

ABSTRACT VOLUME

**World Water Week
in Stockholm**

28 August – 2 September, 2016

Water for Sustainable Growth



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**Seminar 1:
Water as a driver for sustainable growth**

Seminar: Water as a driver for sustainable growth

- Many players, one river: a hydro-economic model for the Kafue.....4
- Water-related economic drag: sector-level analysis in Ethiopia.....6
- Food Corridors: Exploring the Food, Water, Energy and Climate Nexus.....8
- Managing water resources to reduce climate loss and damage.....10
- Bulk water transfers: problem or solution.....12
- 'Zero' coming into fashion in the Indian textile industry.....13
- Enhancing water availability for livelihood improvement in Karamoja region, Uganda.....15
- Optimal water allocation for rainfed agriculture and livelihoods in Ethiopia.....17
- Impact of SDG's on Sustainable Development in the MEANA Region.....18

Many players, one river: a hydro-economic model for the Kafue



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Keywords: Hydro-economic model, optimization, sustainable water management, Zambia

Highlights

A multi-objective hydro-economic model illustrates the trade-offs among alternative growth scenarios in the Kafue River Basin, in Zambia. Hydropower, agriculture, urban and rural water supply, industries, and the environment compete for the same water and a forward-looking water management is needed to harness sustainable growth opportunities in Zambia.

Introduction and objectives

The Kafue River is the lifeblood of Zambia: it hosts major urban centres, it delivers water to large dams and one hydropower station, it serves major agricultural and industrial areas, and it ensures the health of a precious wetland ecosystem and of a rich fishery sector.

The present study analyses the availability and allocation of the waters of the Kafue River within the boundaries given by the policy and legislative framework. Through a combined hydrologic and economic model the study finds the optimal allocation of water resources for multiple uses in a catchment for which limited data is available.

Methodology approach

A multi-objective hydro-economic optimization model is proposed here as a tool to analyse the competing demands for water in the context of developing countries. The model addresses the linkages between surface and groundwater supply and the economic use of water at river basin scale and considers economic, social, and environmental objectives. Competing demands for water in the urban, agricultural, industrial, mining, and environmental sectors are addressed and supporting models are used to provide the hydrological inputs and the agricultural water-yield functions.

Analysis and results

Zambia's development objectives are the increase in irrigated agriculture and the expansion of its hydropower capacity.

It will be possible to further develop hydropower resources on the Kafue River only if minimal agricultural expansions are achieved. This is particularly true in a dry hydrological year when the optimal allocation of water resources strongly depends on the policy priorities of the stakeholders.

Population growth across the Kafue Basin alone will put a strain on water resources. If the current population growth rate is upheld for the coming 10 years, keeping all the other parameters constant, basin-wide net benefits will be reduced by about 12 percentage points in a dry year. Reduction of water delivery system losses and increased efficiency in water use will be paramount if Zambia wants to guarantee sufficient access to safe water and sanitation for its population.

The mining sector is also closely connected to the management of the Kafue due to its considerable dewatering operations. Would dewatering cease, overall net benefits will be reduced by 20 percent with respect to the baseline case (today). It will be necessary to manage alternative sources of livelihood in the Copperbelt and ensure adequate supplies of quality water for the growing cities.

Conclusions and recommendation

Due to a changing and not yet fully implemented water governance framework, inter-sectoral competition already exists in the Kafue Basin, particularly in dry hydrological years. Lack of long-term, coordinated management of the Kafue waters might lead to suboptimal future allocations of water resources across sectors and Zambia risks to forfeit promising growth opportunities.

Policy makers must consider the impacts of development scenarios on all water using sectors and should adopt a holistic assessment of the intrinsic trade-offs between users' objectives to understand the impacts of alternative water allocation scenarios on the society, the economy and the environment.

Water-related economic drag: sector-level analysis in Ethiopia



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Keywords: Ethiopia, sector-level analysis, macroeconomic analysis, water-related economic drag, runoff variability

Highlights

- Novel sector-level analysis of the impacts of runoff on economic output
- Correlation between runoff and economic output is significant: water acts as a drag on multiple economic activities in the Awash basin.

Introduction and objectives

The Awash River basin, in central Ethiopia, is highly heterogeneous in terms of rainfall (ranging from 1,600 mm/yr), land use (from major urban areas of Addis Ababa, to pastoralist areas, and irrigated agriculture) and economic outputs. 14 million people and a range of economic activities rely on the highly variable flow. Irrigation accounts for 90% of the total water demand; other uses include mining, manufacturing and domestic. The aim of this study was to assess the risk posed by water insecurity to economic activities within the basin.

Methodology approach

Recent research (Sadoff et al., 2015) shows that hydro-climatic variables have an impact on countries' GDP. Building on this research, we use novel data on economic performance for different sectors to construct a dataset (1996-2006) of productivity for each of the 23 administrative zones in the basin. Gridded runoff from global hydrological models and rainfall reanalysis data are used to characterize hydrological conditions for the same period. A fixed panel regression methodology is used to quantify the relationship between economic productivity and hydro-climatic data both for the overall macroeconomy and for key sectors at the administrative zone level.

Analysis and results

This study demonstrates for the first time how water insecurity causes economic drag in different sectors in a basin. Results from the fixed panel regression show that agricultural output in the basin is correlated with runoff and rainfall availability, which were used as proxies for hydrological conditions and water availability. A similar statistically significant relationship between economic output and runoff/rainfall was identified for key manufacturing sectors. The macroeconomic analysis for the whole basin confirmed the correlation between economic performance and hydrological variables, providing the first quantitative evidence that hydrological conditions and variability act as a drag on sustainable growth in the Awash.

Results from the macroeconomic analysis were used to inform interviews with local actors to understand how this water-related drag materializes in practice for different sectors. Working in dialogue with interested actors and stakeholders, this analysis identified priority areas for water security interventions to decouple economic activities from runoff variability and enable sustainable economic growth in the basin.

Conclusions and recommendation

Hydro-climatic conditions have a statistically significant impact on multiple economic sectors in the Awash basin. This study demonstrates that economic expansion without adequate provision of water services, management of hydrological variability and protection from water-related risks leaves economic activities in

the Awash exposed to the destructive impacts of water. This work is being used as a stepping stone to inform and appraise investments in water security in the basin. The methodology is transferrable to other river basins in Ethiopia to identify water's role in influencing economic growth.

Food Corridors: Exploring the Food, Water, Energy and Climate Nexus



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Keywords: Sustainable growth, agricultural development, food corridors, water-food-energy nexus, logistics chain management

Highlights

- An agricultural development model has been developed for Southeast Asia considering the resource availability and climate change.
- We explored the feasibility of modeling food logistics within the framework of international corridors, while taking into account the spatial and temporal variation of water resources.

Introduction and objectives

Water supplies and food production are becoming increasingly uncertain due to climate change, population growth, changes in dietary pattern and economic growth. While agricultural development has always been one of the main targets of international aid agencies to achieve sustainable growth, they have tended to focus more on infrastructure development and less on resource logistic management. This research is part of a larger study carried out in South East Asia. We explored the feasibility of modeling resource logistics within the framework of international and intra-national corridors while taking into account the regional comparative advantage of spatial and temporal variation of resource availability and climate uncertainty.

Methodology approach

For our application, we have developed a linear, deterministic, multi-modal transport, and transshipment optimization model in General Algebraic Modeling System (GAMS). Considering the constraints imposed by limited water supply, energy requirement, land availability and climate variability, the model is designed to examine the introduction of new crops in the production regions and into international trade. Different climate scenarios and water resource availabilities have been considered in the model. For the study area, we selected part of the Brunei, Indonesia, Malaysia, and the Philippines, East Asian Growth Area (BIMP-EAGA) to examine our approach. BIMP-EAGA has a combined population of 57.5 million and a land area of 1.6 million square kilometers.

Analysis and results

The case involves a hypothetical study of new agricultural development in the Indonesian Islands of Sumba/Sumbawa and in Mindanao in the Philippines. The model considers multiple crops and dairy production that could be produced in each of the two regions and includes potential internationally traded commodities. One unique aspect of our approach is we included temperature and precipitation variation with elevation as a way of adjusting to climate change in the model. The model shows the optimal allocation of cropping patterns and the tonnage of product and its destination. The model shows the number of rural employment under each agricultural scenario. Results also emphasize the economic importance of dairy products in this region. This is very encouraging with respect to producing more nutritious diets that improves the nutritional status of the poor, particularly children in the region.

Conclusions and recommendation

The case represents an alternative approach to accelerate the pace in sustainable growth. Taking an integrated view of the value chain allows estimation of various resource inputs (i.e. water and labor requirements) in agricultural development. Variation of temperature and precipitation with altitude can be

used to adapt to climate change. Strong employment generation arising from the crop diversification would leave ample scope for sustainable growth. The model could be expanded to include more crops, producing and consuming locations, and time intervals. The model structure however would remain simple; the only limitation is the availability of reliable data to use with the model.

Managing water resources to reduce climate loss and damage



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Keywords: Climate change, water management, loss and damage, UNFCCC

Highlights

Mining through the global disaster database reveals that more than three out of every disaster are water-related. Albeit, managing the water resources has never been an agenda in the UNFCCC's climate change negotiations. This paper harnesses the potential of ecosystem-based options to minimise climate loss and damage from water infrastructures

Introduction and objectives

Water resources, as a sector, is primarily exposed to climate change loss and damage. Over the last few decades, the frequency and magnitude of the water-related hazards have been increasing alarmingly. Vulnerability and exposure further amplifies when the existing water management interventions (e.g., flood defense, drainage infrastructure) fails to prove the efficacy as sustainable adaptation option due to possessing long-term residual impact. Therefore, the main objective of this study to explore a range of ecosystem-based options, including the conventional risk reduction tools along with risk transfer and risk pooling instruments to reduce climate change loss and damage from water-related disasters.

Methodology approach

The method has three distinct parts. First, the authors calculated the loss and damage footprint of the hydrological disasters from the EMDAT dataset. Next, the status quo regarding the coverage of water resources management related concerns in the climate change negotiation process till the recently signed 'Paris Agreement' is evaluated. The potential of using the newly evolved work programme on 'loss and damage' as a window for the inclusion of IWRM principles is assessed. Finally, the authors evaluated a range of existing or innovative water management options through the lens of loss and damage for rejuvenating the hydrological environment.

Analysis and results

The frequency of the hydrological disasters is on the rise in the recent years. Moreover, standardised economic estimates account an average of USD 40 billion worth damage per year resulting from water-related disasters. In spite of the sharp decline in the human death toll and suffering, the economic damage estimates has increased by several folds in the recent decade, which might underscore the role of anthropogenic responses amplifying the infrastructural vulnerability. Other than the tangible economic dimensions, a significant intangible dimension includes the changes in the hydrological regime, particularly changes in the magnitude and seasonality characteristics of the flow system. Moreover, ecosystem services, including the agricultural production loss might rise significantly due to more intense low flow situation, early flood incidences and later recession of flood.

Despite such strong evidence base, water resources management has never been acknowledged as an adaptation option in the climate change negotiation since 1992. The recently evolved work programme on loss and damage might act as the platform for including water resources management in the joint political domain for combating negative impacts of climate change. A range of generalised approaches are proposed including the conventional and innovative water management options to minimise climate loss and damage.

Conclusions and recommendation

Ecosystem-based adaptation options triggering minimum residual loss and damage need to be adopted. Otherwise, the infrastructural adaptation options might trigger more loss and damage in future along with the invasion of false sense of security among the particularly vulnerable communities. At the same time, the trade-off between securing agricultural production and ecosystem conservation need to be balanced effectively. An integrated basin-wide approach is long due to protect the health of the Transboundary Rivers in the greater GBM basins region. The cost of inaction and delayed action might cause irreversible loss and damage of ecosystem components and services.

Bulk water transfers: problem or solution



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Keywords: water, scarcity, transfer, bulk

Highlights

Bulk water transfers via pipelines or ship are becoming commonplace. Are these transfers from water-rich areas to water scarce areas a viable solution to water shortages? Or do they postpone inevitable adaptation to changing circumstances while creating problems in the transferring region?

Introduction and objectives

This presentation will describe bulk water transfers that take place in various locations – Malaysia to Singapore, Lesotho to South Africa, and Turkey to Cyprus – and will also discuss commercial proposals for shipping containers of water as well as domestic transfers. When one area relies on another for vital water needs, a power imbalance may arise. Further, the recipient may postpone taking required measures to adapt to less water, while the area providing the water may be disadvantaging future generations. Both parties may be affecting ecosystems and hydrological cycles.

Methodology approach

Desktop research on bulk water transfers.

Analysis and results

In addition to the transnational bulk water transfers in Asia and Africa, there are also examples of domestic bulk water transfers, such as China's South-to-North Water Transfer Project, Libya's Great-Manmade River, the re-routing of Punjabi rivers into the Indus River instead of the Ganges River, and the system of water transfers in California. Further, companies such as Alaska Bulk Water, Inc. have been established with the sole purpose of shipping tankers full of water to arid areas. Several issues arise with these transfers. First, they allow parched areas to postpone adapting to water scarcity. Secondly, areas contributing the water may need that resource at some point in the future. Thirdly, transferring water from one area to another could affect the regional hydrological cycle and the ecosystems in both areas. Finally, water transfers could make the receiving area dependent on the contributing area, leading to potential conflict should the supply of water be interrupted. For all of these reasons and in spite of technological advances, bulk water transfers should be carefully considered before being enacted.

Conclusions and recommendation

Bulk water transfers are becoming more common through a variety of mechanisms, such as re-routing rivers, using aqueducts and pipes, and shipping containers-full of the liquid. While such transfers may seem like a viable solution to problems of water scarcity, the consequences need to be carefully considered. While obtaining bulk water may seem simpler and more feasible than adapting to less available water, in some cases earlier adaptation to changed circumstances may avoid more serious consequences later.

'Zero' coming into fashion in the Indian textile industry



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Keywords: textile industry, ZLD, wastewater treatment

Highlights

India is seeking to counter impacts on freshwater availability from its textile industry through making the 'zero liquid discharge' approach to wastewater treatment mandatory. Lessons on BAT from Tirupur, which has been the frontrunner in testing feasible methods, are important to move towards sustainable production jointly with Western buyers.

Introduction and objectives

During the early 90s, garment exports from Tirupur, India, exploded and the district became an important generator of employment, wealth – and polluting effluents. In 2006, the Court ruled that a treatment approach regarded as best practice, Zero Liquid Discharge (ZLD), was to be achieved. Following a contempt petition, the Court in 2011 ordered closing of >700 dyeing units. 300,000 workers lost their jobs. Today, the local industry has invested in innovative infrastructure to reuse water and salts, but cannot externalize the costs. ZLD is now made mandatory in the whole of India; implementation lessons can be learned from Tirupur.

Methodology approach

This case study of Tirupur's journey and the ZLD approach coming into fashion builds on field work, oral histories and qualitative interviews with representatives of the industry, authorities, the court system and academia, together with a review of the literature including relevant court cases and media comments. Going back some 25 years in time, it uses transition theory as the lens through which to understand the transformation that Tirupur and India's textile industry has undergone in recent history.

Analysis and results

Tirupur experienced freshwater stress in the 80s, caused by the local textile industry's discharges. When effluent standards were not complied with, subsidies and authority directions to connect factories to common effluent treatment plants not heeded to, and early court interventions failed, other parallel steps were taken to rectify the situation. One was to pipe in treated water from upstream, another to require a combination of wastewater treatment methods. Together, reverse osmosis, RO reject management, evaporators and salt crystallisers would enable water and salt reuse and – ultimately – 'zero' discharge. One textile unit owner paved the way to demonstrate the feasibility, inspired by the use of membrane technology in Europe and the Gulf. His entrepreneurship was awarded by the administration but not much welcomed by peers in the industry who preferred the old regime: Dilution is the solution to pollution. The ZLD approach requires high capital and operating expenditures, and along with high energy consumption and sludge management challenges come CO₂ emissions. Textile units in Tirupur continue to struggle with profitability and optimisation of processes, at the time when the federal government decides to frog-leap to ZLD ahead of the industry feeling the pinch from risks connected to water scarcity.

Conclusions and recommendation

To build legitimacy and willingness to comply with reformed policy on textile wastewater treatment and thereby move towards sustainable growth and production, India needs to take into account that

- the zero discharge method should be defined so that it achieves around 90% efficiency;
- the current (negligible) cost of groundwater does not incentivise reuse;

- Western buyers are yet unwilling to take on indirect costs;
- closing of the water cycle can be achieved in a variety of ways, many of which are not spelled 'ZLD'.

Enhancing water availability for livelihood improvement in Karamoja region, Uganda



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Keywords: Livelihood, Water, vulnerability, capacity, policy

Highlights

The focus of Karamoja Livelihood Programme was to improve community livelihoods through building productive assets water infrastructure (rock catchments, valley tanks, subsurface dams and rain water jars). The aim was to improve crop and livestock production to address food insecurity, mitigate drought related risks at household level, and increase household income.

Introduction and objectives

The Karamoja Livelihood Programme (KALIP) was implemented by the Government of Uganda through the Office of the Prime Minister. The programme was funded by the European Union to address water scarcity in Karamoja, North Eastern Uganda. Water scarcity has severely affected crop and livestock production with negative consequences on people's livelihoods. Consequently, there was need to build communities capacity to be resilient to recurring droughts. Therefore, the project objectives were to: support communities in water infrastructure development, reduce vulnerability of communities against impacts of climate change and enhance the capacity of the communities to manage water resources.

Methodology approach

- Using participatory approaches to support and influence action of policy, plans and strategies
- Demonstrate and support innovative practices to address water insecurity and enhance stakeholder's uptake and up-scaling of water infrastructure
- Knowledge development and capacity building of institutions and local actors in water security through documenting and sharing lessons and best practices
- Continuous monitoring of community infrastructure works to ensure transparency and ownership/responsibility for the completed structures and reducing conflicts between the project and the community

Analysis and results

Overall, the programme provided water infrastructure facilities for production. These include protective rock catchments, valley tanks, subsurface dams, rain water jars, cattle troughs and Micro dams. The district staff and community Water Use Committees (WUC) were trained in operations and maintenance. Water conservation measures aimed at improving crop and tree survival were put in place. Other benefits of the programme included effective collaboration and coordination between KALIP and Government, reduction in trekking distances (greater than 5km) in search of water and pastures which eventually reduced livestock diseases, establishing linkages with other partners to support communities in fuel saving stoves which have been replicated.

The programme component (water for production) has contributed to the implementation of the National Water Policy of 1999 for Uganda which considers water as a social and economic good for all people.

The programme has increased water use amongst stakeholders, enhanced capacity building in community-based watershed management and general soil and water management practices. Also, the interventions contributed to saving time for children to secure water for home and animals use, then go to school and for

adults to engage in other income generating activities. In addition, there has been increased access to water by communities.

Conclusions and recommendation

Conclusion: KALIP was relevant and timely for the Karamoja water stressed region. Putting up strong water infrastructure has supported social and economic aspects, hence, improving community livelihoods. While on the other hand, the programme has contributed to the implementation of the national water policy.

Recommendation: Future programmes targeting the community should involve government. Appropriate measures such as training in operation and maintenance of infrastructure developments should be done to prolong duration of the assets and also to develop a sense of ownership. Therefore, budgets to undertake these tasks should be put in place by government with contribution from communities.

Optimal water allocation for rainfed agriculture and livelihoods in Ethiopia



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Keywords: Rural development; sustainable livelihoods; rural-urban linkages; water governance; common pool resources; semi-arid; Ethiopia.

Highlights

This paper suggests that to increase agricultural output and improve rural livelihoods, scarce dry season water in developing countries should be used to protect rural town water supplies, not allocated to irrigation. This will support urban services and a dynamic rural economy for a large hinterland of rainfed farmers.

Introduction and objectives

This research seeks to answer the question: if scarce dry season water in semi-arid Ethiopia is allocated to rural towns, can this increase agricultural output more than if it is allocated to irrigation? It is concerned with a sustainable water allocation scenario for food security and improved livelihoods. It examines how rural livelihoods and rainfed agricultural practices are connected to a rural town water supply via urban services and livelihood diversification. It also questions the institutional viability of the idea by exploring the water governance framework in Ethiopia.

Methodology approach

The research paper adopts a comparative case study methodology of two rural towns in Ethiopia and four rural kebeles, two proximal to each town. It uses mixed qualitative and quantitative methods including: a rural household survey; focus group discussions with rainfed farmers; an urban water use survey of households and businesses; and semi-structured interviews with water governance stakeholders at all levels of government.

Analysis and results

Statistical analysis of the rural household surveys reveals that rural communities relying more keenly on agriculture for their income are yielding more from their land. Communities proximal to a rural town with a more diverse market trading in higher value crops are wealthier than those proximal to a less diverse market primarily trading grains. The urban water use survey reveals that a significant number of businesses suffer economic losses due to an insufficient, unreliable water supply. Water is a limiting factor for business expansion in rural towns in Ethiopia. There is evidence to suggest that this is having a negative impact on rural livelihoods, limiting expansion of the labour market and job opportunities for the rural poor. This is having a knock-on effect on rainfed agricultural practices as farming households do not have enough capital to invest in inputs. The interviews reveal that the idea of allocating scarce dry season water to rural towns over irrigation is politically favorable as drinking water is the highest policy priority for water resources management in Ethiopia. However, in practice, the institutional framework for water governance is fractured and water resource developments play out in an unregulated and unintegrated way.

Conclusions and recommendation

This research questions the dominant discourse that scarce dry season blue water should be allocated to irrigation to increase overall agricultural input. The allocation of such water to rural towns rather than irrigation can facilitate the intensification of rainfed agriculture to increase overall agricultural output, food security and foster sustainable livelihoods. For this to be institutionally viable, there needs to be a greater integration of water supply management and irrigation management institutions to ameliorate competition between irrigation and water supply for water resources and to ensure that future water resource developments are sustainable.

Impact of SDG's on Sustainable Development in the MEANA Region



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Keywords: Sustainable Development, Sustainable Growth, SDG's, MEANA, Multi criteria, Participatory Approach

Highlights

- SDG's targets and potential implementation
- Gaps in the sustainable development plans in MEANA region presenting the case of Jordan, Egypt and Morocco.
- How to bridge the gaps between national plans and SDG's
- Impact on Sustainable development and Growth in the above countries

Introduction and objectives

Water is identified as enabling resource in five other goals of the SDG. Consequently, unlike the MDGs, which were mainly focused on water supply and sanitation in relation to water under the heading of MDG7 (environmental sustainability), the independent goal under SDG with its proposed target areas of water provides for a significant increase in scope, opportunities and challenges.

Methodology approach

The study is based on conducting national workshops in Jordan, Egypt, and Morocco to study the SDG's impact on the national sustainable development plans. The participatory approach was used to identify the gaps in the current sustainable plans. All stakeholders including political figures were involved in the discussions. The multi criteria analysis tools was used to bridge the gaps between the current sustainable plans and SDG's and what will be the impact on the sustainable development growth in those countries.

Analysis and results

The water-related targets provide countries with common goals, and are as important as benchmarks and standards for progress, not only as aspirations, but as tools to mobilize concrete actions. Countries and stakeholders need robust evaluation systems to track the effectiveness of their institutions and actions in delivering the expected outcomes of the SDG 6, the water goal, and measure what needs to be improved.

The analysis of the workshops outcome showed that the three countries Jordan, Egypt and Morocco have general sustainable development plans in the political dimension and less linked with the following goals; water supply; sanitation; water quality and pollution; water use efficiency across all sectors; integrated water resources management; protection and restoration of ecosystems.

another result; there is considerable evidence that achieving SDG 6 will bring significant economic benefits that exceed the investment needed. For water and sanitation alone, research shows that benefits exceed the cost of an intervention by 3 to 6 times. The economic return on sanitation spending is US \$5.50 per US dollar invested. The estimates suggest that achieving universal access to basic water, sanitation could cost roughly 70% of countries public finance.

Conclusions and recommendation

Most of the MEANA region countries still do not have clear sustainable development plans reflecting the SDG's and future sustainable growth. More work need to be done on the technical part to define the impact on the sub goals level especially the return in the following area.

- Reduced health risk from water related diseases
- Protection of environment and ecosystem
- stability in socioeconomic aspects and minimize migration
- Social protection floors tailored to national needs and capacities promoted

- Promotion of entrepreneurship and sustainable enterprise development