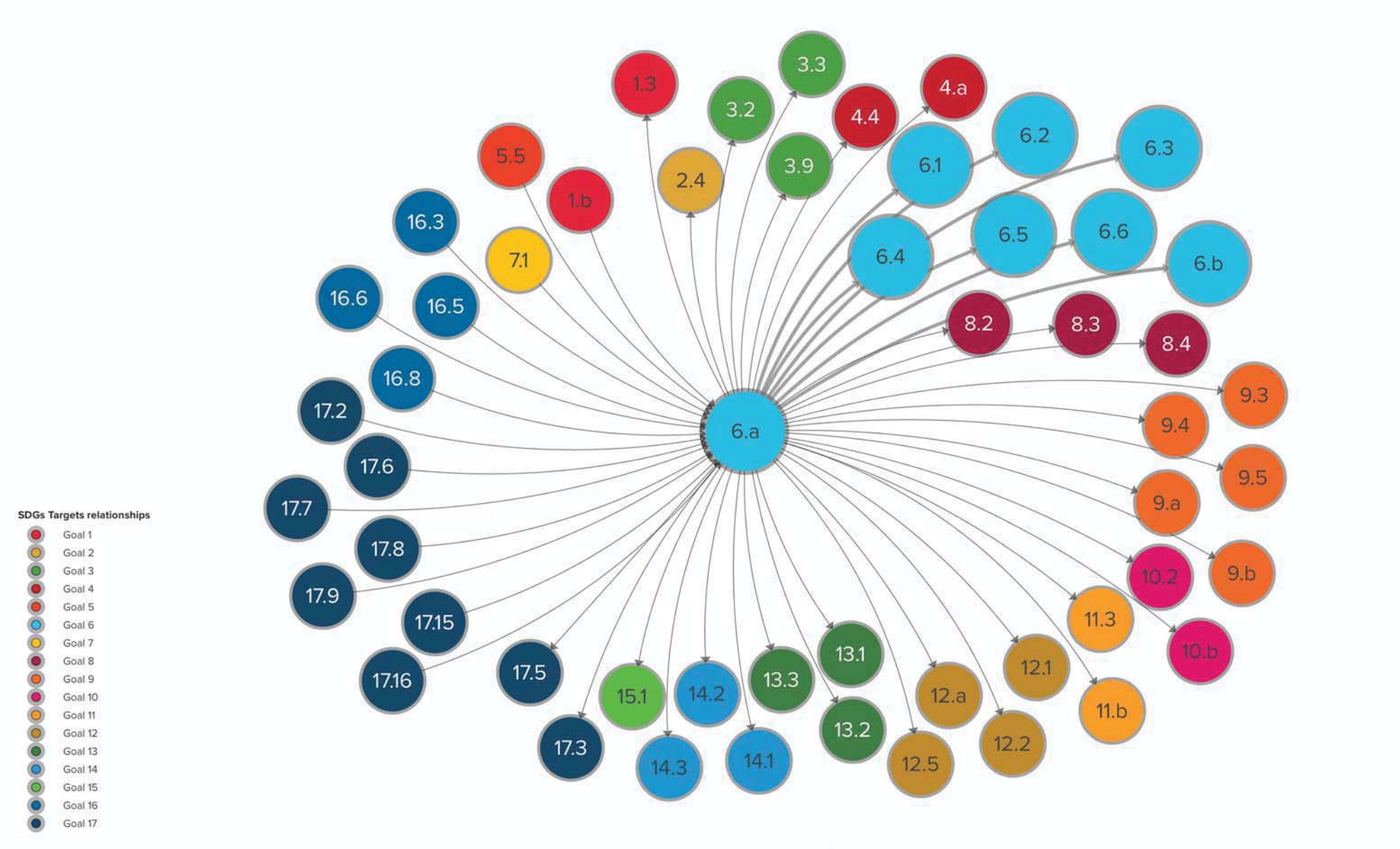
Figure 11: SDG 6 Target 6.6 - Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. Drivers and Responses Map



Target 6.a - Expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. This is the fifth most inter-linked of the eight water and sanitation targets. Target 6.a has direct causal linkages with 53 other targets from 16 of the 17 SDGs. It is indirectly linked with another 23 targets. Target 6.a is directly driven / influenced by 14 other targets and is a key driver / influencer of 39 other targets. Considering the total number of direct inter-target linkages found, Target 6.a is most strongly influenced by SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions) and SDG 17 (Means of Implementation). Target 6.a has the most direct influence on SDG 3 (Human Health and Wellbeing); SDG 6 (Water & Sanitation); SDG 8 (Inclusive and Sustainable Economic Growth); SDG 9 (Infrastructure & Industrialization); SDG 12 (Sustainable Consumption and Production); SDG 13 (Climate Change); and SDG 14 (Sustainable Use of Oceans, Seas And Marine Resources).

SDG 6 Targets	**Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets** (Identified by Target Number)	**Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target.** (Identified by Target Number)
6.a Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. **Total of 53 direct links to other SDG targets** **Total No. of indirect links = 24**	**Total Direct 'Driver' linkages deriving from 6.a: (39)** **SDG 1: 1.3** **SDG 2: 2.4** **SDG 3: 3.2, 3.3, 3.9** **SDG 4: 4.4, 4.a** **SDG 6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.b** **SDG 8: 8.2, 8.3, 8.4** **SDG 9: 9.3, 9.4, 9.5, 9.a, 9.b** **SDG 10: 10.2, 10.b** **SDG 11: 11.3, 11.b** **SDG 12: 12.1, 12.2, 12.5, 12.a** **SDG 13: 13.1, 13.2, 13.3** **SDG 14: 14.1, 14.2, 14.3** **SDG 15: 15.1** **SDG 17: 17.3, 17.5**	**Total Direct 'Response' linkages going to 6.a: (14)** **SDG 1: 1.b** **SDG 5: 5.5** **SDG 7: 7.1** **SDG 16: 16.3, 16.5, 16.6, 16.8** **SDG 17: 17.2, 17.6, 17.7, 17.8, 17.9, 17.15, 17.16,**

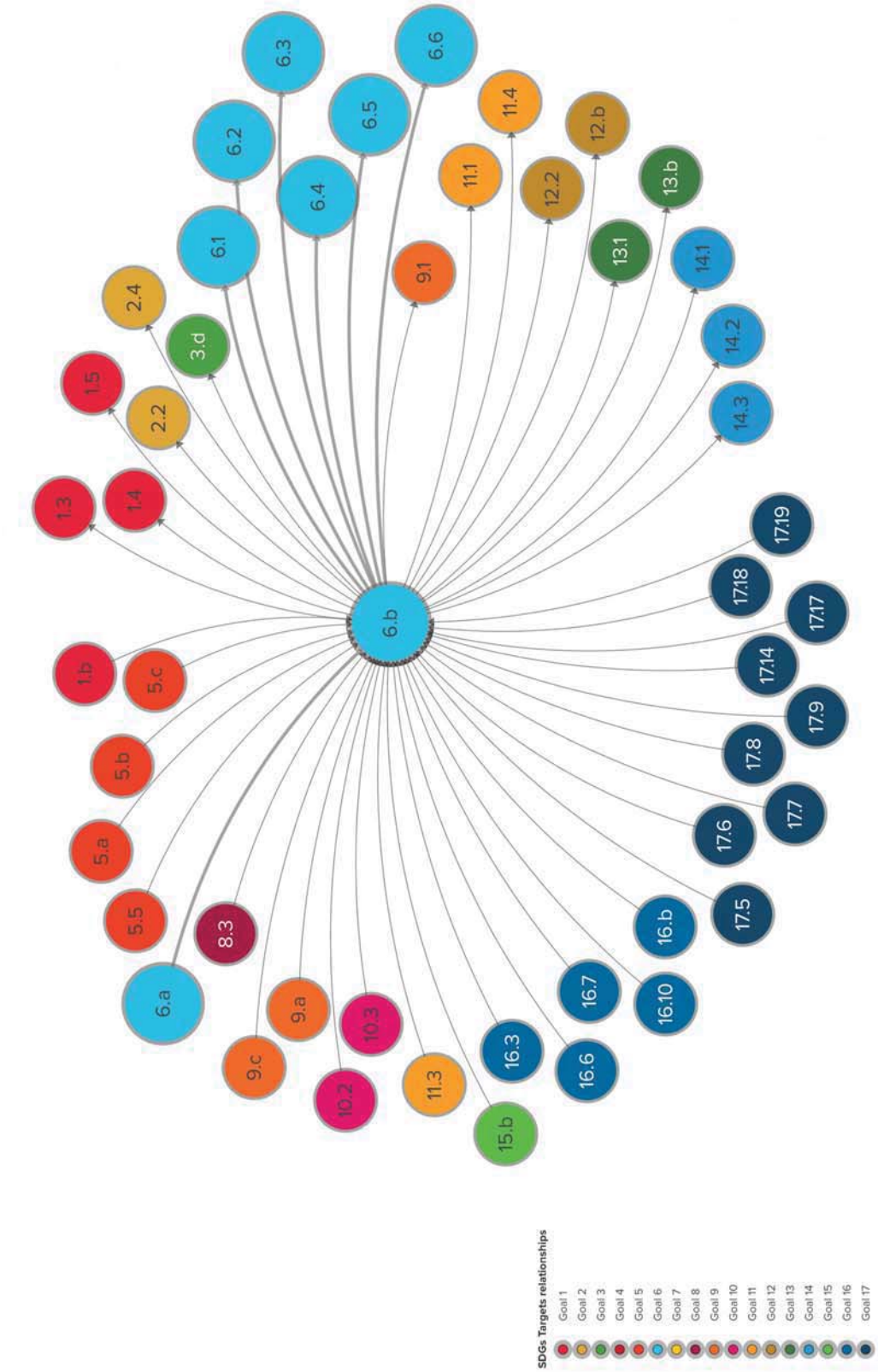
Figure 12: Target 6.a - Expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies: Drivers and Responses Map



Target 6.b - Support and strengthen the participation of local communities in improving water and sanitation management. Target 6.b has direct causal linkages with 48 other targets from 14 of the 17 SDGs. It is indirectly linked with another 28 targets. Target 6.b is directly driven / influenced by 27 other targets and is a key driver / influencer of 21 other targets. Considering the total number of direct inter-target linkages found, Target 6.b is most strongly influenced by SDG 5 (Gender Equality and Empowerment of Women and Girls); SDG 16 (Peaceful, Inclusive, and Just Societies with Accountable Institutions); and SDG 17 (Means of Implementation). Target 6.b has the most direct influence on SDG 1 (Poverty Eradication) and SDG 6 (Water & Sanitation), with fairly significant influence also on SDG 11 (Cities and Human Settlements); SDG 12 (Sustainable Consumption and Production); SDG 13 SDG 13 (Climate Change); and SDG 14 (Sustainable Use of Oceans, Seas and Marine Resources).

SDG 6 Targets	Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets (Identified by Target Number)	Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target. (Identified by Target Number)
6.b Support and strengthen the participation of local communities in improving water and sanitation management. **Total No. of direct links to other SDG targets = 48** **Total No. of indirect links = 28**	**Total Direct 'Driver' linkages deriving from 6.b: (21)** **SDG 1: 1.3, 1.4, 1.5** **SDG 2: 2,2, 2.4** **SDG 3: 3.d** **SDG 6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6** **SDG 9: 9.1** **SDG 11: 11.1, 11.4** **SDG 12: 12.2, 12.b** **SDG 13: 13.1, 13.b** **SDG 14: 14.1, 14.2, 14.3**	**Total Direct 'Response' linkages going to 6.b: (27)** **SDG 1: 1.b** **SDG 5: 5.5, 5.a, 5.b, 5.c** **SDG 6: 6.a** **SDG 8: 8.3** **SDG 9: 9.a, 9.c** **SDG 10: 10.2, 10.3** **SDG 11: 11.3** **SDG 15: 15.b** **SDG 16: 16.3, 16.6, 16.7, 16.10, 16.b** **SDG 17: 17.5, 17.6, 17.7, 17.8, 17.9, 17.14, 17.17, 17.18, 17.19**

Figure 13: SDG 6 Target 6.b - Support and strengthen the participation of local communities in improving water and sanitation management: Drivers and Responses Map



The systems diagrams and interactive presentation are also found on the website of Kumu.io.

KUMU Online SDG 6 Target intra and inter-Linkages Analysis Causal System Diagrams

The online visual and narrative Kumu presentation of the complete **SDG 6 Target intra and inter-Linkages system analysis visually showing the full spectrum of systemic causal direct linkages, leverage points and recommendations for action by ESCAP** is provided on the Kumu website at: https://nonglala.kumu.io/sdg-6-targets-systems-analysis

6. Leverage Point Analysis - Opportunities for Integrated High Impact Interventions

What is a Leverage Point?

Because a systems approach recognizes that improvement in one area of a system can either positively or adversely affect another area of the system, it promotes a problem-analysis-decision process that encourages us to look past a 'silo' approach that isolates a specific problem or policy by the usual disciplines or methods. Systems thinking is quite new to the policy sphere, where policy-makers tend to follow a more linear, decision-making thinking process, due to existing norms and habits, as well as the expediency of the political decision-making agenda and process. Policy decisions often focus on the visible outcomes and behaviours that underscore the events that are brought to policy makers' attention, without looking at the problem from multiple perspectives and points of causes and effect, and progression. Linear, or reductionist analysis, which isolates the problem area and looks at immediate cause and effect, often misses the deeper rooted, and often times quite indirect, reasons that are the real cause of the problem, or are the things that keep giving them life. Interventions at these 'intuitive' places regularly have little long-term effects, and can even (if not often) lead to unforeseen negative consequences later in time in another part of the system. Most often, if not always, there are multiple reasons or causes to a problem that 'reinforce' each other through system feedback. Most often the focus for solving a problem is placed on the wrong "leverage points" (Meadows, 2009).

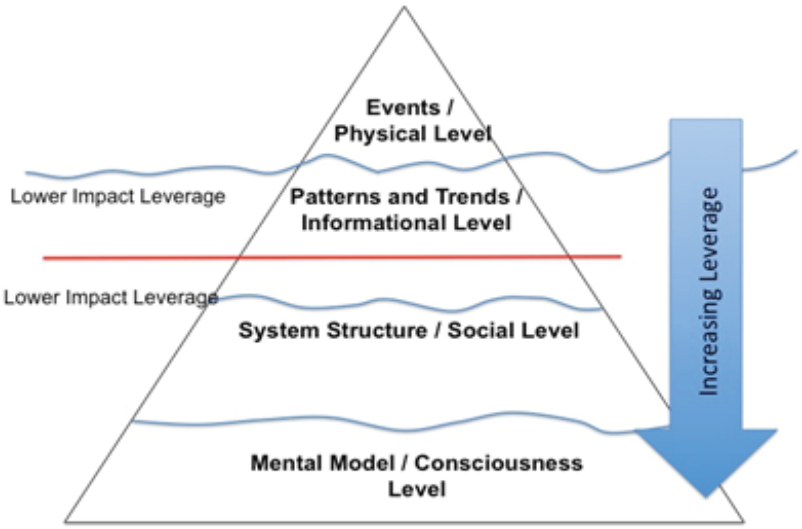
The primary question at the core of a systems analysis is: "How do we change the structure of systems to produce more of what we want and less of that which is undesirable?" (Meadows, D. 2009) The answer, from a systems perspective, is commonly referred to as a "leverage point". In systems thinking, a leverage point is a place in a system's structure where a solution element or intervention can be best applied to achieve desired long-term results that are sustainable. Meadows (2009) stressed that often leverage follows the principle of economy of means: whereby the best results come not from large-scale efforts but from small well-focused actions. Thus, there can be "low impact" leverage points and "high impact" leverage points, both of which can be acted upon.

A low leverage point is one where a small amount of change force causes a small change in system behaviour. This change is most often short-lived and not at all sustainable. Low leverage points characterise attempts to solve intermediate causes, and by themselves, interventions enacted at a low leverage point will be unsuccessful in the intermediate or long term if nothing else is acted on to resolve the root causes of the undesirable system behaviour. An example of a low leverage intervention is tweaking or adjusting numbers and parameters (e.g. the minimum wage rate, or the legal level of certain pollutants in waste water discharge) with policy decisions. The drawback to this type of intervention is that the overall change is relatively superficial to the system and therefore will be temporary, not long-term, as something else more fundamental to the problem will push back on it towards a business as usual condition.

In contrast, high leverage points resolve the root or underlying causes of the undesired system behaviour. They are found at the deepest level of system change, which unfortunately is more difficult to bring about. It also tends to be qualitative, not quantitative, but once a change occurs at this level the change propagates itself through the system, creating a systemic, profound, and often enduring shift. High (deep) leverage includes the realms of (Paradigm, mindset, or goals that the system is orienting on (Patterson, 2010).

A common, but effective systems thinking tool, the iceberg, provides an easy visualization of where low and high leverage are found in relation to events (problems) that we see above the water's surface, so to speak (Figure 14). The iceberg illustrates how events or patterns (places of low leverage) are likely caused by underlying structures in a system and people's mental models. The iceberg analogy helps us in asking the right questions. This in term guides us in our analysis of the event and where and how to make change – or more directly, to identify and act on the system's "leverage points."

Figure 14. System Iceberg and Leverage



To help with illustrating the importance of understanding system structure and dynamics in leveraging positive change, a classic water policy example demonstrates how good intentions can result in unintended problems when actions are taken without a systems perspective and an understanding of leverage. For example, in an attempt to increase agricultural productivity to feed their for growing populations as well as for export to contribute to economic growth, many countries have created policies and incentives (e.g. fuel subsidies) for farmers to increase water consumption. These policies assisted farmers to tap into underground water aquifers. This increased agricultural yield, but as more farmers drilled wells and tapped into this source, and as precipitation patterns began to change (for other linked reasons), pumping more water from the ground eventually lowered the water level of these underground sources, which increased the farmers costs of irrigation, and also brought salt to the surface, thus causing long-term damage to soil fertility, causing some farmers to go into debt, and having an overall effect of decreasing agricultural productivity going forward in time.

Increasing water consumption by drilling into underground water sources did indeed create short term positive change, but this was a low level leverage point which was pushed back on by other factors, such as lack of proper water management accounting (knowing limits), rules, and the mindsets of the individual farms within an economic systems stressing growth without accounting for externalities such as long-term environmental impact; all of which lie deeper down the iceberg and are points of high leverage.

An important note that Meadows and other systems thinkers acknowledge is that successful change towards a tipping point (i.e. transformation from the current state of the system) requires taking action at multiple leverage points congruently as there they are likely to be causally linked through various pathways (Atkisson, 2011). Thus, only working on one leverage point, even high leverage root-cause types can fail if the intermediate and lower leverage points are also not addressed at the same time. Taking a systems-based approach to problem solving challenges us to address these problems in a more "non-linear" and integrative way. Seeing the challenge of achieving the water and sanitation SDGs in this way is the key to finding the best and most effective intervention opportunities.

SDG 6 Leverage Point Assessment

The assessment methodology used to identify the high impact leverage points for each of the SDGs' targets consisted of a two-step analytical process. For the first step, Donella Meadows' 12-point leverage point impact framework was applied to assess every identified 'direct driver' linked to each of the eight SDG 6 water and sanitation targets. This framework is considered the definitive analysis of the concept and application of "leverage points." According to Meadows, the highest impact leverage points primarily are those that fall within rungs 9-1 (in descending order of long-term system impact) on her 12-point framework. This framework is divided into four distinct levels: Physical (levels 12-10), Informational (levels 9-6), Social (levels 5-3), and Consciousness (levels 2-1), which also correspond to the iceberg model presented in Figure 14. Meadows' argues that the most high impact leverage is to be found in the lower two levels - the social and consciousness levels (levels 3 and 4), with additional high impact leverage - depending on its coupling qualities with other lower level leverage points - found in the informational level (level 2). It must be noted that use of Meadows' 12-rung framework is subjective to the analysis team and situational context that it is applied.

With respect to the SDG targets of this assessment, this does not mean that targets equating with the upper level (10-12) of the 12-point framework cannot be leverage points for intervention, but they are seen as less likely to be effective in the long-term, particularly if they are acted at in isolation and are not coupled with action taken on targets that are identified as high impact – i.e. the levers described from 9 down to 1. The 12 leverage points that make up Meadows' framework are described in Table 1 below.

Table 1: Donella Meadows' 12 Leverage Points for System Intervention

Leverage Point Impact Level	Type of Leverage	System Intervention Lever
12	**Physical**	**Constants, parameters, numbers (such as subsidies, taxes, standards) -** Parameters are points of lowest leverage. Attacking a problem by changing constants, parameters, flow rates and numbers are the most commonly perceived leverage points for system change. However, they rarely change system behaviour in a longer-term. Parameters become leverage points when they go into ranges that affect any of the elements lower on this list. Common physical parameter leverage points (which are really targets) might be changes in interest rates, for example, birth rates, water flow rates, oil production, etc.
11		**The size of buffers and other stabilizing stocks, relative to their flow -** A buffer's ability to stabilize a system is important when the stock amount is much higher than the predicted amount of inflows or outflows. With the case of sustainable water for all, a protected forest, a wetland or even a reservoir can be viewed as a buffer. If there is a lot more of it than inflow or outflow, the system stays stable. However, some big buffers such as water reservoirs cost a lot to build or maintain. Buffers are usually physical entities that may seem easy to change, but seldom if ever generate long-term system behaviour change. Thus the stress on the system remains.
10		**Structure of material stocks and flows –** Factory, water flow system structure, road network layout and vehicle transportation structure, city zoning, investment portfolios (i.e. the stocks and flows, and their physical arrangement) are all material stock and flow structures, and can have enormous effects on how the system behaves. Physical structure is crucial in a system, but it is rarely a leverage point because changing it is rarely quick or simple. The leverage point is in proper design in the first place. The only way to fix a system that is laid out poorly is to redesign and rebuild it. After a structure is built, the leverage lies in understanding its limitations and bottlenecks, and managing it within limits for maximum efficiency by refraining from creating large fluctuations or expansions that strain its capacity (e.g. economic stimulus to solve economic structural issues).

9	**Informational**	**Length of delays, relative to the rate of system changes -** Delays in feedback loops are critical determinants of system behaviour. They are common causes of oscillations. If you're trying to adjust a stock, but you receive only delayed information about what the state or condition of the stock is, there will be a strong probability of either overshooting or undershooting your goal. The same is true if information is timely, but response is not. A delay in a feedback process is critical relative to rates of change in the stocks that the feedback loop is trying to control. Delays that are too short cause overreaction, resulting in oscillations amplified by the suddenness of the response. Delays that are too long cause inhibited, sustained, or exploding oscillations. Extremely long delays in a system with a threshold limit, a range past which irreversible damage can occur, eventually lead to system collapse (e.g. overshoot of the planet's biocapacity regeneration). The length of a delay can be a high leverage point, however, unfortunately, delays are not often something that can be changed easily, especially in social systems. It is usually easier to slow down the change rate, so that inevitable feedback delays do not cause so much trouble.
8		**Strength of balancing feedback loops, relative to the effect they are trying to correct -** Balancing feedback loops are found everywhere in life. They are goal focused by nature. The nature naturally sets them, and humans create them as controls to keep important stocks within safe limits. A thermostat type loop is the classic example here, whereby when room temperature is reached, the air conditioner reduces output. The strength of a balancing loop, its ability to keep its appointed stock at or near its goal, depends on the combination of many things, including all its parameters and links, the accuracy and frequency of monitoring, the quickness and power of the response, and the accuracy and size of corrective flows to name a few. The strength of a balancing feedback loop as a 'leverage point' is important relative to the impact it is designed to correct. If the impact increases in strength, the feedbacks have to be strengthened as well. Not an easy job.

7		**Gain around driving positive reinforcing feedback loops –** A reinforcing feedback loop is by nature, self-reinforcing, meaning that it accelerates the speed of the overall behaviour. The more it works, the more it gains speed and power, driving system behaviour in one direction faster and stronger. Reinforcing feedback loops are sources of growth and degradation, and if not checked, system collapse. Reducing the gain around a reinforcing loop, i.e. slowing the growth, is usually a more powerful leverage point in systems management than strengthening balancing loops, and far more preferable than letting the reinforcing loop to run away with itself.
6		**Structure of information flow (who does and does not have access to what kinds of information) –** Missing information flows are among the most common reasons for system malfunction. Adding or restoring information can be a powerful intervention, and is often much easier and cheaper than having the redesign and rebuild physical infrastructure. Information flow is neither a parameter, nor a reinforcing or slowing loop, but a loop that delivers new information to decision points in the system. It is safe to say that there is a tendency on the part of humans to avoid accountability for their own decisions. That is why there are so many missing feedback loops—and why this kind of leverage point is so often popular with the people but unpopular with the people in power. It is a highly effective leverage point if you can get the people in power to accept it. Bottom line - It is cheaper and easier to change information flows than it is to change structure.
5	**Social**	**Rules of the system (such as incentives, punishment, constraints) –** The rules of a system define its scope, its boundaries, and its degrees of freedom available in its processes. A country's constitution is one example of social rule as a system leverage point. Physical laws, such as the second law of thermodynamics, and gravity are absolute rules, whether we understand them or like having to obey them. Laws, punishments, incentives, and informal social agreements are progressively weaker rules. Imagining what response restructured, or new rules would cause in people's behaviour who would be affected by them, can help us to understand their power. Rules are high

		leverage points, and power to set rules is real power. The key point for change is - pay attention to rules, and to who makes them.
4		**Power to add, change, evolve, or self-organize system structure -** Self organizing is a system's ability to change itself by creating new structures, adding new negative and positive feedback loops, promoting new information flows, or making new rules. Living systems and some social systems can change themselves by creating whole new structures and behaviours – think of Eastern Europe after the fall of the Berlin Wall. In biological systems, that power is called evolution. In human economies it might be called a disruptive innovation or social revolution. In systems lingo it's called self-organization. The ability to self-organize is the strongest form of system resilience.
3		**Goals of the system -** The goal of a system is a leverage point even more powerful than that of the self-organizing ability of a system. Changing goals changes everything higher in this framework, including physical stocks and flows, feedback loops, information flows, and even self-organising behaviour. All of these will be adjusted or changed to conform to that goal. Changing the goal of a feedback loop can change a piece of the system, but changing the goal of the system changes everything!
2	**Consciousness**	**Mindset or paradigm that the system —** its goals, structure, rules, delays, parameters — arises from - The shared ideas in the minds of society, the big unstated assumptions, or a system of thought that is the foundation of complex social structures constitute that society's paradigm, or deepest set of beliefs about how the world works. Paradigms are the sources of systems. From them, from shared social agreements about the nature of reality, come system goals and information flows, feedbacks, stocks, and everything else about systems. Paradigms are very hard to change, but there are no limits to paradigm change, and a paradigm change in an individual can happen in a millisecond.

1		**Power to transcend paradigms -** There is one leverage point that is even higher than changing a paradigm. This is the ability to transcend paradigms. This involves going beyond challenging fundamental assumptions, to actually challenging and changing the values and priorities that lead to the assumptions. The Power to transcend paradigms is the ability to keep oneself unattached in the arena of paradigms, to stay flexible, to realize that no paradigm is "true," that everyone, including the one that shapes one's own worldview, is a tremendously limited understanding of an immense and unfathomable universe that is likely to stay forever beyond human comprehension. Obviously the most difficult to do, but also the most impacting!

Source: Meadows, Donella. Whole Earth, Winter 1997. Places to Intervene in a System. Donella Meadows Institute.

As described previously, for this assessment we focused on identifying the SDG "direct driver" targets that are high impact leverage points for intervention in achieving the 8 targets of SDG 6 on water and sanitation. Thus, only the targets that could be associated with the 9-1 levers were selected. Hereafter, the analysis of the high impact leverage points for intervention for each of the respective SDG 6 targets is described in a tabular format followed by graphical representation for illustration using the Kumu software. The targets are ordered in descending order from highest impact (level 2) down to lowest impact (level 9) with regards to long-term sustainable system change, according to Meadows' framework. Additional graphs that follow each target present the highest impact leverage points as the longest levers compared to the lower impact, which are shorter levers.

SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.1 Achieve universal and equitable access to safe and affordable drinking water for all.	**Level 4 levers - Power to add, change, evolve, or self-organize system structure** 1.3 – Build and strengthen social protection systems and measures. 5.a - Women have equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources. 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 7.1 - Universal access to affordable, reliable and modern energy services. 8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sector. 9.a - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support. 9.b - Domestic technology development, research and innovation in developing countries, by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities. 11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement. 16.7 - Responsive, inclusive, participatory and representative decision-making at all levels.) 17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology. 17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries. 17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

Level 5 levers - Rules of the system (such as incentives, punishment, constraints

1.4 - Equal rights to economic resources and access to basic services, ownership and control over land and other forms of property, inheritance, natural resources.

5.5 – Women enjoy full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management)

10.3 - Equal opportunity and reduced inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard.

16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all.

16.b - Enforced non-discriminatory laws and policies for sustainable development.

Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information

11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.

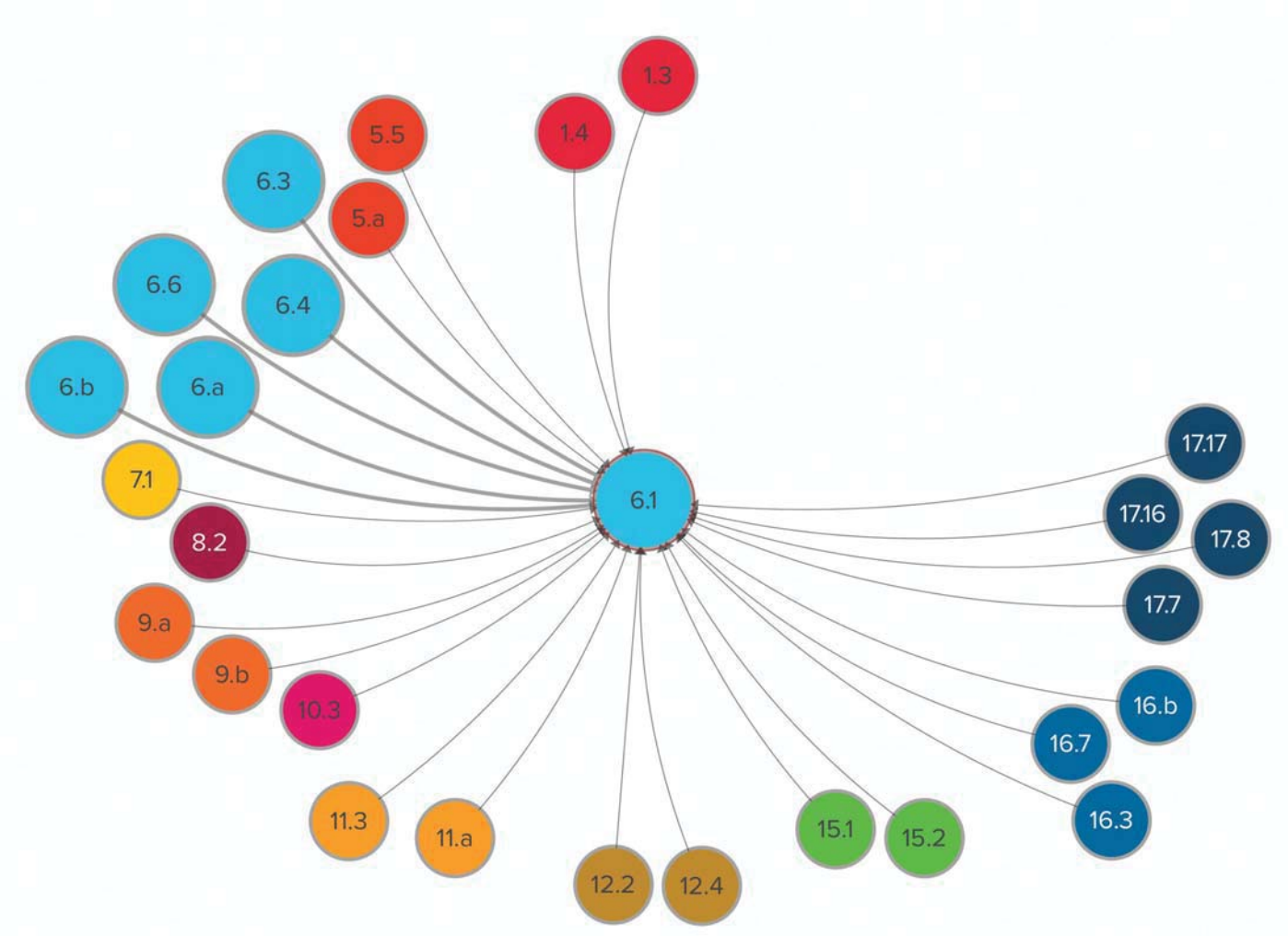
Level 7 levers - Gain around driving positive reinforcing feedback loop)

6.3 - Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

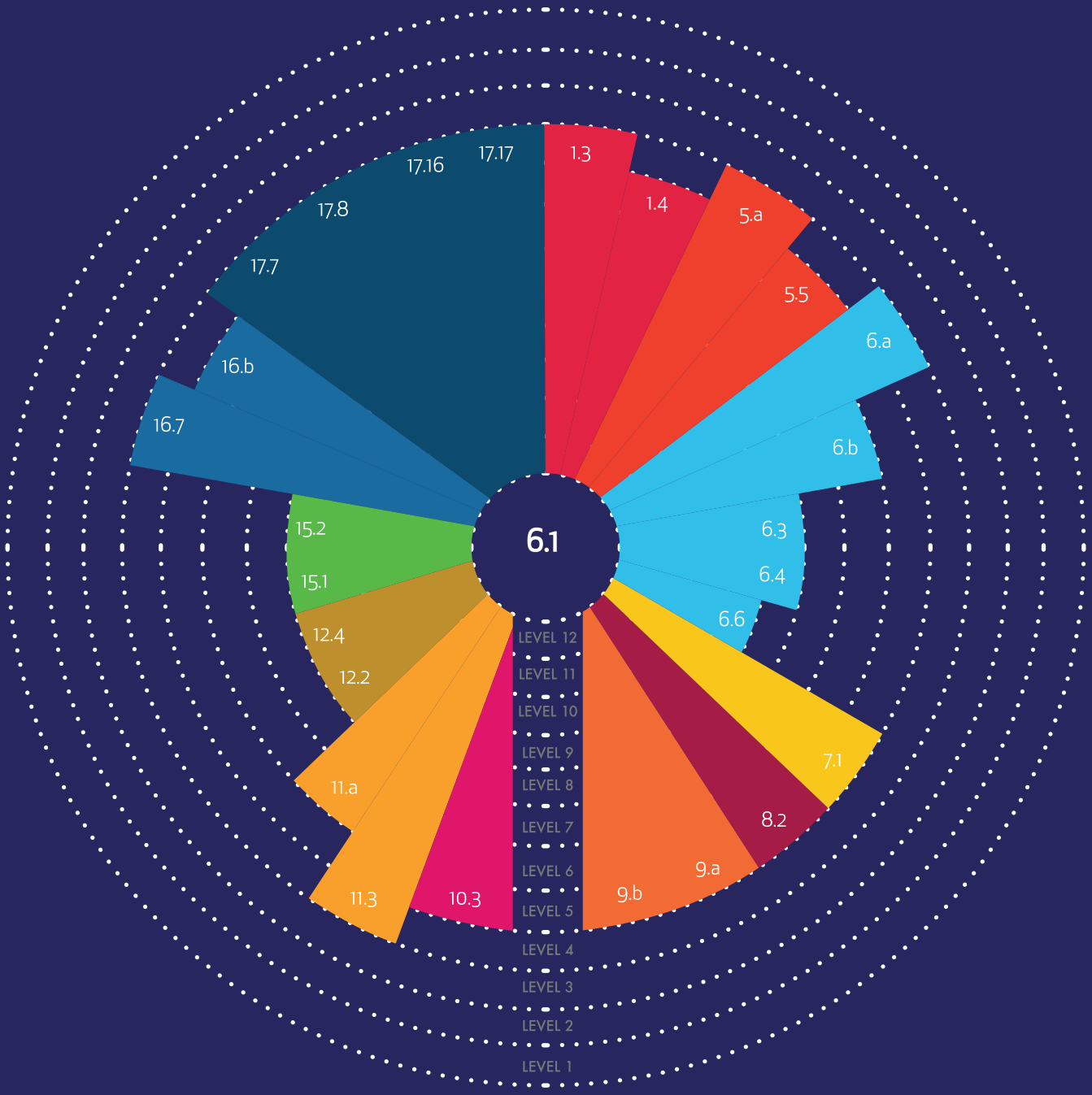
6.4 - Increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

	Level 8 levers - Strength of balancing feedback loops, relative to the effect they are trying to correct 6.6 – Fully protected/restored water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. 12.2 - Sustainable management and efficient use of natural resources. 12.4 - Environmentally sound management of chemicals and all wastes throughout their life cycle. 15.1- Conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands. 15.2 - Sustainable management of all types of forests, halt deforestation, restore degraded forests.

Figure 15: SDG 6 Target 6.1 - Potential High Impact Leverage Points



ACHIEVE UNIVERSAL AND EQUITABLE ACCESS TO SAFE AND AFFORDABLE DRINKING WATER FOR ALL



SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.2 Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.	**Level 4 levers - Power to add, change, evolve, or self-organize system structure** 1.3 - Social protection systems and measures. 5.a - Women have equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources. 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sector. 9.a - Sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support. 11.1 - Access for all to adequate, safe and affordable housing and basic services and upgrade of slums. 11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management. 13.b - Mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities. 17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology. 17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.

17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

Level 5 levers - Rules of the system (such as incentives, punishment, constraints

5.5 - Women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management)

16.3 - Rule of law at the national and international levels and ensure equal access to justice for all.

16.b - Enforced non-discriminatory laws and policies for sustainable development.

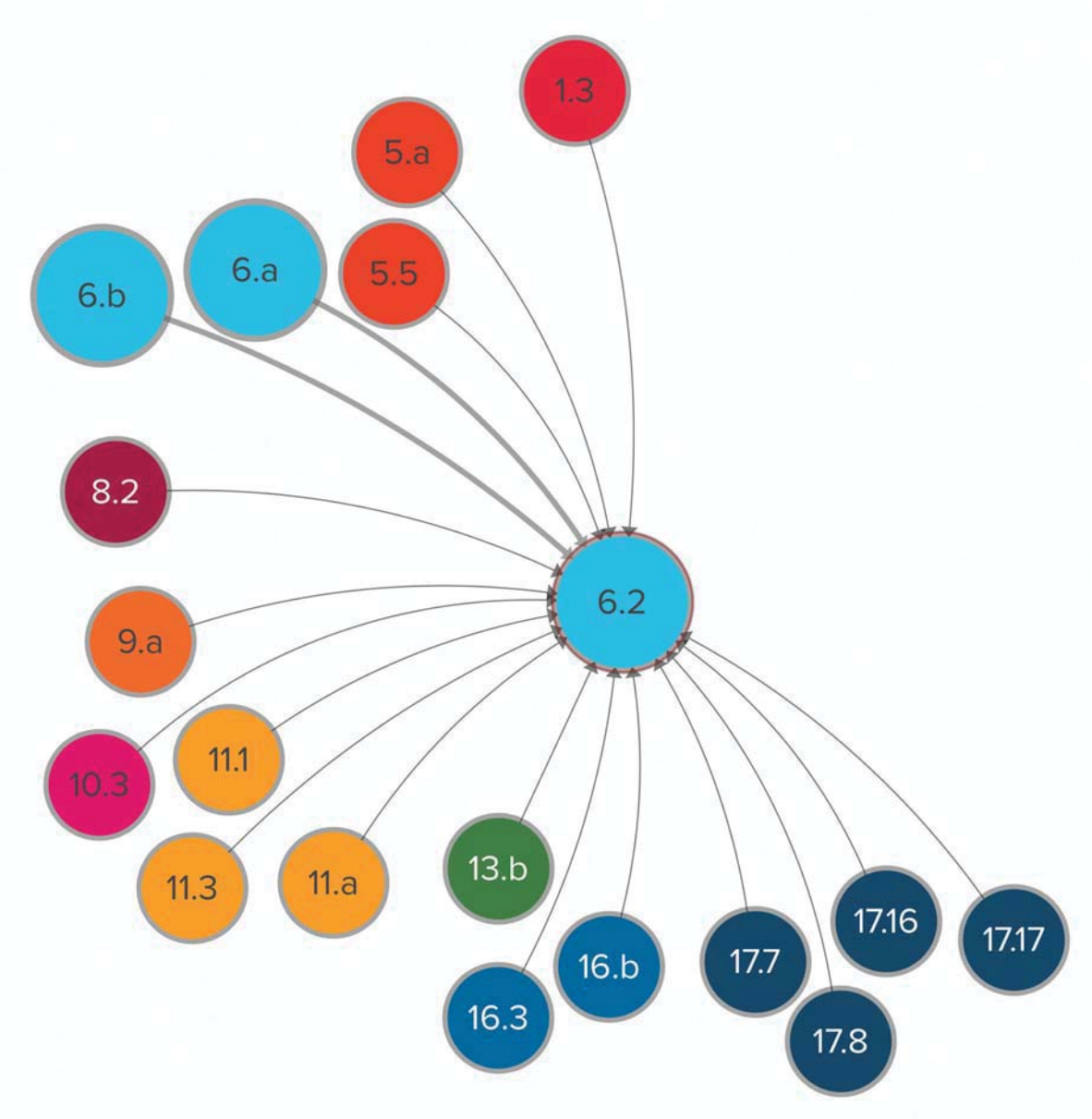
Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information

11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.

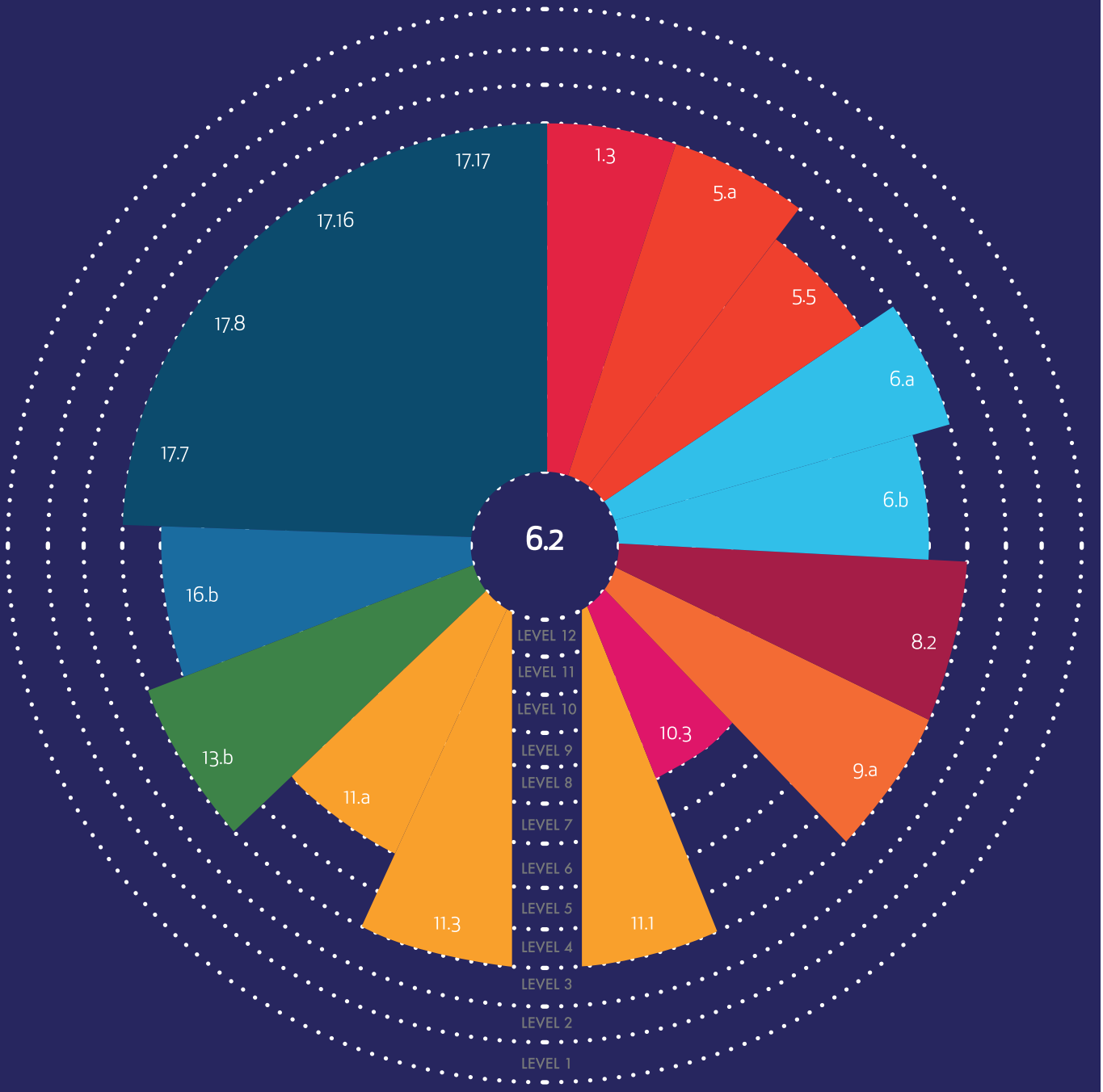
Level 8 levers - Strength of balancing feedback loops, relative to the effect they are trying to correct

10.3 - Equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard.

Figure 16: SDG 6 Target 6.2 - Potential High Impact Leverage Points



ACHIEVE ACCESS TO ADEQUATE AND EQUITABLE SANITATION AND HYGIENE FOR ALL AND END OPEN DEFECATION, PAYING SPECIAL ATTENTION TO THE NEEDS OF WOMEN AND GIRLS AND THOSE IN VULNERABLE SITUATIONS.



SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.3 Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	**Level 2 lever - Mindset or paradigm that the system — its goals, structure, rules, delays, parameters — arises from** 4.7 - All learners acquire the knowledge and skills needed to promote Sustainable Development thru ESD and sustainable lifestyles. 15.9 - Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. **Level 3 lever - Goals of the system** 2.4 - Sustainable food production systems and resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change. **Level 4 levers - Power to add, change, evolve, or self-organize system structure** 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 6.5 - Integrated water resources management at all levels, including through transboundary cooperation. 8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sector. 9.3 - Increased access of small-scale industrial and other enterprises to financial services, including affordable credit, and their integration into value chains and markets. 9.4 - Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes. 9.a - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support. 11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement. 12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action.

12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action.

17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.

17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology.

17.14 - Policy coherence for sustainable development.

17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.

17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

Level 5 levers - Rules of the system (such as incentives, punishment, constraints

6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management)

16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all.

Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information

9.c - Access to information and communications technology and provide universal and affordable access to the Internet in least developed.

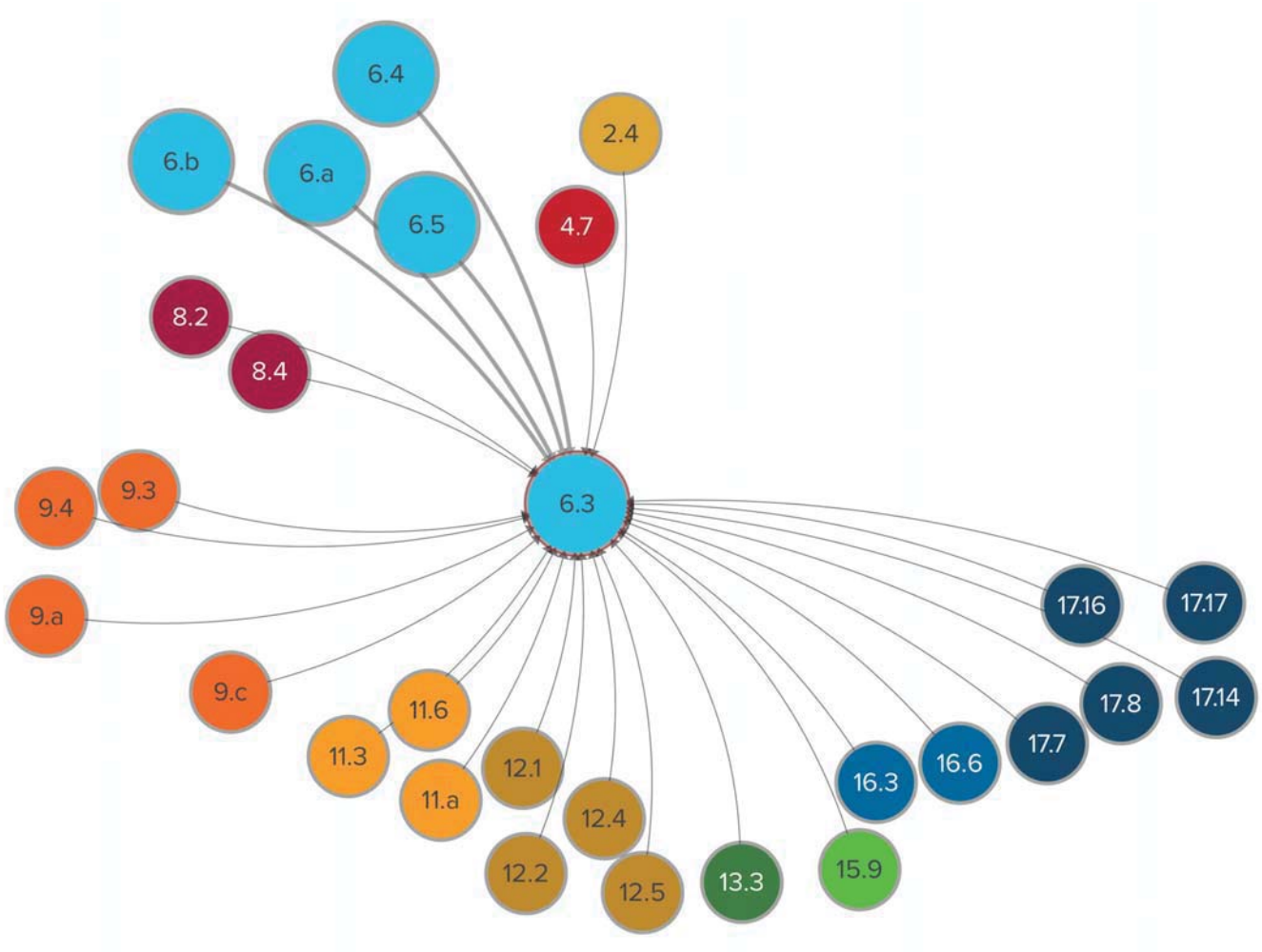
11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.

13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

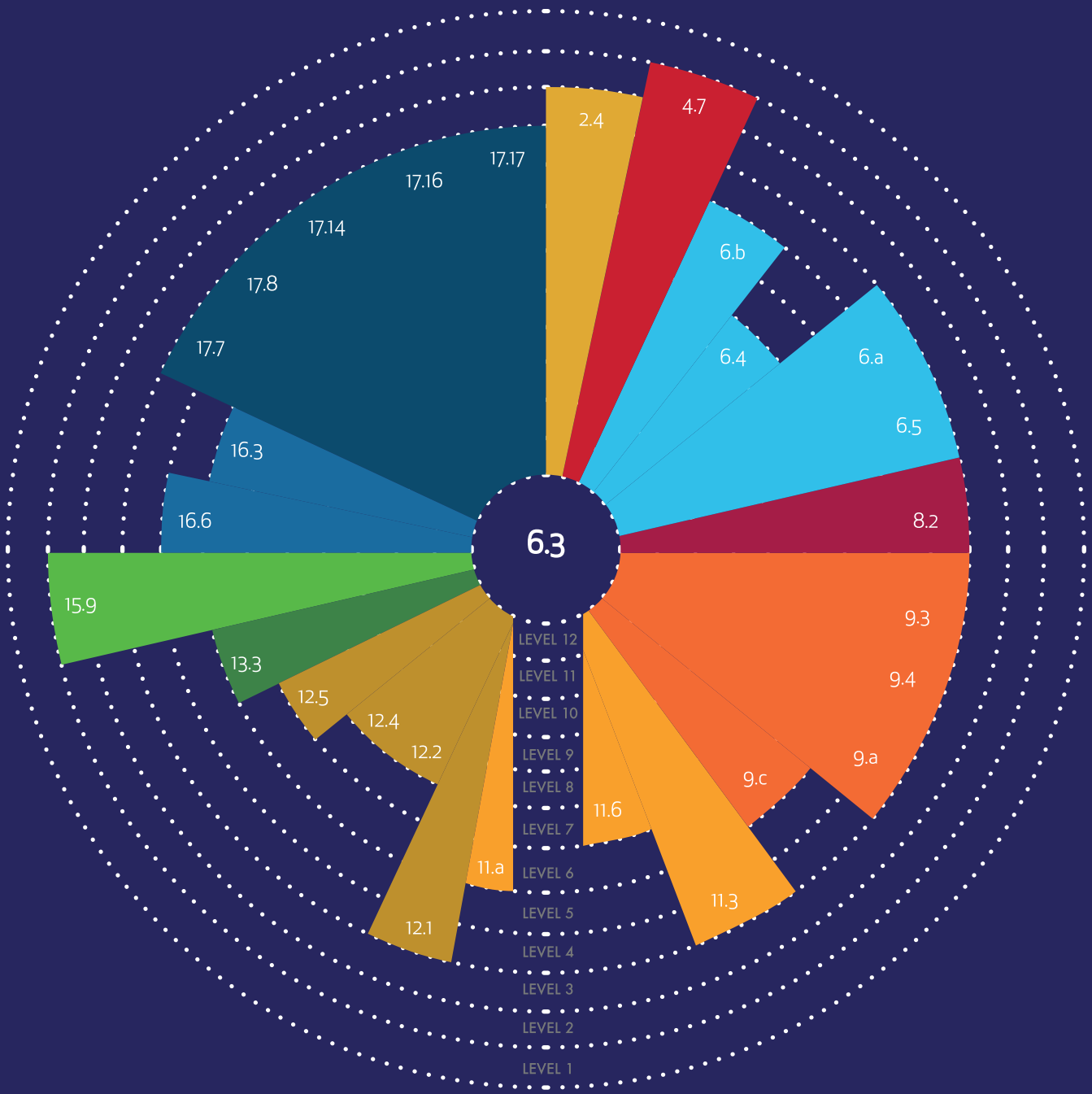
16.6 – Effective and accountable and transparent institutions at all levels.

	Level 7 levers - Gain around driving positive reinforcing feedback loop) 6.4 - Increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. 8.4 - Improve global resource efficiency in consumption and production and work to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production. 11.6 - Reduce the adverse environmental impact of cities (e.g. air quality and municipal and other waste management). 12.5 - Reduce waste generation through prevention, reduction, recycling and reuse. **Level 8 levers - Strength of balancing feedback loops, relative to the effect they are trying to correct** 12.2 - Sustainable management and efficient use of natural resources. 12.4 - Environmentally sound management of chemicals and all wastes throughout their life cycle.

Figure 17: SDG 6 Target 6.3 - Potential High Impact Leverage Points



IMPROVE WATER QUALITY BY REDUCING POLLUTION, ELIMINATING DUMPING AND MINIMIZING RELEASE OF HAZARDOUS CHEMICALS AND MATERIALS, HALVING THE PROPORTION OF UNTREATED WASTEWATER AND SUBSTANTIALLY INCREASING RECYCLING AND SAFE REUSE GLOBALLY.



SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.4 Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.	**Level 2 lever - Mindset or paradigm that the system — its goals, structure, rules, delays, parameters — arises from** 4.7 - All learners acquire the knowledge and skills needed to promote Sustainable Development thru ESD and sustainable lifestyles. **Level 3 lever - Goals of the system** 2.4 - Sustainable food production systems and resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change. **Level 4 levers - Power to add, change, evolve, or self-organize system structure** 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 6.5 - Integrated water resources management at all levels, including through transboundary cooperation. 8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sector. 9.3 - Increased access of small-scale industrial and other enterprises to financial services, including affordable credit, and their integration into value chains and markets. 9.4 - Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes. 9.5 - Enhanced scientific research, upgraded technological capabilities of industrial sectors in all countries, in particular developing countries. 9.a - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support. 11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement. 12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action.

13.2 - Integrate climate change measures into national policies, strategies and planning.

17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.

17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology.

17.14 - Policy coherence for sustainable development.

17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.

17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

Level 5 levers - Rules of the system (such as incentives, punishment, constraints

6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management)

16.3 - Rule of law at the national and international levels and ensure equal access to justice for all.

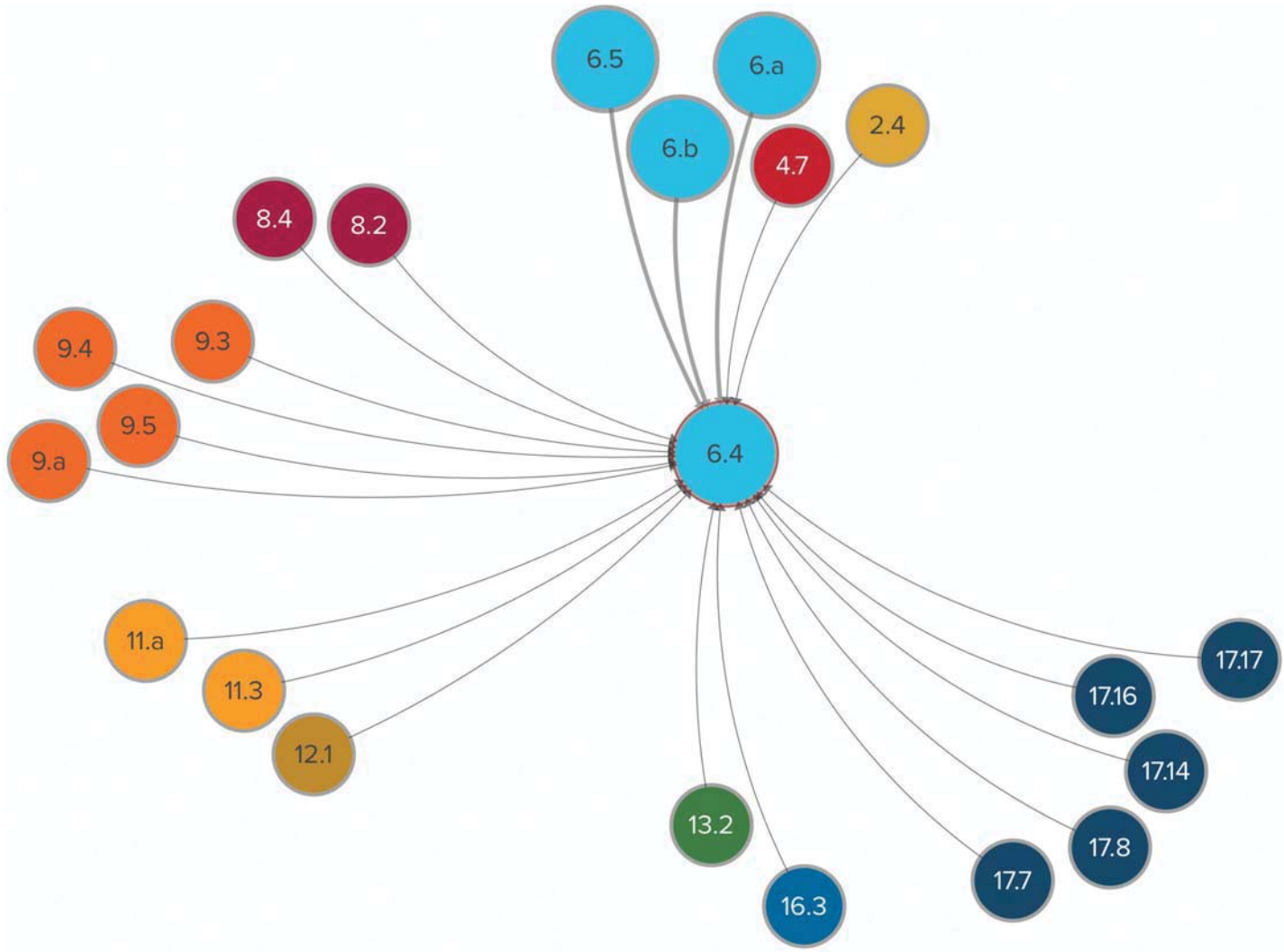
Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information

11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.

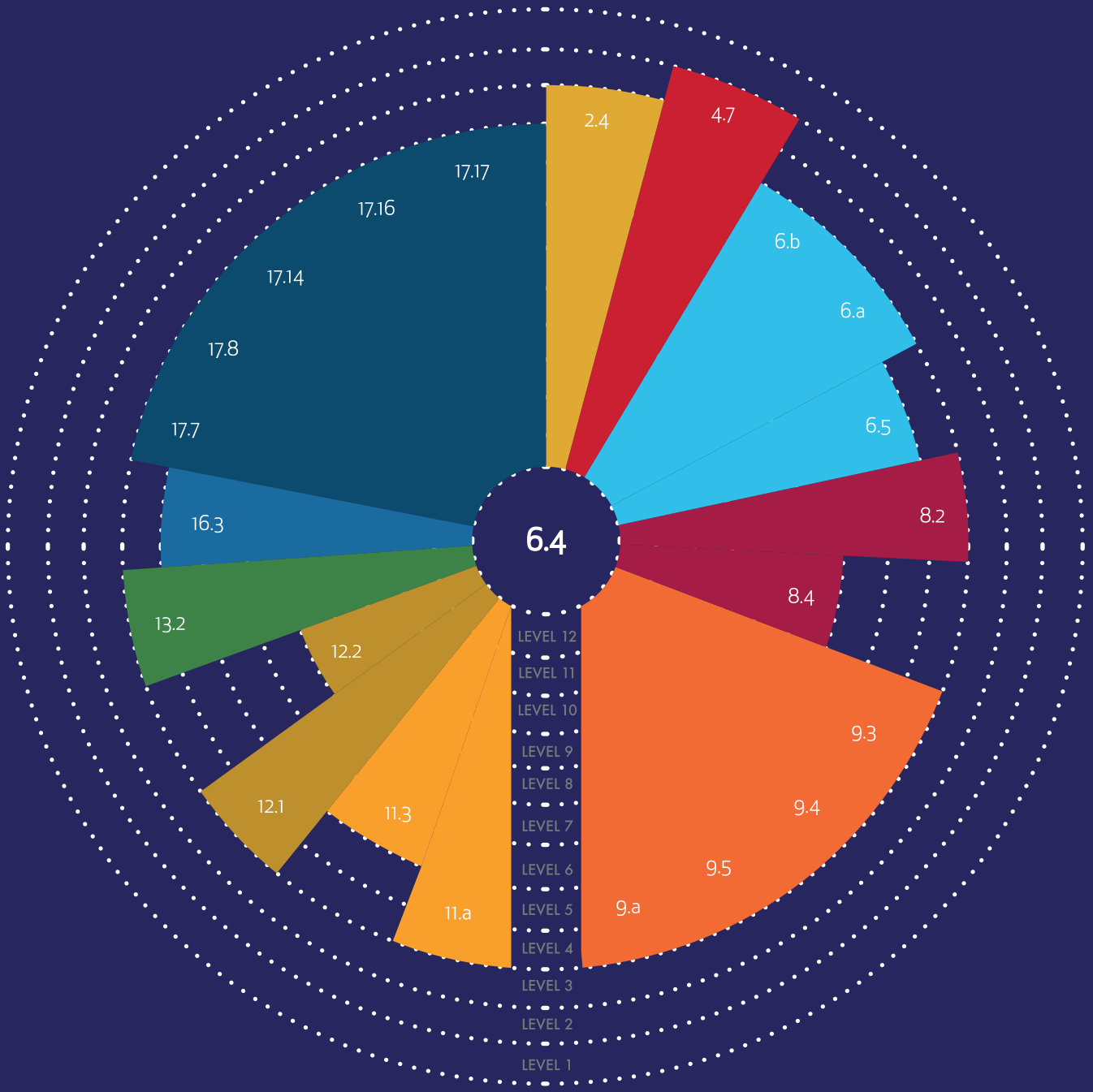
Level 7 levers - Gain around driving positive reinforcing feedback loop)

8.4 - Improve global resource efficiency in consumption and production and work to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production.

Figure 18: SDG 6 Target 6.4 - Potential High Impact Leverage Points



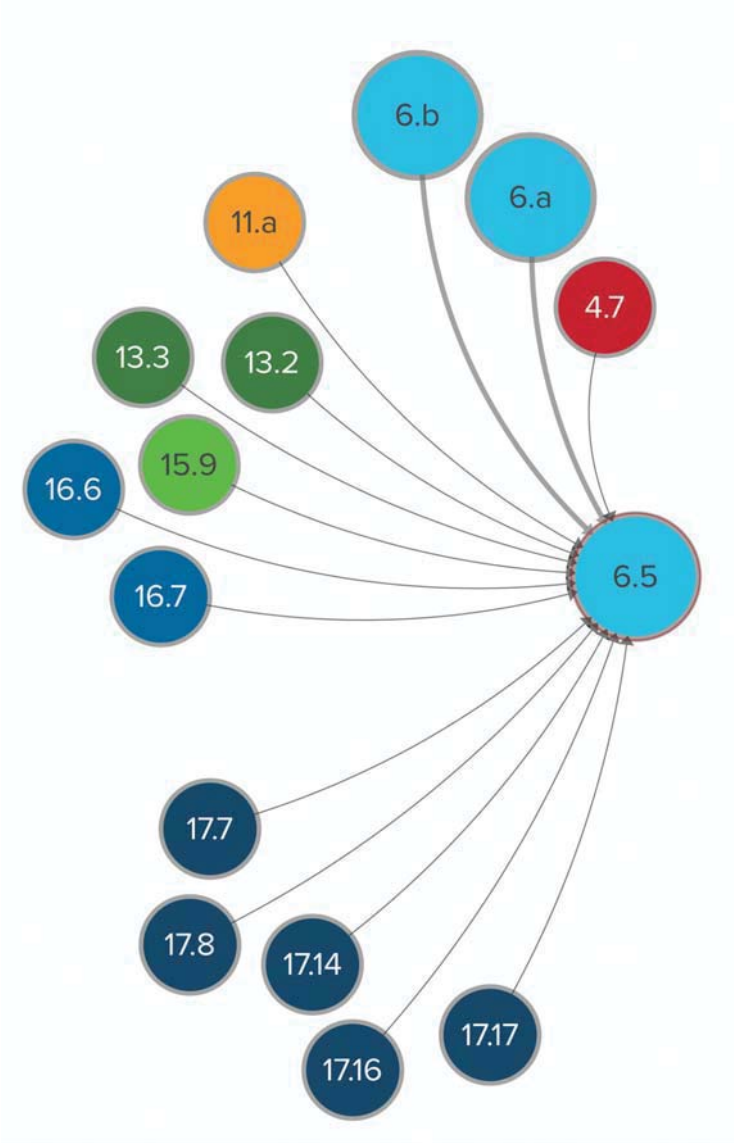
SUBSTANTIALLY INCREASE WATER-USE EFFICIENCY ACROSS ALL SECTORS AND ENSURE SUSTAINABLE WITHDRAWALS AND SUPPLY OF FRESHWATER TO ADDRESS WATER SCARCITY AND SUSTANTIALLY REDUCE THE NUMBER OF PEOPLE SUFFERING FROM WATER SCARCITY.



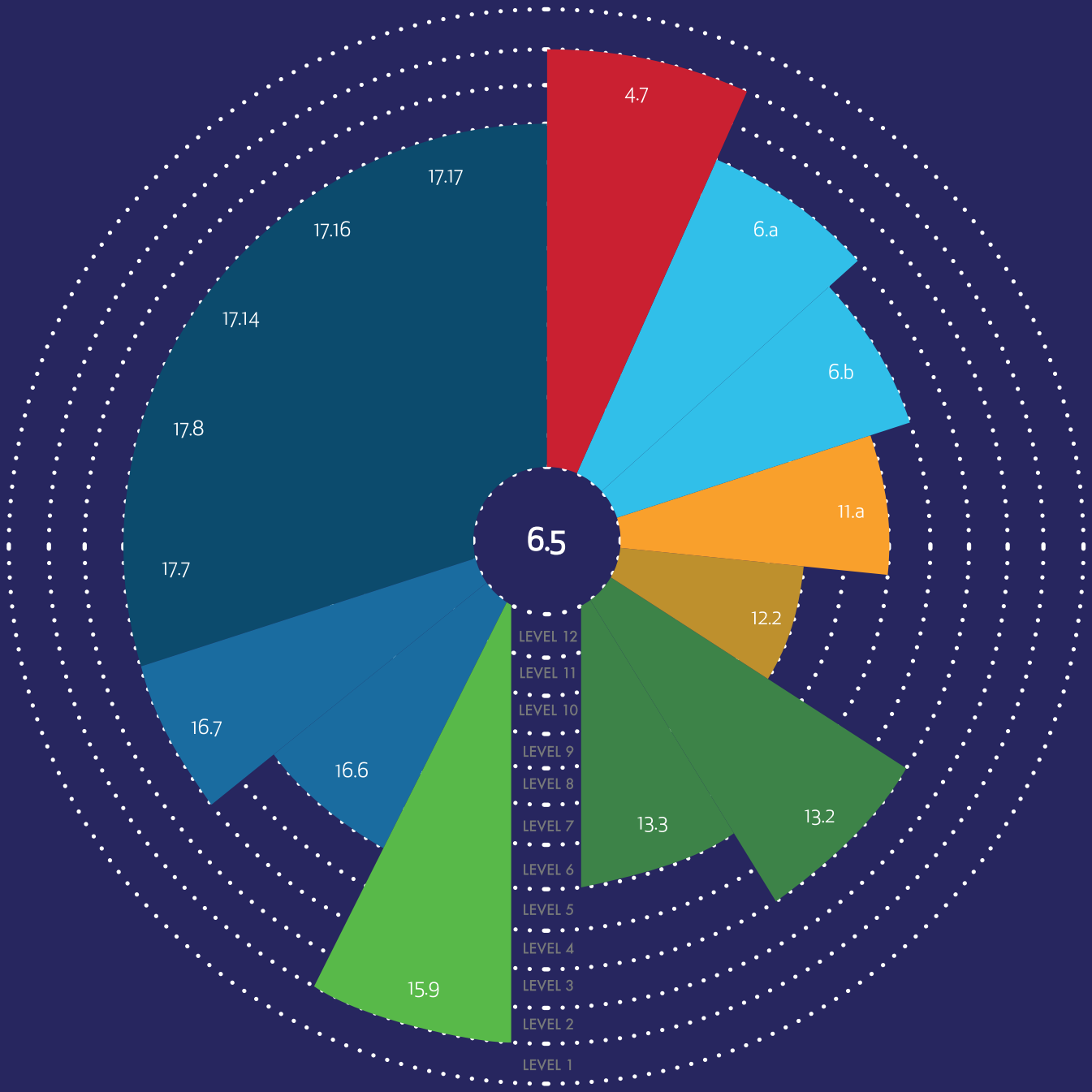
SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.5 Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.	**Level 2 lever - Mindset or paradigm that the system — its goals, structure, rules, delays, parameters — arises from** 4.7 - All learners acquire the knowledge and skills needed to promote Sustainable Development thru ESD and sustainable lifestyles. 15.9 - Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. **Level 4 levers - Power to add, change, evolve, or self-organize system structure** 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 13.2 - Integrate climate change measures into national policies, strategies and planning. 16.7 - Responsive, inclusive, participatory and representative decision-making at all levels. 17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology. 17.14 - Policy coherence for sustainable development. 17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries. 17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

	Level 5 levers - Rules of the system (such as incentives, punishment, constraints 6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management). **Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information** 11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning. 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. 16.6 – Effective and accountable and transparent institutions at all levels.

Figure 19: SDG 6 Target 6.5 - Potential High Impact Leverage Points



IMPLEMENT INTEGRATED WATER RESOURCES MANAGEMENT AT ALL LEVELS, INCLUDING THROUGH TRANSBOUNDARY COOPERATION AS APPROPRIATE



SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.6 Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.	**Level 2 lever - Mindset or paradigm that the system — its goals, structure, rules, delays, parameters — arises from** 4.7 - All learners acquire the knowledge and skills needed to promote Sustainable Development thru ESD and sustainable lifestyles. 15.9 - Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. **Level 3 lever - Goals of the system** 2.4 - Sustainable food production systems and resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change. **Level 4 levers - Power to add, change, evolve, or self-organize system structure** 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 6.5 - Integrated water resources management implemented at all levels, including through transboundary cooperation. 7.1 - Universal access to affordable, reliable and modern energy services. 13.2 - Integrate climate change measures into national policies, strategies and planning. 16.7 - Responsive, inclusive, participatory and representative decision-making at all levels. 17.4 - Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress. 17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology.

17.14 - Policy coherence for sustainable development.

17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

Level 5 levers - Rules of the system (such as incentives, punishment, constraints

15.6 - Fair and equitable sharing of the benefits arising from the utilization of genetic resources and ensure appropriate access to such resources, as internationally agreed.

16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all.

Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information

6.b - Participation of local communities in improving water and sanitation management (i.e. Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management)

11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.

13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

16.6 – Effective and accountable and transparent institutions at all levels.

16.10 - Public access to information and protection of fundamental freedoms, in accordance with national legislation and international agreements.

Level 7 levers - Gain around driving positive reinforcing feedback loop)

6.3 - Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

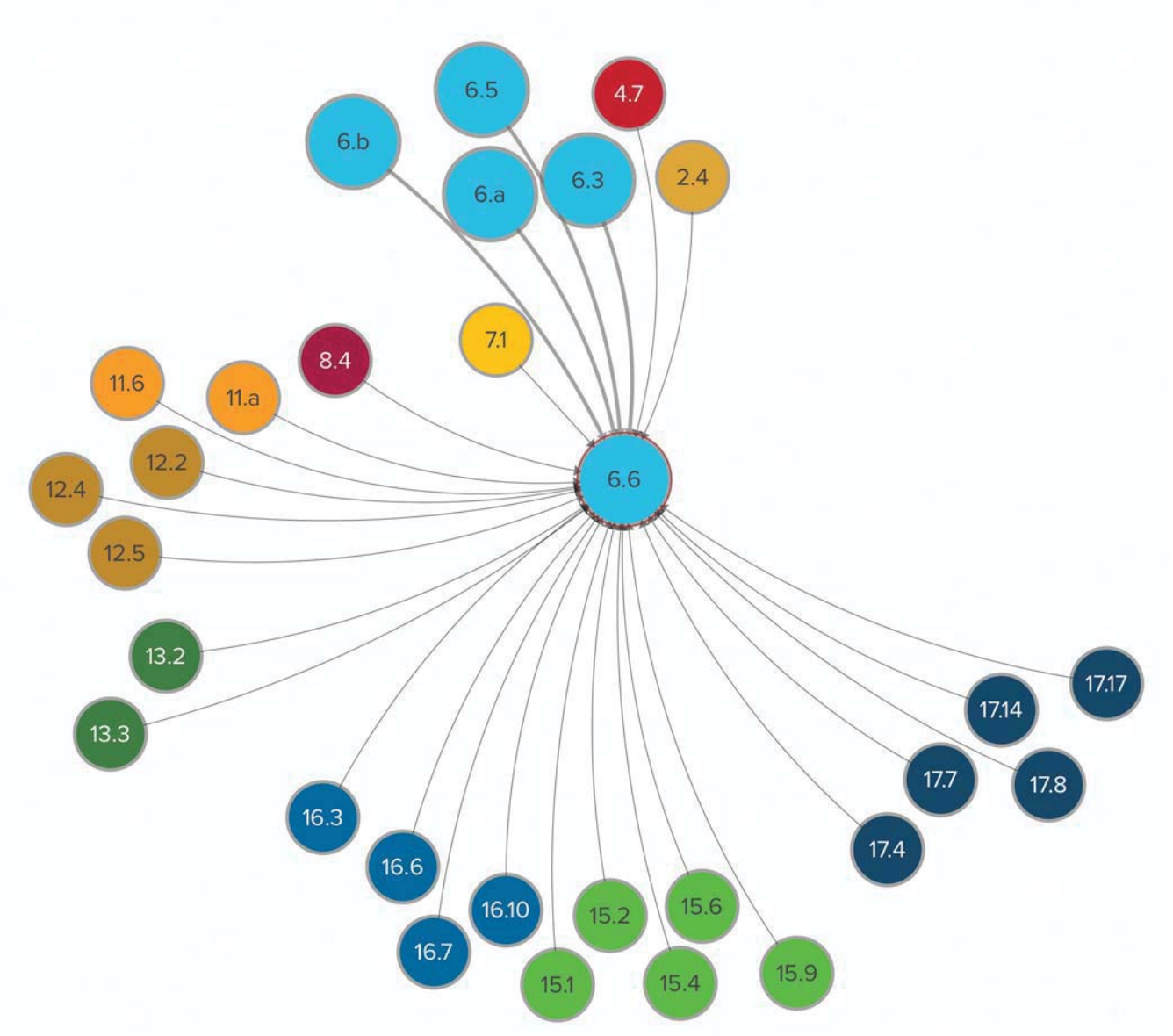
8.4 - Improve global resource efficiency in consumption and production and work to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production.

11.6 - Reduce the adverse environmental impact of cities (e.g. air quality and municipal and other waste management).

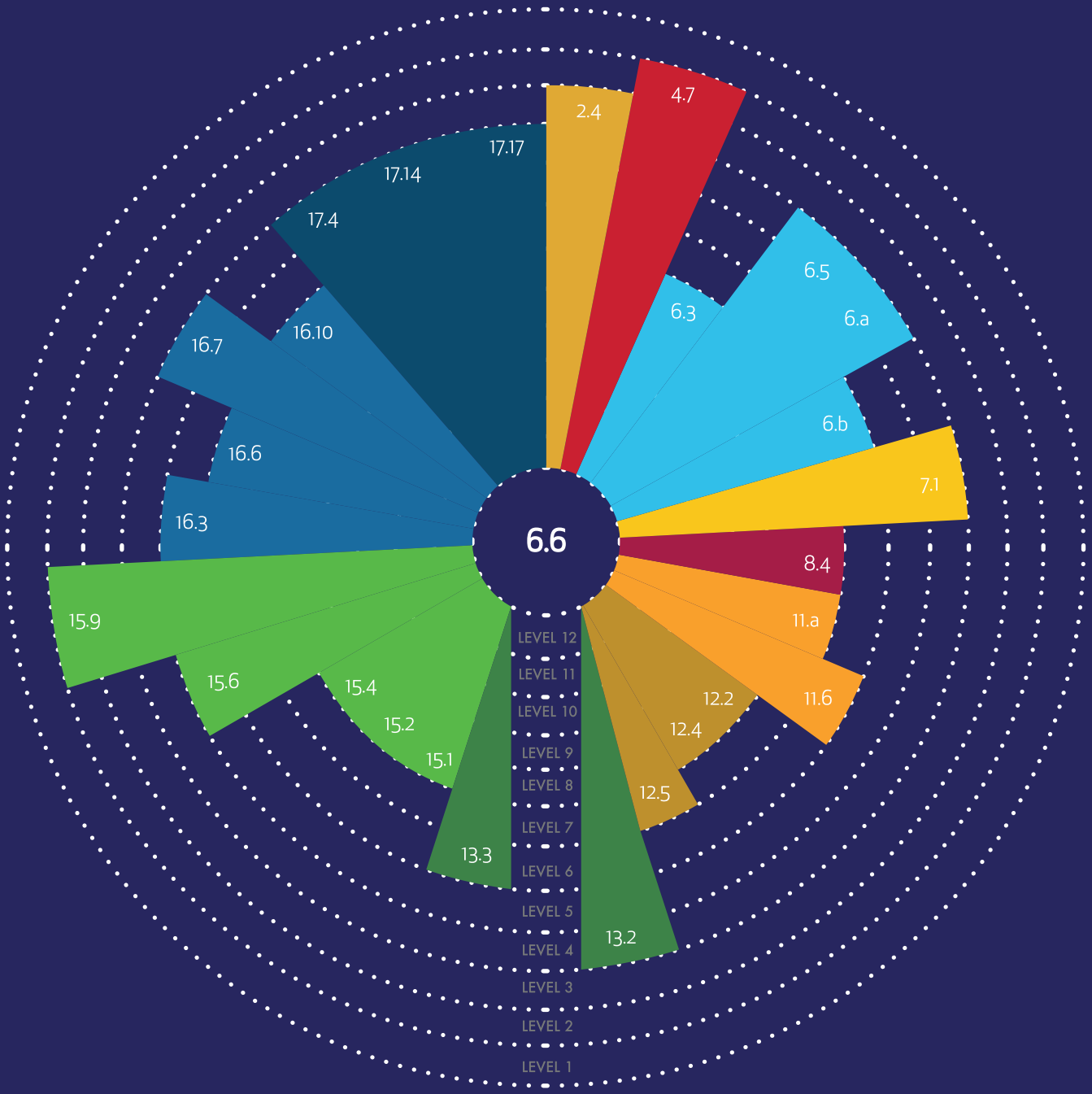
12.5 - Reduce waste generation through prevention, reduction, recycling and reuse.

	Level 8 levers - Strength of balancing feedback loops, relative to the effect they are trying to correct 12.2 - Sustainable management and efficient use of natural resources. 12.4 - Environmentally sound management of chemicals and all wastes throughout their life cycle. 15.1- Conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands. 15.2 - Sustainable management of all types of forests, halt deforestation, restore degraded forests. 15.4 - Ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.

Figure 20: SDG 6 Target 6.6 - Potential High Impact Leverage Points

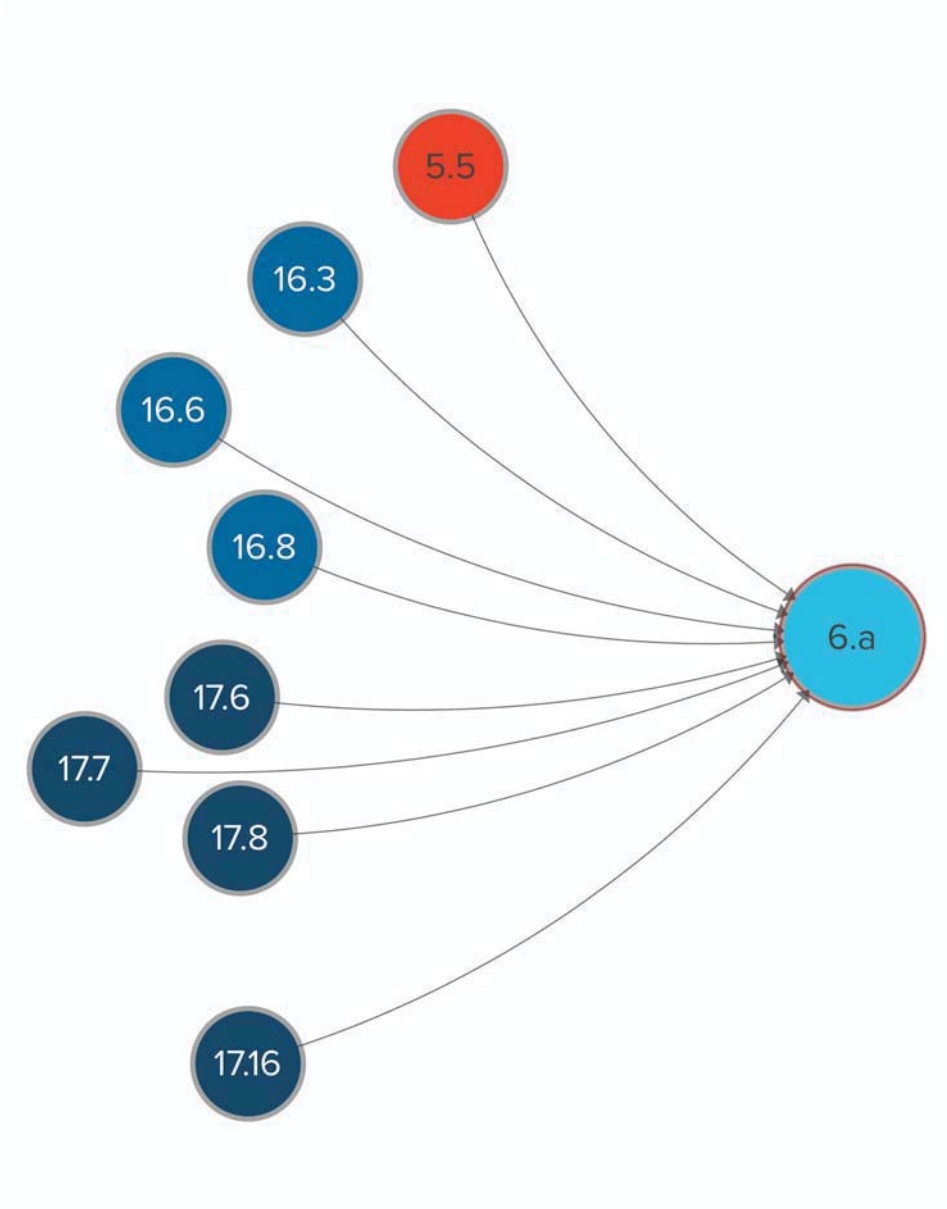


PROTECT AND RESTORE WATER-RELATED ECOSYSTEMS, INCLUDING MOUNTAINS, FORESTS, WETLANDS, RIVERS, AQUIFERS AND LAKES.

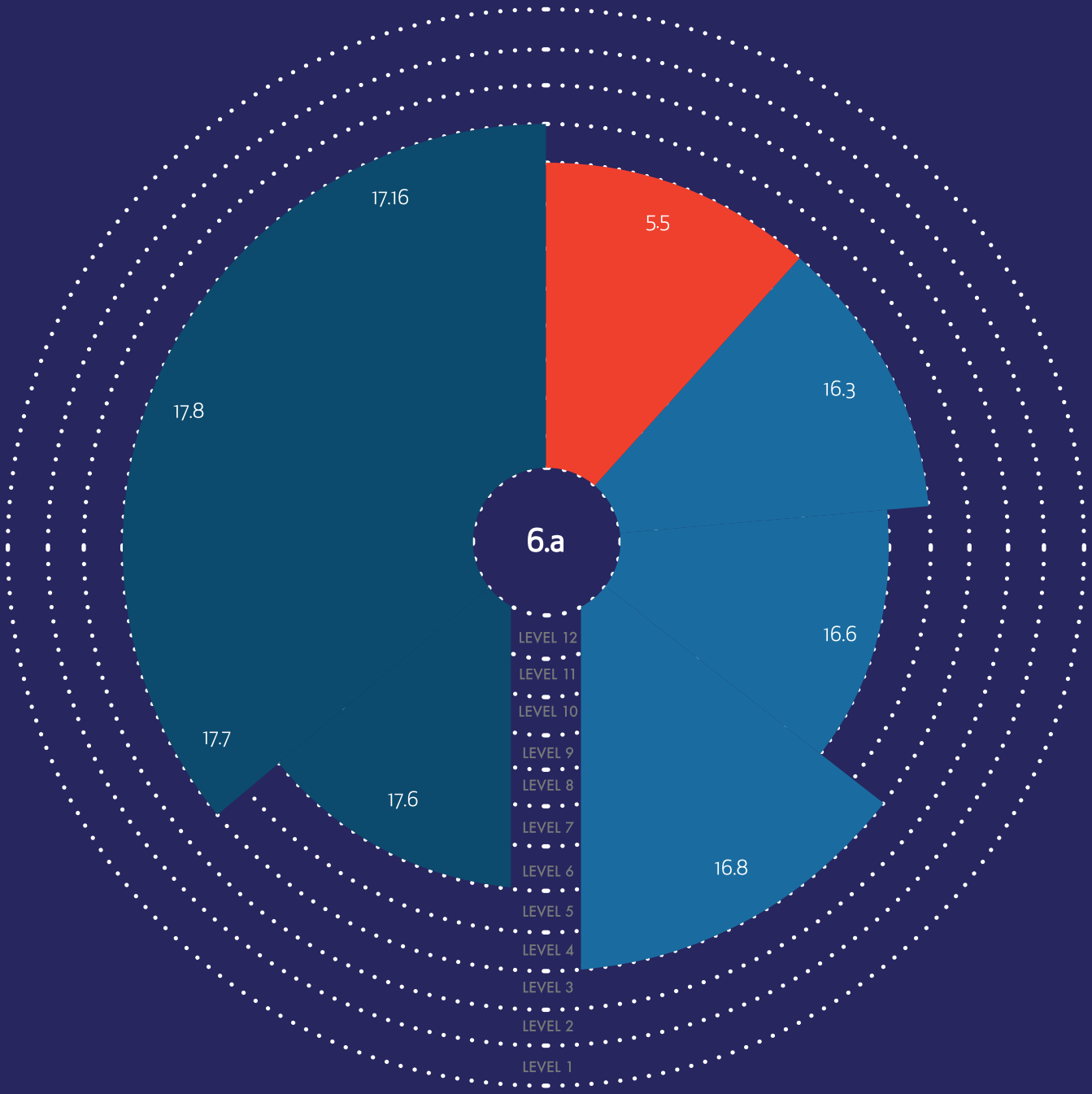


SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.a Expand international cooperation and capacity-building support to developing countries in water- and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	**Level 4 levers - Power to add, change, evolve, or self-organize system structure** 16.8 - Broaden and strengthen the participation of developing countries in the institutions of global governance. 17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology. 17.16 - Global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries. **Level 5 levers - Rules of the system (such as incentives, punishment, constraints** 5.5 - Women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life. 16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all. **Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information** 16.6 – Effective and accountable and transparent institutions at all levels. 17.6 - Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the UN level, and through a global technology facilitation mechanism.

Figure 21: SDG 6 Target 6.a – Potential High Impact Leverage Points



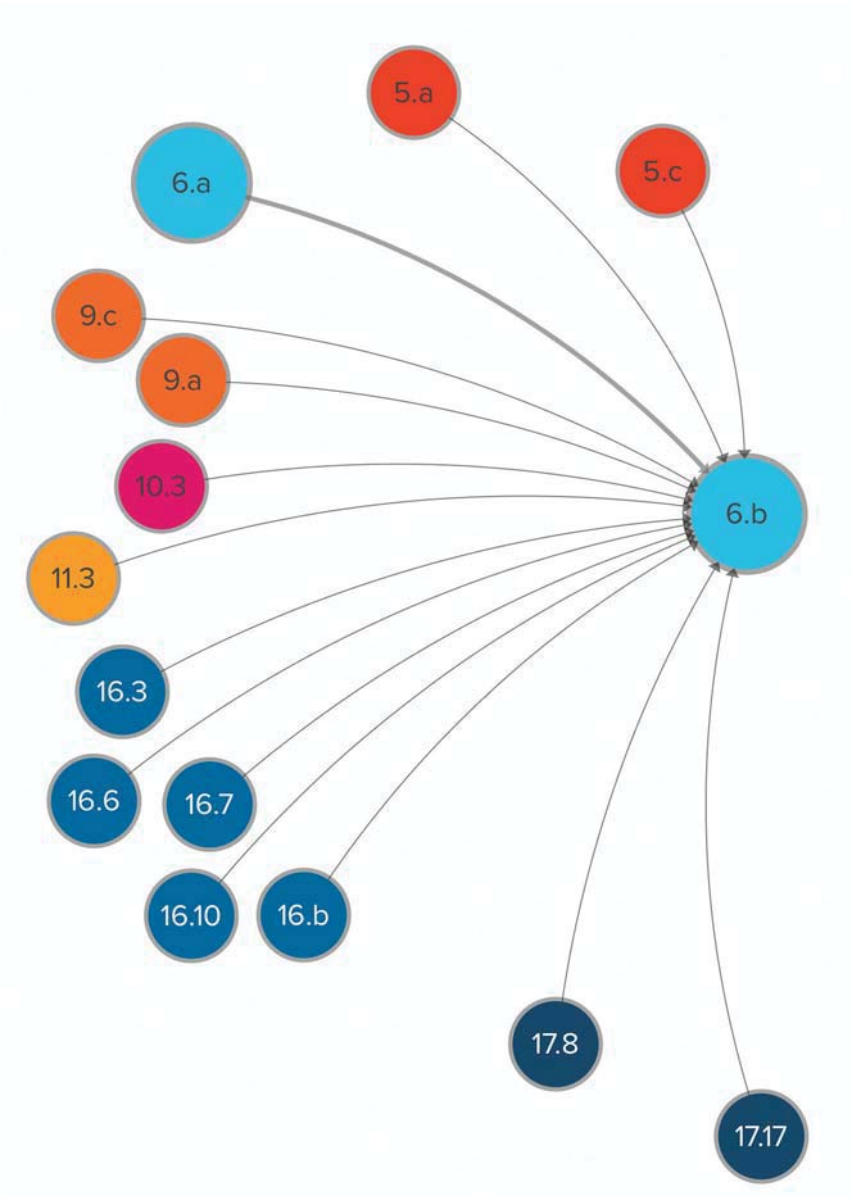
EXPAND INTERNATIONAL COOPERATION AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRIES IN WATER AND SANITATION RELATED ACTIVITIES AND PROGRAMMES, INCLUDING WATER HARVESTING, DESALINATION, WATER EFFICIENCY, WASTEWATER TREATMENT, RECYCLING AND REUSE TECHNOLOGIES.



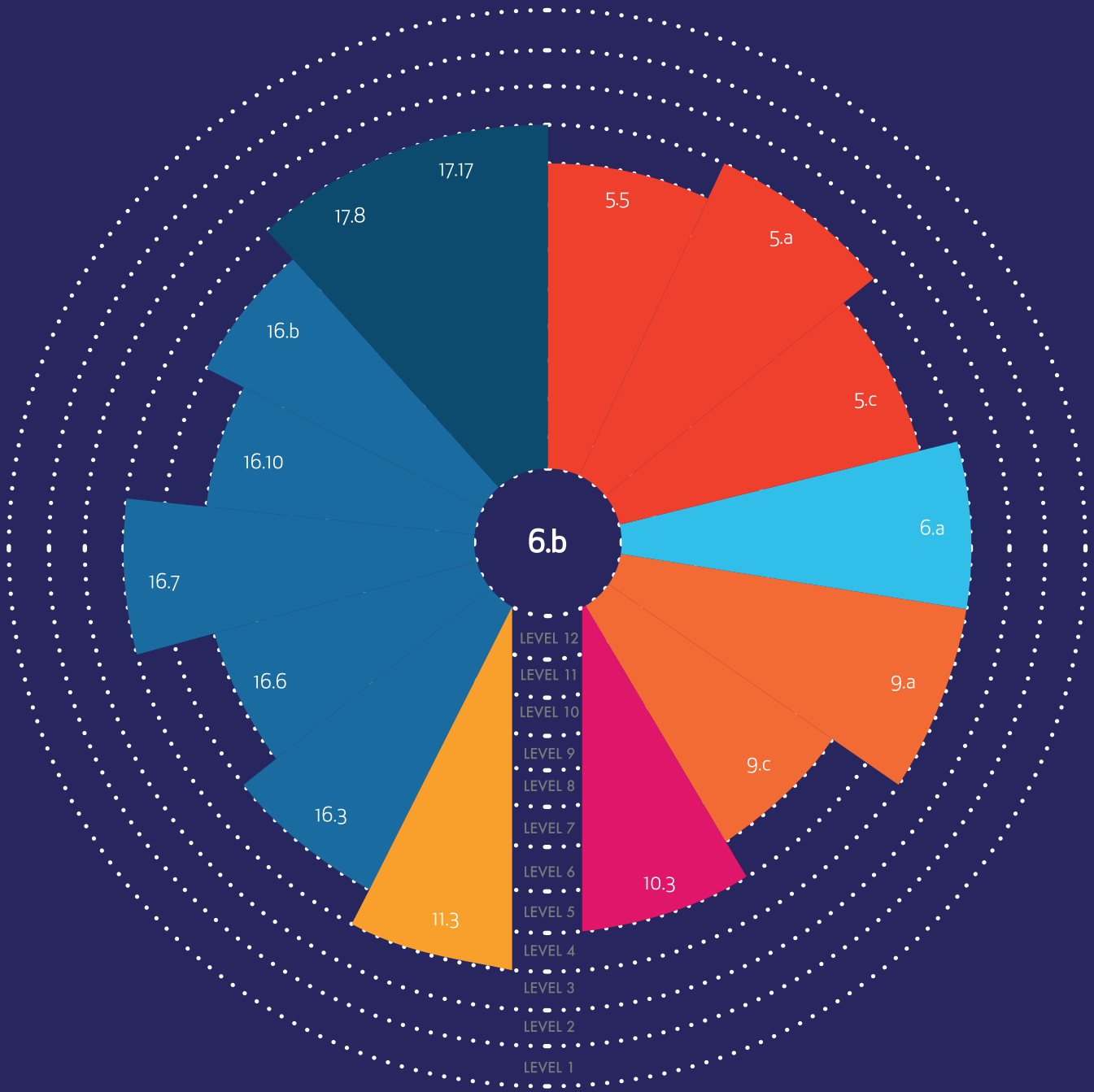
SDG 6 Target	Recommended Highest Impact Leverage points for Intervention to Achieve SDG 6 targets (organized from highest impact to lesser impact on long-term sustainability according to Meadows' 12 level framework)
6.b Support and strengthen the participation of local communities in improving water and sanitation management.	**Level 4 levers - Power to add, change, evolve, or self-organize system structure** 6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. 5.a - Women have equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources. 9.a - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support. 11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement. 16.7 - Responsive, inclusive, participatory and representative decision-making at all levels. 17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology. 17.17 - Effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships. **Level 5 levers - Rules of the system (such as incentives, punishment, constraints** 5.5 - Women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life. 5.c - Sound policies and enforceable legislation that promote gender equality and the empowerment of all women and girls at all levels. 10.3 - Equal opportunity and reduced inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard. 16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all. 16.b - Enforced non-discriminatory laws and policies for sustainable development 9.c - Access to information and communications technology and provide universal and affordable access to the Internet in least developed countries.

	Level 6 levers - Structure of information flow (who does and does not have access to what kinds of information 9.c - Access to information and communications technology and provide universal and affordable access to the Internet in least developed countries. 16.6 – Effective and accountable and transparent institutions at all levels. 16.10 - Public access to information and protection of fundamental freedoms, in accordance with national legislation and international agreements.

Figure 22: SDG 6 Target 6.b – Potential High Impact Leverage Points



SUPPORT AND STRENGTHEN THE PARTICIPATION OF LOCAL COMMUNITIES IN IMPROVING WATER AND SANITATION MANAGEMENT.



The second part of this assessment is to identify which of the high impact leverage point targets identified in the previous analysis have overall the most direct linkages to the eight SDG 6 targets. This provides an additional level of analysis that helps us to see which high impact leverage point targets are most connected overall to SDG 6 targets. Why is this important? Having an idea of the high impact leverage point targets that have direct links to multiple SDG 6 targets can open the space for more efficient and effective collaborative action from multiple UN agencies, and other supporting actors, each with possibly differing goals and/or objectives, but with an understanding of the systemic nature of the entire SDG framework, thus allowing for integrative strategies to be developed and implemented. This can lead to less redundancy and overlap between actors and more effective use of limited resources available to each.

Table 2 shows the results in descending order of direct connections, with the target leverage point described along with the number of SDG 6 targets that each is a leverage point for; the position that each has with respect to Meadows' leverage point framework; and the listing of the specific SDG 6 targets that it drives. The results show that SDG target 6.a is the most connected of the other SDG 6 targets, having direct connections to the other 7 targets. Furthermore, three SDG 17 targets 17.7,17.8, 17.17 are also quite significant drivers, with 7 direct connections also to the SDG 6 targets. Additionally, we can see that targets 11.a, 6.b, 11.3, 16.6, 17.16 are also quite significant leverage points when considering the overall achievement of SDG 6.

Table 2: SDG Target Leverage Points High Impact Ranking on SDG 6 Targets

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
17.8 - Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries and enhance the use of enabling technology…	8	4	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.a, 6.b	10
6.a - Expand international cooperation and capacity-building support in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.	7	4	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.b	9
16.3 - Promote the rule of law at the national and international levels and ensure equal access to justice for all.	7	5	6.1, 6.2, 6.3, 6.4, 6.6, 6.a, 6.b	8.6
17.7 - Development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.	7	4	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.a	9
17.17 - Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships	7	6	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.b	8.33
6.b - Support and strengthen the participation of local communities in improving water and sanitation management.	6	5	6.1, 6.2, 6.3, 6.4, 6.5, 6.6	7.6
11.a - Positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning.	6	6	6.1, 6.2, 6.3, 6.4, 6.5, 6.6	7.33

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
9.a - Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support.	5	4	6.1, 6.2, 6.3, 6.4, 6.b	7
11.3 - Inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management.	5	4	6.1, 6.2, 6.3, 6.4, 6.b	7
16.6 - Develop effective, accountable and transparent institutions at all levels.	5	6	6.3, 6.5, 6.6, 6.a,6.b	6.33
4.7 - All learners acquire the knowledge and skills needed to promote Sustainable Development thru ESD and sustainable lifestyles.	4	2	6.3, 6.4, 6.5, 6.6	8
5.5 - Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.	4	5	6.1, 6.2, 6.a, 6.b	5.6
8.2 - Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sector.	4	4	6.1, 6.2, 6.3, 6.4	6
16.7 - Ensure responsive, inclusive, participatory and representative decision-making at all levels.	4	4	6.1, 6.5, 6.6, 6.b	6
17.14 - Enhance policy coherence for sustainable development	4	4	6.3, 6.4, 6.5, 6.6	6
2.4 - Sustainable food production systems and resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change.	3	4	6.3, 6.4, 6.6	5

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
5.a - Women have equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources.	3	4	6.1, 6.2, 6.b	5
6.5 - Integrated water resources management implemented at all levels, including through transboundary cooperation.	3	4	6.3, 6.4, 6.6	5
8.4 - Improve global resource efficiency in consumption and production and work to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production.	3	7	6.3, 6.4, 6.6	4.14
10.3 - Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard.	3	5	6.1, 6.2, 6.b	4.6
12.2 - Sustainable management and efficient use of natural resources.	3	8	6.1, 6.3, 6.6	4
12.4 - Environmentally sound management of chemicals and all wastes throughout their life cycle.	3	8	6.1, 6.3, 6.6	4
13.2 - Integrate climate change measures into national policies, strategies and planning.	3	4	6.4, 6.5, 6.6	5
13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	3	6	6.3, 6.5, 6.6	4.33
15.9 - Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.	3	2	6.3, 6.5, 6.6	7

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
16.b - Enforced non-discriminatory laws and policies for sustainable development.	3	5	6.1, 6.2, 6.b	4.6
1.3 - Social protection systems and measures.	2	4	6.1, 6.2	4
6.3 - Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.	2	7	6.1, 6.6	3.14
6.4 - Increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.	2	7	6.1, 6.3	3.14
7.1 - Universal access to affordable, reliable and modern energy services.	2	4	6.1, 6.6	4
9.3 - Increased access of small-scale industrial and other enterprises to financial services, including affordable credit, and their integration into value chains and markets.	2	4	6.3, 6.4	4
9.4 - Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.	2	4	6.3, 6.4	4
9.c - Access to information and communications technology and provide universal and affordable access to the Internet in least developed countries.	2	6	6.3, 6.b	3.33
11.6 - Reduce the adverse environmental impact of cities (e.g. air quality and municipal and other waste management).	2	7	6.3, 6.6	3.14
12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action.	2	4	6.3, 6.4	4

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
12.5 - Reduce waste generation through prevention, reduction, recycling and reuse.	2	7	6.3, 6.6	3.14
15.1- Conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands.	2	8	6.1, 6.6,	3
15.2 - Sustainable management of all types of forests, halt deforestation, restore degraded forests.	2	8	6.1, 6.6	3
16.10 - Public access to information and protection of fundamental freedoms, in accordance with national legislation and international agreements.	2	6	6.6, 6.b	3.33
1.4 - Equal rights to economic resources and access to basic services, ownership and control over land and other forms of property, inheritance, natural resources.	1	5	6.1	1.6
5.c - Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels.	1	4	6.b	3
6.6 – Fully protected/restored water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.	1	8	6.1	2
9.5 - Enhanced scientific research, upgraded technological capabilities of industrial sectors in all countries, in particular developing countries.	1	4	6.4	3
9.b - Domestic technology development, research and innovation in developing countries, by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.	1	4	6.1	3
11.1 - Access for all to adequate, safe and affordable housing and basic services and upgrade of slums.	1	4	6.2	3

	# of SDG 6 Targets that the target leverage point links to (A)	Meadows' Leverage Point Framework Level (B)	High Impact driver leverage target for SDG 6 targets	C=(A+8)/B
13.b - Mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.	1	4	6.2	3
15.4 - Ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.	1	8	6.6	2
15.6 - Fair and equitable sharing of the benefits arising from the utilization of genetic resources and ensure appropriate access to such resources, as internationally agreed.	1	5	6.6	2.6
16.8 - Broaden and strengthen the participation of developing countries in the institutions of global governance.	1	4	6.a	3
17.4 - Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress.	1	4	6.6	3
17.6 - Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the UN level, and through a global technology facilitation mechanism.	1	6	6.a	2.33

It must be noted that the scope of the analysis could be widened to compare how many targets are influencing each other respectively versus how many targets are directly influencing (driving) each other. The ratio between targets with a high level of driving interconnectedness and targets influencing it (driving it), would possibly identify the highest leverage potential for long-term sustainable change.

7. Recommendations for integrated high-impact interventions

The systems-based analysis and assessment of the "high impact leverage points" for intervention as described in the previous chapters provide a framework for achieving SDG 6 and its 8 targets on water and sanitation. In addition, the systems-based analysis re-emphasizes that an effort to achieve success in any SDG will require an interdisciplinary systemic approach that connects interventions across multiple SDGs and targets. Implementation of water and sanitation-related SDGs is an expeditious and cost effective way to achieve sustainable development. Prosperous countries will be those with planned and sustainable access to sufficient water allocations for food, rural and urban development, industries and natural eco-systems, as well as provisions of sanitation and well managed and re-utilized waste water. Success will also require both top-down and bottom up approaches that are based on individual country needs, priorities, capacity and other context linked to the global scale means of implementation and partnerships (SDG 17). National and sub-regional circumstances and situations should be taken into consideration when discussing sustainable water for all issues.

Interventions will of course be at the country level and context as described, however the leverage points identified in this analytical framework can provide a macro perspective for possible roadmap for a more holistic and strategic approach to supporting country level action from UN ESCAP.

Recommendations for what ESCAP and other UN agencies could consider as interventions and activities to support member states in advancing on the SDG 6 targets that have the potential to drive change are provided below with a focus on the means of implementation (MOIs) including human, institutional and financial resource constraints, which are crucial for attaining any significant and long-lasting level of achievement. This corresponds to the findings of the assessment presented in this study that highlights five targets from SDG 17 (Means of Implementation and Global Partnerships) (targets 17.7, 17.8, 17.14, 17.16, 17.17) as high impact leverage points for achieving SDG 6 targets.

Other Recommendations and corresponding leverage points include:

1. **Law and Governance:** Law, at both the domestic and international level, and good governance can create the foundation for cooperation at all levels, as both aspects form a foundation for future policy actions. ESCAP can take a strong role to work with countries to create legal and governance frameworks. ESCAP can also facilitate high level meetings involving governments and stakeholders of transboundary river basins. Some high impact leverage points identified in this area include: SDG 5.5, SDG 5.a, SDG 5.c, SDG 6.b, SDG 10.3, SDG 16.3, SDG 16.6, SDG 16.7, SDG 16.b, and SDG 17.14.

2. **Data Gathering and Sharing:** Frameworks of law and governance ought to incorporate data gathering, sharing and monitoring as legal provisions and best practices. Such data sharing can act as a source of further cooperation in regional river basins, providing neutral activities stakeholders can cooperate on which can promote the building of trust and further cooperation. ESCAP can play a facilitating role by promoting and supporting data collection and sharing as methods of best practice. Some high impact leverage points identified in this area include: SDG 4.7, SDG 9.c, SDG 12.1, SDG 12.4, SDG 13.3, SDG 16.10, SDG 17.8, SDG 17.16 and SDG 17.17.

3. **Strong Links to the Environment and Pollution:** The concept of sustainable water for all is multi-faceted and includes a strong link to and concern for the environment. However, various conceptual tools, including the Water-Food-Energy Nexus and policies do not incorporate sufficiently environmental concerns. Thus, it is desirable that stronger environmental linkages, through a holistic perspective, are elevated in future policy discussions and formulation so as to better reflect environmental systems concerns and limits. ESCAP can promote further research in the region to understand the impact of various persistent and emerging pollutants, including plastic/micro-plastics, pesticides, herbicides and other toxic substances entering natural water eco-systems, and impacting on human health and wellbeing. Climate change and sustainable water for all should be considered in synergy, and also examine the health of ecosystems and impact on human health. It important that water needs are developed (produced) not just managed. It's not just about conservation of water – we need to develop water (natural ecosystems). Some high impact leverage points identified in this area include: SDG 2.4, SDG 4.7, SDG 6.5, SDG 11.a, SDG 11.6, SDG 12.1, SDG 12.4, SDG 13.2, SDG 13.3, SDG 15.1, and SDG 15.9.

4. **Human and Institutional Capacity Building**: Increasing knowledge and capacity on water related issues is required to support effective policy-making. Knowledge gaps need to be identified and filled, and then ESCAP and other UN agencies must continue to build the capacity of developing countries in integrated water resources management and in addressing water security challenges. ESCAP can provide training for water professionals and capacity building for policy makers, by partnering with regional institutions. Some high impact leverage points identified in this area include: SDG 4.7, SDG 6.a, SDG 6.b, SDG 11.3, SDG 13.3, and SDG 17.8, though capacity building needs to take place at all targets.

5. **Mobilisation of Financial Resources:** Ultimately, if multidimensionality of water is accepted and enabling environments are established to support financing and implementation of SDG 6 solutions, it will be possible to close the gap between promise and practice in the management of global water resources. (Schuster-Wallace and Sandford, 2015). Water efficient technologies and the financial opportunities for investing in these technologies need to be identified and explored at different levels (i.e. through public–private partnerships and public–public partnerships).

ESCAP can assist countries and organizations in overcoming the financial gaps in order to implement the necessary activities through a promotion and facilitation of public-public and public-private partnerships. Identified high impact leverage point targets in this area include SDG 6.a, SDG 9.3, SDG 17.5, SDG 17.7, SDG 17.16, and SDG 17.17 among others.

6. **Transboundary cooperation** will be essential in delivering on water mandates: Transboundary river issues related to conflicting uses of shared river basin water resources are most effectively dealt with through regional cooperation and dialogue, which can lead to regional agreements and transboundary river conventions. ESCAP has an important role to play to support effective integrated water resource and river basin management, which requires increasingly shared knowledge of river basins and resilience, as well as technologies for monitoring and early warning systems. The high impact leverage point targets identified include SDG 6.5, SDG 16.8, SDG 17.16.

8. Conclusion

In conclusion, all 17 of the SDGs are interconnected in one whole, indivisible and holistic system, and attaining many of the agreed targets will rely on access to water resources and will depend on provision of sanitation. On the other hand, success in implementation of the water and sanitation targets of the SDG 6 will depend on understanding the interdependencies of SDG 6 with the other SDGs. Understanding the complementarities that exist between the various targets, especially the ones that have high leverage points potential, while using integrated management and system based analytical approach, such as constructing stock and flow diagrams and modelling, would benefit and assist countries in the region in their work to strategically plan the SDGs' implementation, to identify leverage points for focused action and to attract investments. Undertaking such systems approach will also facilitate developing more cohesive monitoring, follow up and review mechanisms, including coordination between existing frameworks, maximising available resources for implementation, and ensuring that certain goals are not achieved to the detriment of others. On a practical level, improved communication and interagency collaboration institutional frameworks will be needed in order to integrate implementation of SDGs' targets. To this end, water professionals, researchers, and practitioners need to harmonise key definitions so that each sector speaks the same language when it comes to implementing water related targets and priorities (Schuster-Wallace and Sandford, 2015).

KUMU Online SDG 6 Target intra and inter-Linkages Analysis Causal System Diagrams

The online visual and narrative Kumu presentation of the complete **SDG 6 Target intra and inter-Linkages system analysis visually showing the full spectrum of systemic causal direct linkages, leverage points and recommendations for action by ESCAP** is provided on the Kumu website at: https://nonglala.kumu.io/sdg-6-targets-systems-analysis

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Annex I: Full Matrix of Analysis of Direct and Indirect Linkages Between the SDG 6 Targets and the Targets of the Other SDGs

See attached document

Annex II: Box on Water Security / Sustainable Water

Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability. (UNESCO-IHP, 2012a)

The discourse on water security in recent years contains a number of common, key elements that define water security or lack thereof. Some of these include:

- Access to safe and sufficient drinking water at an affordable cost in order to meet basic needs, which includes sanitation and hygiene (cf. United Nations General Assembly, 2010), and the safeguarding of health and well-being;
- Protection of livelihoods, human rights, and cultural and recreational values;
- Preservation and protection of ecosystems in water allocation and management systems in order to maintain their ability to deliver and sustain the functioning of essential ecosystem services;
- Water supplies for socio-economic development and activities (such as energy, transport, industry, agriculture, tourism);
- Collection and treatment of used water to protect human life and the environment from pollution and excess extraction;
- Collaborative approaches to transboundary water resources management within and between countries to promote freshwater sustainability and cooperation;
- The ability to cope with uncertainties and risks of water-related hazards, such as floods, droughts and pollution, among others; and,
- Good governance and accountability, and the due consideration of the interests of all stakeholders through: appropriate and effective legal regimes; transparent, participatory and accountable institutions; properly planned, operated and maintained infrastructure; and capacity development.

Source: UN-Water, 2011. Water Security – A Working Definition. 4th Draft (Internal Document).

Annex III: BOX 2: Water Security in Five Dimensions

AWDO measures water security in five key dimensions because a single focus on any one of these is insufficient to guide decisions or assess outcomes in the water sector. The AWDO vision of water security is designed to represent the multiple dimensions of water in People's lives and livelihoods, with poverty reduction and governance as crosscutting perspectives in each of the five dimensions.

- Household Water Security
- Economic Water Security
- Urban Water Security
- Environmental Water Security
- Resilience to Water-Related Disasters

Findings

Water governance plays a central role in boosting water security in each of the five key dimensions, and also in managing the trade-offs between the dimensions. It is an intersectoral process that requires leaders to break through silos, to span boundaries, and to create a positive nexus among water, food, and energy security. This process is known as integrated water resources management (IWRM), and most countries in the region have already adopted policies and legislation to support its implementation.

There are, however, no one-size-fits-all solutions across the region. Rather, the appropriate solutions in each country will reflect the country's resource endowment, economic development, culture, and chosen development path. As the national water security assessments in AWDO 2013 demonstrate, there is an urgent need to strengthen the capacity for integrated planning and management nationally as well as in river basins and cities.

Ref: ADB, 2013. Asian Water Development Outlook 2013. Accessed in July 2016 at: http://www.adb.org/publications/asian-water-development-outlook-2013

Annex IV: Glossary

Causal Loop Diagram	Is the way to visualize relationships of important variables in the system, where a change in one causes either decrease or increase in another. Source: K.North, An Introduction to Systems Thinking: http://courses.umass.edu/plnt597s/KarlsArticle.pdf)
Integrated Basin River Management (IRBM)	is an approach to water resources management that takes into account all factors linked to land and water resources, including social and economic activities. Its broad scope not only covers water resources, but also environmental management aspects such as pollution control, development planning and biodiversity conservation. Source: Keizrul Abdulla, B. Christensen, Integrated River Basin Management, link: http://www.bem.org.my/publication/juneaug04/CF(IRBM)(21-23).pdf
Integrated Urban Water Management (IUWM)	provides a framework for planning, designing, and managing urban water systems. It is a flexible process that responds to change and enables stakeholders to predict the impacts of interventions. Source: Global water Partnership, Integrated Urban Water Management (IUWM): Towards Diversification and Sustainability
Integrated Water Resources Management (IWRM)	is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems Source: Global Water Partnership
Leverage points	are places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything Source: D.Meadows, Places to Intervene in a System, link: https://center.sustainability.duke.edu/sites/default/files/documents/system_intervention.pdf
Mental models	are psychological representations of real, hypothetical, or imaginary situations Source: Mental Models&Reasoning, What are mental models?, link: http://mentalmodels.princeton.edu/about/what-are-mental-models/
Systems Thinking	is a way of approaching complex problems as one whole system and by means of applying systems dynamics to understand the connections between the components of the system - be these environmental, social, and economic or policy related, and what behaviour of interest these connections generate.