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The Role of Large Scale Artificial Water Storage in the Water- Food-Energy Development Nexus

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This brief is based on a report that reviews the current status of medium to larger scale artificial water storage development with a focus on Africa. It assesses the linkages between water, energy and food security, and the role of water storage facilities in this nexus. Best practices in water storage development and management infrastructure for building sustainable livelihoods and mitigate climate change are reviewed.

Key findings

1. **Large-scale water storage plays an increasingly important function as a buffer against rainfall variability in support of economic development and building water security.** Several examples at the global level demonstrate how water storage has supported rapid socio-economic development in many countries and regions such as Sweden and Norway. Expansion in irrigated agriculture land areas has fostered greater food security, and electricity generated from hydropower has contributed to large scale grid-based electrification boosting economic growth. Hydraulic infrastructure and dams play an important part in controlling unpredictable hydrological variability and mitigating the impacts of floods and droughts.
2. **Effectively planned and well-built dams bring substantial benefits.** Many dams do not reach their expected potential that was predicted during the pre-commissioning stages. Social and environmental tradeoffs may overtake the economic benefits. Hydropower dams, however, seem to be the type of dam that, more than other dams, exceeds the targets of achieving economic returns and development outcomes. Existing hydropower electricity generation capacity can be strengthened through technical improvements during the project's life-cycle. Reasons for lower than expected outputs are often found at the initial planning stages of dam projects that affect subsequent project implementation stages.
3. **Large scale water storage contributes to regional integration and benefit sharing.** Evidence points towards an important role for larger scale water storage in promoting regional integration and the sharing of benefits from cooperative development. In the development of regional power markets hydropower is an important source of fuel for electricity generation. Major co-owned water storage schemes have functioned during times of civil strife and can serve as a rationale for further integration in other areas.
4. **Climate change brings a new dimension to the role of water storage and there is potential in developing hydropower to mitigate climate change impacts through wider use of renewable energy.** Developing regions, and particularly those in Africa, have significant potential in their hydropower sectors; only 7 percent of the sector's potential technical capacity is currently exploited. By developing the sector to include national and trans- national electrical grid networks, regions and nations can realise large gains in social and economic benefits. The development of hydropower can partly off-set the use of fossil fuels.
5. **Environmental and social tradeoffs and challenges at the local and regional levels need to be addressed up-front when developing water storage.** Issues of resettlement, compensation and environmental degradation are critical factors to consider in medium and large scale water storage projects. In most cases, projects will affect people and ecosystems. Consequences include livelihood losses, impacts on traditional and cultural values, and degradation of public health. Compensation to rectify these tradeoffs has at times proven unsatisfactory. Lessons learned demonstrate good strategies for engaging affected populations and creating meaningful livelihoods.
6. **There are several ways in which tradeoffs from water-storage projects can be mitigated. These are found both in project design and implementation but more often upstream in the early planning stages.** Environmental and social impacts should be addressed through proven governance and technical solutions at the early planning and design stages. Strategic Environmental Assessments (SEA) are, for example, gaining increasing attention globally as an instrument to bring upfront environmental and social issues of major development programs into the planning, project development and investment finance process.
7. **Donor organisations at the bilateral level are not typical sole financiers of large-scale water storage projects.** There are high capital costs associated with large scale water storage that are often well beyond the financial contributions by bilateral donor organisations. As illustrated in several

bilateral donor policy documents, there is a focus on policy reform for climate change, renewable energy and safeguarding the environment rather than the infrastructure investment per se. Water storage projects are often a component in complex developing schemes allowing a wide range of investment opportunities.

8. **Bilateral funding can play an important role in financing good water storage.** New estimates indicate that Africa's annual financing requirements for water could be 50 billion USD for drinking water and sanitation, wastewater, desalination, irrigation and water management, hydropower and multi-purpose storage. Compared with this need, current financial flows are deficient in many respects. Bilateral grant financing can play an important role in leveraging domestic and external public and private financing by lowering political and technical risk. Donor financing can target less commercial components of water storage projects by focussing on the social and environmental issues and by building a pipeline of investment projects at a pre- and full feasibility level. Underutilised financing, particularly in Developing Financing Institutions (DFI), can be unlocked through strategic bilateral grant financing.
9. **Engaging in water storage.** The attitude towards investment in water storage is changing amongst IFIs. This is demonstrated in inter alia the UN Johannesburg Summit 2002, the General Assembly Resolution on reliable and stable transit of energy, the World Bank's water strategy and in the policy framework on water, climate change and energy amongst many bilateral donors. A common characteristic of these policy frameworks is that they recognise the need to increase investment the water value chain including water services, water management and development and water governance.

What could Sida do?

Investment opportunities with partners in the implementation of the infrastructure component of water storage include:

- **Increase effectiveness.** There are major opportunities to make existing projects more effective. Investments can be made in upgrading existing technology in order to harvest greater power generation from existing plants without expanding actual storage volumes. Investment in project feasibility studies are important features towards improved development.
- **Technology development.** Investments can be made in modernising irrigation schemes relating to infrastructural components of irrigation networks such as pipelines, pumps and canals, thus ensuring the functionality of these elements. Water storage technology improvement is another key area that is developing rapidly with run-of-the-river technology gaining acceptance as a way to reduce the need for large scale water storage.
- **Mitigating environmental tradeoffs.** Mitigating environmental impacts is appropriate for development finance and can include project components focussing on watershed management, environmental flows and other technical aspects. Adaptive measures to help areas cope with new conditions can include creating spawning areas for fish and wildlife to introduce species suited for new environments and potentially valuable as sources of livelihood.

Investments opportunities in the governance aspect of water storage include:

- **Institution and capacity building.** Support to administrative and institutional capacity building in connection to water storage schemes will be crucial. There are several areas to consider including: water resources management, watershed management, anti-corruption efforts, transaction advisory services, communication skills, stakeholder engagement, and technical expertise.
- **Resettlement.** Increase efforts to find normative and sustainable frameworks for addressing resettlement and compensation issues.
  - o A general increase in resources to develop resettlement schemes should not only focus on the short term but also on the long term. Effective schemes should have suitable timeframes, making sure that short term needs and basic services are well in place before resettlement occurs. Longer term livelihood options should include assessments of diversified income possibilities.
  - o Best practices show that regulating frameworks need to be structured in a more standardised manner to ensure participation in developing compensation schemes. Resources should be allocated to institutional functions dealing with compensation issues and to develop systems that provide consensus.
- **Strategic Sectoral, Social and Environmental Assessment (SEA).** Resources can be allocated to develop and enhance strategic programme environmental impact assessments. Upstream Strategic Environmental Assessment (SEA) that takes a programmatic overview on financial, economic, environmental, social and technical feasibility should be promoted. SEA supports good decision making by clients and financiers, assess options and build project pipelines.
- **Regional integration and power market development to deepen regional integration.** Analyses, assessments and support for the emerging power pools in Africa is essential to achieve reliable and cost efficient power systems in areas were markets are small and scattered and where production of electricity is expensive. The Scandinavian power market model (NORDPOL) is a good example of effectively linking generation and transmission systems.

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