



Proceedings of
E-discussion
**Operationalizing
water-energy nexus in
Nepal**



The views and opinions presented in this document are of the E-discussion participants and do not necessarily reflect those of the organizers.

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FOREWORD

The organizers are continuously engaged in stimulating debate and research on the management of water resources. The E-discussion session on “Operationalizing water-energy nexus in Nepal” was organized on behalf of NNWW-2014 to stimulate discussion and prepare synthesized report on the topic “Operationalizing water- energy nexus in Nepal”.

Fifteen participants actively participated and shared many posts on the E-discussion held during 09 – 23 March, 2014.


Discussions were basically focused on four sub-themes:

- Current status of water-energy nexus research in Nepal
- Barriers in operationalizing water-energy nexus in policies and practices
- Experience from other parts of the world
- Ways forward

The e-discussion was jointly moderated by Dr. Vishnu Prasad Pandey (AITM), Dr. Sangam Shrestha (AIT) and Mr. Dilli Bhattarai (SEN).

TABLE OF CONTENTS

Foreword	i
Table of contents	ii
1. INTRODUCTION	1
1.1 Background and objectives	
1.2 Approach and scope	
2. THEME – I SUMMARY	2
CURRENT STATUS OF NEXUS RESEARCH IN NEPAL	
2.1 Relevance of nexus research in Nepal	
2.2 Completed and ongoing nexus research in Nepal	
3. THEME – II SUMMARY	3
BARRIERS IN OPERATIONALIZING WATER-ENERGY NEXUS IN POLICIES & PRACTICES	
3.1 Identifying roles of relevant stakeholders	
3.2 Inadequate deliberations at different levels	
3.3 Inadequate data, information, knowledge and skill	
3.4 Lack of thinking from system and life-cycle perspective	
3.5 Ambiguity in policy and regulatory frameworks	
4. THEME – III SUMMARY	4
EXPERIENCE FROM OTHER PARTS OF THE WORLD	
5. WAYS FORWARD	5
5.1 Harmonized nexus database and research	
5.2 Better integration	
5.3 Governance, institutions and policy coherence	
5.4 Capacity development	
5.5 Enabling environment	
Annex 1: List of participants	7
Annex 2: Partial list of resources/literatures in the areas of water-energy nexus	7



1 INTRODUCTION

1.1 Background and objectives

UN-Water has dedicated World Water Day 2014 to the theme “Water and Energy”. About 15% of the world’s total water is withdrawn for energy production (World Energy Outlook, 2012), which is approximately the same rate that water flows down the Ganges River in South Asia. Water and energy has symbiotic relationship. Production and consumption of water involve energy use and energy production requires water for consumptive as well as non-consumptive use. Integration of water and energy policies into a single framework is necessary for optimizing resource use and this in turn demand proper estimation of water-energy linkage. The water-energy nexus is based on **water for energy** - not limited to extraction/mining, hydropower, fuel production, emission control and **energy for water** - not limited to extraction, treatment, transport, distribution, excess water and waste water treatment and reuse, and these are interlinked. The nexus approach integrates management and governance across sectors and scales and lobbies for putting water in energy security agenda and vice-versa. The interconnected nature of water and energy has been recognized and supported by a number of examples around the globe; however, there is relatively limited understanding of how to tackle these complex relationships when conducting assessments and taking action.

Operationalizing water-energy nexus in policies and practices is a challenging endeavor. Synthesizing viewpoints of diverse stakeholders may help devise strategies to operationalize water-energy nexus in policies and practices. In this context, Asian Institute of Technology and Management (AITM), Center of Research for Environment Energy and Water (CREEW), The Small Earth Nepal (SEN) and Asian Institute of Technology (AIT) has initiated the E-discussion with following objectives;

- To provide a common platform for young to senior research scholars, academia, practitioner and policy makers in the areas of water and energy for sharing ideas to operationalize water-energy nexus in Nepalese context.
- To synthesize current issues, efforts and ways forward to quantify and channelize the nexus approach in policy and practice in Nepal.

1.2 Approach and scope

The event was announced through email networks as well as web-platform (<http://www.smallearth.org.np/detail.php?cid=192&id=6>). Technical arrangements were made such that the participants can post directly in the web portal (<http://www.smallearth.org.np>) or send an email in the group mailing list (urbanwater@googlegroups.com). Participants were diverse, representing government agencies, non-government organizations, academia, research scholars, students, scientists, private sectors and policy-makers. The participants shared their ideas/thoughts, knowledge, experiences, queries and lessons learnt focusing to the following sub-themes.

- Current status of “water-energy nexus” research in Nepal
- Information on ongoing and planned research activities, their outcomes, lessons learnt
- Barriers in operationalizing the nexus in policies and practices
- Experience from other parts of the world
- Ways forward

2 THEME - I SUMMARY

CURRENT STATUS OF NEXUS RESEARCH IN NEPAL

2.1 Relevance of the nexus research in Nepal

Nepal's energy use for water services is likely to rise sharply in coming years. A rapidly growing population means increased demands for water. Declining water quality and availability in our watersheds could require more energy-intensive treatment processes, and pumping from greater distances and depths, to maintain a reliable water supply while protecting public health and environment. Future energy use for water could outstrip our ability to provide renewable energy if wasteful water practices continued to go unchecked.

The anticipated rise of energy-intensive treatment processes, the need to pump water from greater distances and depths, and population growth together suggests an exponential increase in the energy use to provide water services. Higher fuel costs coupled with an increased need for cooling and irrigation could mean steep increase in operating costs for manufacturers, farmers and homeowners. Declining water quality, for example, could mean significant increase in capital and energy costs if advanced treatment or importing of water were required to manufacture materials. Agricultural sector is similarly prone to water and energy related risks. Drought conditions and high fuel prices could put irrigators at increased financial risk.


Rising energy costs, the imperative to reduce greenhouse gas emissions and a changing waterscape implies that water and energy conservation are fundamental to creating sustainable communities, farms and businesses in Nepal. However, research in understanding the water-energy nexus and operationalizing nexus approach in policy and practice is practically non-existence in Nepal.

Apart from Water and Energy, it is reasonable to bring Food and Carbon too in the nexus research, i.e. studying "Water-Energy-Food Nexus" and/or "Water-Energy-Carbon Nexus". It is because, securing food and curbing greenhouse gas emissions are intimately linked with water and energy.

2.2 Completed and ongoing nexus research in Nepal

No such information was shared in the discussion.





3 **THEME - II SUMMARY**

BARRIERS IN OPERATIONALIZING NEXUS IN POLICIES & PRACTICES

Operationalization of water-energy nexus is very urgent for upgrading the lifestyle of people to more sustainable and productive ones. This is equally important to contribute for climate change adaptation and mitigation alongside maintaining the global sustainability concerns. Some of the constraints or barriers or difficulties in operationalizing the nexus in policies and practices are outlined hereunder.

3.1 Identifying roles of relevant stakeholders

The major stakeholders in the process of operationalizing the nexus in policies and practices are researchers/inventors, investor/owner (private sectors), policy makers/politician, and consumer/costumers. The stakeholders should play following roles for effective operationalization of the nexus:

- Researcher/inventor: focus on inventing and develop energy-efficient water systems and water-efficient energy technologies.
- Policy makers/politician: formulate policies that encourage and support high productive water-energy relationship.
- Investor/owner: invest on user friendly water-energy efficient technologies, value chain development, and market creation, among others.
- Consumer/costumer: develop a good understanding on water-energy nexus and change behaviors for adopting those friendly options.

Meaningful collaboration between various stakeholders helps build trust among them, and therefore, develops a feeling of ownership to operationalize the nexus in policies and practices.

3.2 Inadequate deliberations at different levels

The nexus approach is relatively new. Understanding different aspects of the nexus at various levels and by relevant stakeholders is necessary for effective operationalizing of the nexus. That needs adequate deliberations on its rationale, trade-offs and opportunities at different levels at frequent interval. It helps all the stakeholders to get prepared mentally to operationalize the nexus in policies and practices.

3.3 Inadequate data/information, knowledge and skill

Facts and figures developed based on data, information and research-based knowledge are the basis to convince the people importance of the nexus. However, there is no harmonized nexus database or analytical framework that could be used for monitoring or trade-off analyses. Potential synergies between land, water and energy management are not well understood. Suitable spatial scale for analysis of nexus is still a topic of debate. Furthermore, technical capabilities are inadequate to install, operate and manage large-scale water-energy systems.

3.4 Lack of thinking from system and life-cycle perspective

We are strongly practicing sectoral-approach for resource utilization and development. As water and energy forms a system and their trade-offs should be analyzed from life cycle assessment perspective.

3.5 Ambiguity on policy and regulatory framework

Many government agencies such as Alternative Energy Promotion Centre (AEPCC), Department of Electricity Authority (DoED), Nepal Electricity Authority (NEA), etc. are involved in promotion and development of hydropower projects. Local Self Governance Act (1999) has authorized local government bodies (VDC, Municipality and DDC) to develop and manage natural resources within their political boundary. It means they also have authority over water and energy. Due to lack of an integrated water and energy policy, service deliver in water and energy sectors are fragmented.

4

THEME - III SUMMARY

EXPERIENCE FROM OTHER PARTS OF THE WORLD

This section presents some experience of practicing water-energy nexus in policies and practices at other parts of the world shared in the e-discussion.

- **Will Allen, founder of Growing Power, USA:** use age-old continuum of agricultural lessons and practices such as vermiculture, aquaponic and energy production. They take water out of mountains and as it passes down the mountain, they dig ponds and then grow fish in the ponds and the water passes through a series of ponds and it goes out to the valley to water the plants. We are promoting this kind of natural concepts, being practiced by humans since a long ago.
- **San Antonio Water System (SAWS) & CPS Energy:** recognize water-energy nexus in operational level and manage the two in tandem to help maintain reliable and sustainable supplies of the both. CPS Energy has used recycled water since 1963 to cool its power plant. SAWS provide up to 50,000 acre-feet of highly treated recycled water per year for CPS Energy.
- **Improved energy access for sustainable intensification of the irrigation economy in Gujarat, India:** India strongly relies on groundwater for agriculture. Irrigation has been a major driver behind India's green revolution, providing food and income to large parts of the population. Pumping for irrigation is very energy intensive: about 20% of India's electricity use is for irrigation, and in fact more than half of India's hydropower production is going into pumping groundwater. Rapidly growing food and energy demands (and hence water demands) in India are addressed through a mix of internal measures, e.g. increased agricultural subsidies for irrigation, electricity, fertilizer and seeds, expansion of biofuels, inter-basin water transfers, and external measures, in particular large-scale investments in land. In Gujarat, the state government has introduced innovative win-win strategies involving support for massive rainwater harvesting, micro-irrigation and groundwater recharge schemes. In particular, the government has introduced an innovative 'Jyotigram' (lighted village) scheme, which is based on redistributing electrical power and 'intelligent rationing', and covers more than 90% of Gujarat's villages. The scheme has 're-wired' the state with thousands of kilometres of new power lines, and separated electricity supplies for villages from that for irrigation tubewells. While villages can now rely on 24 hours of constant electricity, farmers were offered a reliable and predictable supply of eight hours of uninterrupted full voltage power along a strictly scheduled roster (which also helps to separate in time peak energy demand for irrigation from that for villages). Helped by a succession of good monsoons, the groundwater levels throughout Gujarat have not only stabilized but are recovering; consumption of electricity for pumping groundwater and electricity subsidies has declined; the gap in livelihoods between rural villages and cities has narrowed; and enterprises such as mills, tailoring, welding and many others have a reliable power supply – vital for creating new jobs. Key success factors for the introduction of the new power system were the early involvement of senior policy-makers, who saw the benefits for their constituencies, and the support of farming communities, who were convinced by the promotion of the scheme as an intervention to provide continuous power supply to uplift the rural population.
- **Water-Energy-Food Security nexus in Brazilian Cerrado:** Using a "system approach", Brazil over a period of about 1.5 decades has achieved 130% increase in total grain production, a four-fold increase in soybean production and a 10-fold increase in beef exports. The approach has involved higher agricultural inputs (fertilizer, lime, etc.); plant and livestock breeding (e.g. high yielding forage grasses, tropical soy bean, cattle); introduction of double cropping and zero tillage; rehabilitation of land, e.g. with leguminous, nitrogen-fixing plants; to some extent an integration of crop-livestock and agro-forestry systems; and an increase in the land area under cultivation. The impressive development is the joint efforts of the Brazilian government (the Ministry of Agriculture in particular, which has offered incentives such as attractive credits and issued coherent agricultural policies), Embrapa (the Brazilian Agricultural Research Corporation, which has invested on agricultural research and development and new technologies), and the private sector, which has seized agro-business opportunities. While production and resource use intensity in the Cerrado region have grown through agricultural intensification, it is not clear how overall water and energy use efficiency have developed. From a nexus perspective it is important to better understand the overall changes in efficiency and benefits derived from this intensification. Brazil is promoting a transfer of the Cerrado development model to sub-Saharan Africa via new regional offices and other support, in part because of similarities between the two regions in terms of climate, (poor) soil conditions, large savannah regions, and initially low resource productivity.



5 WAYS FORWARD

The participants suggested several ideas to move forward in operationalizing water-energy nexus in policies and practices in Nepal. They can be summarized under following categories.

5.1 Harmonized nexus database and research

As harmonized nexus database is the entry point to promote research-based knowledge of the nexus, an agency should take a lead to develop such database. Adequate research should be promoted to understand: How much would be total energy required for water-related services (e.g. to heat, treat, deliver and remove water) in cities of Nepal? How much is the total energy and water potential of Nepal (estimate based on the best available state of the art techniques)? What is the prospect/potential of generating energy from waste water treatment plants (WWTPs) in the form of biogas and biosolids to offset the energy needs of those plants? What could be the role of our traditional and indigenous knowledge and practices to strengthen our existing knowledge and systems of water-energy nexus?

5.2 Better integration

It may consist of:

- Better integration of water and energy monitoring, reporting, management and efficient programs to help build favorable environment to operationalize water-energy nexus
- Examining energy use and efficiency opportunities across economic sectors through a “water sector” lens that includes cold water, hot water and steam
- Multi-stakeholder resource planning to promote cross-sectoral and cross-departmental approaches to planning and working with stakeholders at different levels to improve public sector-led governances, planning and information flows
- Considering system and life-cycle perspectives in the development and management practices. For example, bring food and carbon too in the nexus approach; i.e. look into nexus of “Water-Energy-Food” and “Water-Energy-Carbon”
- Interlink several projects together (e.g. integrating hydropower projects with water supply and irrigation) to generate multiple benefits and optimize water and energy uses
- Socio-cultural norms/ethics, welfare, and behavior work simultaneously to move towards common goal of water-energy security

5.3 Governance, institutions and policy coherence

It is necessary to account for trade-offs and build on the increased interconnectedness of nexus. Given the social and environmental values are not always well served by markets, regulation and collective action promoted by social learning can help guide investments and innovation, so that negative externalities across sectors are minimized, benefits are shared equitably, and human rights are secured. Part of this process is promoting, identifying and eliminating contradictory policies. Learning platforms for social innovation and adaptive management can enable horizontal and vertical policy coherence. Coherence in institutions help improve governance. From the context of Nepal, it needs to roll back to establish “Ministry of Water Resources” by merging “Ministry of Irrigation” and “Ministry of Energy” together.

Additionally, it should influence policies on trade, investment and environment/climate focusing on improving ecosystem management to increase resource productivity, thus contributing to poverty alleviation and green growth. Specific investments could include:

- Market-led resource pricing to account for local impacts (social and environmental costs of resource exploitation) and global impacts (contribution to climate change).
- Investments in “smart” environmentally and socially sound infrastructure, especially that which is adaptive and focused at regional level. A key part of these investments should be investing in natural infrastructure.
- Promoting more effective waste management by reducing waste and using it in more diverse ways in production
- Stimulating development through economic incentives, including working with local stakeholders, and poor and rural populations to provide incentives to manage ecosystems.

5.4 Capacity development

From the perspective of nexus, several training and capacity building programs should be tailored with the nexus implementation strategies to make sure that capacity of institutions and people do not limit operationalizing of the nexus. Though Nepal has developed technical and managerial capacity and skills in the micro-hydro sector (up to 100 kW), capacity needs to be developed for beyond 100 kW. The areas could be enhancing knowledge on the installation, management, operation and maintenance of large renewable energy systems, upgrading knowledge and human resources capacities for manufacturers, installers and maintenance technicians for above 100 kW hydro power plants, above 1 kW solar projects and above 10 m³ biogas plants.

Engaging stakeholders to build awareness and capacities about the interconnected nature of the elements of the nexus, share ways to minimize trade-offs, explore synergies and suggest actions for changing behaviors with regard to the nexus also adds value to capacity development objectives.

5.5 Enabling environment

Additional enabling conditions for a nexus approach include political will, change agents, capacity building and awareness raising programs. Informing the public, policymakers and practitioners of the mutual benefits of reducing water and energy use would create mutual trust among stakeholders and therefore creates enabling environment to operationalize the nexus. Role of media, both online and paper-based, blogs, social networking sites would be crucial in this regard.

The environment should encourage collaboration between water and energy expertise for developing innovative synergistic solutions.

Enabling environment should:

- Encourage collaboration between water and energy expertise for developing innovative synergistic solutions.
- Promote adoption of water and energy soft paths by prioritizing conservation of water and energy over new infrastructure; recognizing the impacts of new water infrastructure on energy use, and new energy infrastructure on water.
- Promote innovation to identify technological choices and investments that explore water-energy synergies and could be implemented to achieve desired changes on the ground.

ANNEX 1

List of participants

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ANNEX 2

Partial list of resources in the areas of “water-energy nexus”

- Translating Nexus Research into Nexus Policy-making: an interview with a senior research fellow at SEI: http://www.water-energy-food.org/en/news/view__630/translating-nexus-research-into-nexus-policy-making.html
- Nexus in action: <http://www.gracelinks.org/2052/the-nexus-in-action>
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