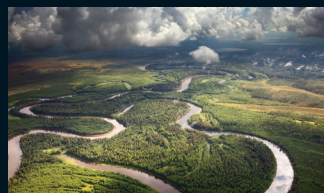
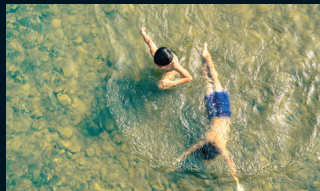




International
Resource
Panel



Options for decoupling economic growth from water use and water pollution



Summary for
Policy Makers

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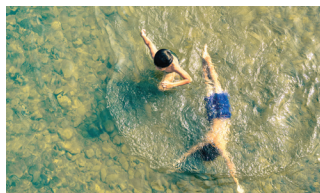
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Summary for policy-makers



Options for decoupling economic growth from water use and water pollution

Produced by the **International Resource Panel**.

This document highlights key findings from the report and should be read in conjunction with the full report. References to research and reviews on which this report is based are listed in the full report.

The full report can be downloaded from **www.unep.org/resourcepanel**. Additional copies can be ordered via email: resourcepanel@unep.org, or via post:

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Preface

Growing demand for water from households, industry, agriculture, and to maintain the health of our environmental services poses rapidly growing challenges for the rational management of this resource. Uncertainty regarding the future availability of water and universal access to it is increasing on all continents. Water availability, scarcity and management are among the top global risks, according to the 2015 World Economic Forum Global Risk Report. By 2030, the world could face a 40% shortfall in water supply if no changes are made in how water is managed. The total demand for agricultural products in 2030 is expected to grow by around 60% to meet the demands arising from growing populations and higher incomes.

Water resource management problems are multi-faceted, and cover a wide variety of economic, political and social issues. Some of these challenges can be addressed through sustainable, equitable and efficient governance, which optimizes water use between different sectors and ecosystems and balances current and future needs. This calls for governments, businesses, consumers and other sectors to step up and play an active role in improving management of water resources. In this context,

the Sustainable Water Management Working Group of the International Resource Panel (IRP) seeks to offer an original and sustainable approach to water management.

This document is the second IRP report on sustainable water management. The first report in the series provided a detailed account of how a decoupling policy can be measured. It introduced and discussed the analytical methods needed to ensure that water use can be properly quantified over the life cycle, and integrated into other measures within the green economy.

This second report draws on the conceptual frameworks developed by IRP research and the existing literature, to provide a conceptual and analytical basis and compelling case for decoupling policy and decision-making in water resource management.

The report explores innovative technological and policy instruments and opportunities to accelerate decoupling and achieve the environmental and economic benefits of increased water-use efficiency and productivity for both developing and developed countries. The possibilities and limitations of these tools and approaches are presented for agricultural,

municipal and industrial sectors followed by larger scale water system level approaches, for example the river basin.

More broadly, it examines the interlinkages between consumption and production, and analyzes, among other issues, the ways in which global trade affects the geographical distribution of water use and water pollution. Resource and impact decoupling in the water sector is particularly important in areas

where water resources are under pressure and pose threats to human and ecosystem health.

Decoupling human well-being from water use and impacts is at the heart of the recently -approved Sustainable Development Goal (SDG) for Water. The contributions of this report are particularly relevant for the implementation of the Water Goal and those Goals related to sustainable consumption and production, and resource efficiency.

Co-Chairs, International Resource Panel (IRP)



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Foreword

Water is essential for healthy human societies and natural environments to thrive and prosper. Yet as the population approaches nine billion, nearly half of those people could suffer water stress by 2030 as a result of accelerating urbanization, new consumption habits and climate change. This report provides options for a viable and sustainable alternative; one that swaps economic growth fuelled by escalating water use and environmental degradation for a more durable model of social, economic and environmental resilience.

If the world continues on its current course, by 2030, annual demand for water in North America and Sub-Saharan Africa could increase by 42 and 283 per cent respectively, compared to 2005 levels. That is why the ambitious 2030 Agenda for Sustainable Development seeks to decouple economic growth from water consumption and pollution by integrating water related issues across each of the 17 goals and making a specific commitment that *“ensures availability and sustainable management of water and sanitation for all.”*

Therefore, this new report outlines the challenges to delivering these goals, while drawing on the many existing success stories to

highlight some of the available solutions and provide a scientific assessment of technological and policy tools. Covering agricultural, municipal and industrial uses as well as water systems, these solutions have already proven to be practical and effective, with huge potential for scaling up. The report will help public and private sector decision makers to better understand the strengths and limitations of various approaches, which alone or in combination, could help break the link between escalating water use, economic growth and environmental degradation.

I would like to thank all of the experts at the UNEP-hosted International Resource Panel for the effort and cooperation behind this work. While I cannot mention everyone by name, I would like to say a particular thanks to Kevin Chika Urama, former Executive Director of the African Technology Policy Studies Network, Peter Koefoed Bjørnsen, Director of UNEP-DHI and Kalanithy Vairavamoorthy, Professor at the University of South Florida School of Global Sustainability for their commitment and leadership in this endeavor.



Achim Steiner
UN Under-Secretary General
and Executive Director,
UNEP Nairobi, Kenya, March 2016



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Executive Summary

Global trends have pointed to a relative decoupling of water – that is, the rate of water resource use is increasing at a rate slower than that of economic growth. Despite this progress at the global level, it is projected that by 2030 there will be a 40% gap between water supply and water demand if current trends in water development and management continue (Water Resources Group, 2009). Increases in water withdrawal and consumption are driven by anthropogenic factors, including population and economic growth; changing consumption patterns due to increases in standards of living globally; macroeconomic processes such as trade globalization; and food and energy security policies.

In September 2015, United Nations member countries adopted the *Transforming our World: the 2030 Agenda for Sustainable Development* (2030 Agenda), committing to eradicate poverty; conserve and protect terrestrial, marine and climate systems; and build peaceful and prosperous societies for all by 2030. At the heart of the 2030 Agenda, a group of seventeen Sustainable Development Goals (SDGs), which when taken together, put forward a holistic approach to achieving global sustainability ambitions. SDG 6: *Ensure access to clean water and sanitation for all*, recognizes the centrality of water to human welfare, equitable growth and development. In addition to targeting achievement of universal and equitable access to safe and affordable drinking water, sanitation and hygiene, the goal strives to improve water quality by reducing pollution, increasing water-use efficiency across all sectors, implementing integrated water resources management systems, and protecting and restoring water-related ecosystems.

The ‘*Options for decoupling economic growth from water use and water pollution*’ report of the Water Working Group of the International Resource Panel puts forward the case for water decoupling given the challenges associated with changing demands

and availability of water, the role of water in economic development, and the essential nature of water for human welfare. Drawing on lessons learnt from successful decoupling practices across the planet, a collection of technical and policy tools are proposed to achieve decoupling, including consideration of equity issues, to help the forward looking policy-maker in addressing water-related challenges, and achieving SDG 6.

Decoupling is imperative to meet global water demand to sustain economic growth and human well-being

Human societies depend on water in many complex and interlinked ways. Water is a prerequisite for human health and well-being. It is an essential component for the preservation of the environment and ecosystem services, upon which human societies rely. In addition to enabling achievement of basic human needs including sanitation services, water as a resource is critical to sustainable development for its role as a major source of energy, a key input to agriculture and industrial processes, and in some countries, as an integral part of transport systems (UNESCO, 2015).¹

¹ <http://www.un.org/waterforlifedecade/>



Currently, estimates project that up to one third of the global population is already subject to water stress, and if current management, withdrawal and use trends continue, this could increase to roughly half the global population by 2025 (UN-Water, 2009; Commission on Climate Change and Development, 2009). Often, large

amounts of disposable income are invested towards ensuring access to water, directly impacting the ability of persons to engage in other activities that are essential to escape poverty. Water-related disasters are the most recurrent and pose the greatest threat to human security and sustainable economic development, and their frequency and severity is being

exacerbated by climate variability, inappropriate management policies, population growth, and inadequate and expanding human settlements.

Furthermore, water-related agents make up 4% of the global disease burden (Ezzati and Lopez, 2003), and water-borne diarrhoea is the third most common cause of child mortality in West-Africa. While agricultural activities contribute the largest quantity of pollutants to water bodies, a whopping 70% of industrial waste is dumped untreated into waters (UN-Water, 2009). The labour productivity in these sectors are also economically impacted by polluted waters: inadequate sanitation measures are estimated to cost up to US \$6.3 trillion in Indonesia, US \$4.1 billion in the Philippines, and US \$780 million in Viet Nam (World Bank, 2008; Tropp, 2009). Globally, water pollution and the increasing number of water withdrawals have constrained the potential of water bodies to properly function as sinks and sources, and impeded the proper functioning of ecosystem services upon which many depend for their livelihoods. Further, climate change is already impacting the hydrological cycle, and these impacts are slated to lead to intensified changes in water supply and demand.

Water withdrawals and pollution are a direct result of human activities in economic

sectors – especially across key sectors of agriculture, industry and energy, and municipal uses. The food-energy-water nexus is particularly salient as agriculture currently accounts for roughly 70% of all freshwater withdrawals globally (90% of which occurs in least developed countries) and energy a further 15%, expected to increase by 20% through 2035. With irrigated agriculture accounting for 40% of the world's food, especially in developing nations, the projected 40% increase in the demand for food production by 2050 (FAO, 2009) highlights the importance of resource decoupling, especially in areas where non-renewable groundwater resources are the primary source of irrigation. In developed countries, where industry often uses up to 59% of extracted freshwater, improving efficiencies of industrial water use will be essential to meet the production and consumption demands of a growing population. Municipal water use – that is, water used in households and commercial settings such as offices and restaurants - accounts for approximately 12% of total water withdrawals worldwide. Impacts of the depletion of non-renewable water resources and changes to water ecosystems on human welfare and health, and on economic systems highlight the imperative of relative and impact decoupling of water from economic activities.



Decoupling is already happening

Overall, global trends point to a relative decoupling of water from economic development. Between 1900 and 2000, the global economy expanded thirty-fold, while global water consumption grew by only six fold (IHP-UNESCO, 1999; Bradford de Long,

1998). Most significantly, in the developed world, the ratio of domestic water use to GDP has been declining. In Australia, total water consumption declined by about 40% between 2001–2009 while GDP grew by over 30% in that same period (Smith, 2011d). In Israel, since 1999 a decoupling between the total water supplied and water derived

from surface and groundwater sources achieved by largely cross-sector efficiency and the recycling of urban effluent, has led to a cut in natural water use of over 20% (Gilmont, 2014).²

In the developing world, progress on relative decoupling can be seen. In China, market based and regulatory policies have meant that the rate of water consumption levelled out in the 1980s while GDP growth continued to increase (Gleick, 2003). In Singapore, measures to reduce demand for water and improve water efficiencies, cut waste and expand alternative sources of freshwater have led to a five-fold increase in water usage (or a two-fold per capita increase) despite economic growth rates in excess of 10 per cent over the last 40 years (UNEP, 2014).³ These and many other examples from across the globe demonstrate the viability of a relative decoupling of water use from economic growth.

Analysis of these and other successful water management strategies reveals that

achieving sustainable decoupling in the water sector will require a holistic and cross-sectoral approach. Key success factors include putting in place innovative structural transformations of economic pathways; integrated water management policy and practices at local, national, river basin, and global scales; and substantive investments in improved technologies and innovations for improving water efficiency and productivity at the appropriate temporal and spatial scales (World Water Council *et al.*, 2012). Based on the lessons learnt and global best practice, policy makers can draw on a suite of technological (see Box 1) and policy innovations for decoupling water from economic growth across the three key sectors of water withdrawal and consumption: agriculture, industry and energy, and municipal use.

Despite the inherent constraints on the economic management of water – including its public goods and natural monopoly properties, typically externalised costs, and high transaction costs – policy innovation,

² Gilmont, Michael (2014) Decoupling dependence on natural water: reflexivity in the regulation and allocation of water in Israel.

³ UNEP (2014) Decoupling 2: technologies, opportunities and policy options. A Report of the Working Group on Decoupling to the International Resource Panel. von Weizsäcker, E.U., de Lardereel, J, Hargroves, K., Hudson, C., Smith, M., Rodrigues, M.



including those using economic instruments, can be leveraged to encourage decoupling. Successful implementation of economic approaches to water management include the case of Australia, which leveraged water markets to increase agricultural water productivity; and China, which has reduced per capita water use through a

combination of regulatory and economic approaches.

Markets alone, however, are unable to provide for public goods – such as environmental flows. Therefore, policy and regulatory intervention is an important aspect of achieving water decoupling. To



counteract the problem of economic allocation resulting from the high transaction costs and the dispersed nature of water, economic instruments such as taxes, subsidies and fees can be used. In the agricultural sector, this can take the form of volumetric water pricing, and water markets trading; for the municipal sector,

strategies include appropriate water pricing and public awareness campaigns; for the industrial sector, appropriate water pricing and corporate water accounting are the policy solutions to reduce rates of water abstraction described in the report.

Box 1: Technological innovation and decoupling

The *Options for decoupling economic growth from water use and water pollution* puts forward a suite of technological innovations at the sector and system-level based drawing from global best-practices in water decoupling. These includes:

In the **agricultural sector**, technologies to improve the management and use of rainwater, increase the efficiency of irrigation delivery systems including strategies for deficit irrigation and irrigation scheduling, and improve drainage infrastructure. Additionally, the use of hydroponics and crop selection strategies; as well as strategies for recycling and reusing wastewater, are put forward in the report.

For the **municipal sector**, strategies for a reduction in abstraction for urban water use and improvement in the collection and treatment of urban wastewater include diminishing leakage from domestic water supply systems; improvements to household water use

efficiency; and the improved collection, treatment and reuse of urban wastewater. Further, water efficiencies can be achieved through the use of strategies for disaggregated urban water supply infrastructure and integrated urban water supply systems.

Strategies for reducing water use in the **industrial sector**, especially in the sectors of minerals and mining, pulp and paper, textiles, and chemicals industries – where huge potential for savings exist – target water use in the areas of heating and cooling; rinsing and cleaning of products; and the transport of goods.

While sector-based interventions to increase water use and consumption efficiencies are essential to achieving decoupling, also crucial are **system-level technological approaches** to reduce water abstraction at scales consistent with the hydrological cycle – including natural water purification and multiple-use systems with cascading reuse of water.

While a sectoral approach to policy innovation is effective, in the long run, Integrated Water Resources Management (IWRM) strategies have been shown to be the most cost effective means of achieving water decoupling. IWRM incorporates all parts of the water cycle across spatial scales and time, and views the different water sectors and users as components of an integrated physical and institutional system to promote the implementation of innovative approaches to improve water efficiency and water productivity. IWRM systems-level strategies to support efficient water management can include strategies for the conjunctive management of surface water and groundwater, water efficiency trading schemes and investment offsets – including at the basin-scale, using a life-cycle assessment approach, virtual water trading, and a water neutrality approach to economic development.

No single policy or set of practices will achieve resource or impact decoupling at the global, national and regional scales simultaneously. Inherent complexities, uncertainties and ignorance still limit current understanding of hydrological cycles and the complex relationships of water with other sectors. An integrated and adaptive systems approach to sustainable water resource management policy needs to incorporate

the relevant hydrological scales (typically a river basin), geomorphology of aquifers, the social anthropology of users, the socio-economics of uses, and the associated uncertainties and surprises in each context. IWRM therefore requires substantial investments in human capacities to adapt to unpredictable hydrological events and in designing water delivery systems that are resilient in the face of change.

Global action for decoupling must be strengthened to avoid a water resource crisis

Many countries that have embarked on measures to improve efficiency in water supply and demand have also seen a decoupling with the rates of economic growth. However, increased rates of growth in human populations, economic activities, water pollution and inefficiencies in the water supply systems have obscured the marginal efficiency gains in water uses per GDP growth at the global scale. A range of water related ecosystem services are already impaired in many river basins due to growing water scarcity, climate change and pollution. If urgent measures are not taken to improve water efficiency, global demand for water will outstrip currently



accessible supplies by 40 per cent by 2030 (2030 Water Resources Group, 2009).

Access to water is becoming a limiting factor to development in many regions, due to water scarcity, a changing climate, unsustainable use and projected changes in demand (Biggs and Watmough, 2012; Kundewicz et al., 2007;

Nicol and Kaur, 2009; Oates et al., 2011; Refsgaard et al., 2012; Shaw et al., 2011; Sowers and Weinthal, 2011). Increased agricultural demand will be most intense in India and sub-Saharan Africa, while China will account for the greatest growth in industrial use. On the supply side, readily available sources of fresh water are already under significant

stress: many freshwater lakes are shrinking; some rivers are drying up and often fail to reach the ocean; and ground water resources are already overused in many regions. Increasing rates of pollution loads are already limiting available water resources for economic activities, with over 405 dead zones recorded in coastal waters, globally. Water quality challenges are exacerbating physical water scarcity and water stress in many river basins. The number of people vulnerable to flood disasters worldwide may reach two billion by 2050 as a result of climate change, deforestation, rising sea levels, population growth and human settlements in flood-prone lands.

Many countries have a mixed track record in managing their water resources, often under-investing in water resource systems and their integrated management, and prioritising increases in supply through infrastructure investments over targeted governance reform for improved allocation and productivity. There is evidence that global subsidies to domestic use may be as much US \$1 trillion per year, and these subsidies may encourage inefficient water use through artificially low prices. Many water supply infrastructures are dysfunctional with high levels of leakage and non-revenue water (NRW). More than 5% (reaching 80% in extreme cases) of the drinking water supply is lost from

municipal distribution systems before it reaches the consumer. Over US \$18 billion worth of water is considered as non-revenue water per year worldwide. This is especially the case if 'virtual water' – the amount of water required to produce a product, and closely related to the concept of a water footprint - is taken into consideration. As such, there is huge potential for efficiency and productivity gains.

Enabling Policies and Strategies for Decoupling the Water Sector

Heading off looming water resource constraints over the next twenty years requires a package of responses based on decoupling – including measures to improve technical and allocative efficiency. Improving technical efficiency means enabling production of greater output from the same amount of water resource inputs and pollution, or producing the same output with less water resource inputs and pollution, without increasing the amount of other inputs. Allocative efficiency, on the other hand, aims to generate a larger total welfare from the available water resources. Improving technical and allocative efficiency and resource productivity in key water use sectors could offset up to 60% of the anticipated growth in demand for water by 2030.



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The ‘*Options for decoupling economic growth from water use and water pollution*’ report proposes six strategies to enable taking full advantage of the potential benefits of decoupling economic growth from water uses and water pollution.

- *Invest more in research and development concerning improved and additional technological tools for water-use efficiency gains.* Technical water efficiency can help reduce wasteful use of the limited water resources, up to a point where the marginal cost of efficiency gains exceeds the marginal value of water.
- *Consider and apply policy measures to curb water demand and re-allocate water between sectors and users* according to where water produces goods and services most beneficial to society, i.e. where it contributes to most economic output per drop. Water pricing and market instruments could be used to achieve this. However, water is a basic human need and such measures need to be balanced against measures to protect vulnerable groups, particularly the poor.
- *Consider ways to internalize current externalities*, i.e. removing disincentives to using water more efficiently. For example, if fines for polluting water resources are too low, it may discourage efforts towards water resources protection and hence decoupling. In other words, if ecosystem services are not factored into the equation water may not be used in society’s overall best interest.
- *Strengthen research into the value of ecosystem services* in order to better integrate those value elements into the economic growth equation. If we neglect or miscalculate the value of ecosystem services, we risk making sub-optimal use of scarce water resources.
- *Do more to document the efficiency and effectiveness of different measures.* The lessons learned on what does and does not work – and under which circumstances – need to be shared widely in order to inspire and encourage stakeholders and decision-makers.
- *Do more to assess and communicate virtual water contents, water footprints and related impacts* so that we know better how international trade patterns could be used to support decoupling where it is most needed.



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Conclusion

Decoupling water resource use from economic growth is key to sustainable development. Some countries have already achieved a relative or absolute decoupling of water, and key lessons can be drawn from these successful experiences. Despite the progress on decoupling, growing population and economic growth pressures on non-renewable water resources necessitates stronger action to achieve relative and absolute water decoupling. Significant opportunities exist for increasing water efficiency and productivity both in developing and in developed countries. The '*Options for decoupling economic growth from water use and water pollution*' proposes a list of technological and policy tools at the

sector and system-wide scale that are available for water decoupling. Six key strategies to facilitate water decoupling are proposed, and include: investment in research and development of advanced technologies for water efficiency; developing policy frameworks to curb water demand; removing policy and regulatory disincentives for efficient use of water; strengthen research on the value of ecosystem services and water to human welfare and economic development; document the impact of implemented measures; and finally, assess and communicate the use of water in internationally traded products to facilitate a better understanding of how water flows through an economy.

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This summary report highlights key findings from the report of the International Resource Panel *“Options for Decoupling Economic Growth from Water Use and Water Pollution”*. This second report provides a conceptual and analytical basis and compelling case for decoupling policy and decision-making in water resource management.

Global trends point to a relative decoupling of water – that is, the rate of water resource use is increasing at a rate slower than that of economic growth. However, it is projected that by 2030 there will be a 40% gap between water supply and water demand, and that half the global population will live in water stressed areas by 2025 if current trends persist.

Drawing on the conceptual frameworks developed by the IRP research and the existing literature, the report provides an independent assessment of technological and policy-relevant tools and approaches for implementing the sustainable management of water withdrawal and consumption considering environmental and welfare impacts over the full life cycle. It explores innovative instruments and opportunities to strengthen decoupling and achieve the

environmental, social and economic benefits of increased water-use efficiency and productivity for both developing and developed countries.

The report focuses on decoupling water resource use and impacts from economic growth in the agricultural, municipal and industrial sectors. It also presents integrated and adaptive systems approaches to sustainable water resource management at larger spatial scales. Finally, the report makes the case for building a better knowledge base of water resource management practices to ensure water services are allocated to where they provide the most social benefit and the least environmental impact. Key strategies are proposed to enable the decoupling of economic growth from water uses and water pollution, and to help the forward looking policy-maker in addressing water-related challenges.

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