Upper Anseba's surface water potential

Water shortages severely affect the densely populated Upper Anseba region in Eritrea, a country whose dry season lasts nine months of the year. As reservoirs are the most important source of surface water, knowing about their capacity and how the water is used is crucial to informed decision-making. This project explored the potentials of geographic information system technology and satellite imagery to generate that knowledge.

Sustainable development challenge

Around the world, river water is shared by communities upstream and downstream, often over long distances, for different uses such as farming, drinking water supply, industry, and crafts. This can trigger conflict, especially where water is in short supply. Attempts to mitigate conflicts over water often require involvement of several levels of governance – from local to national, and sometimes transnational. But a lack of sound data on water availability – especially in water-scarce regions – often hampers mitigation efforts.

Water scarcity is a major development challenge in Eritrea, a Sahelian mountain country with a semi-arid climate. As the country has no perennial rivers, reservoirs provide an effective coping mechanism for ensuring water supply during the nine-month-long dry season (Tadesse and Bissrat 2005). Reservoirs are particularly important in the central highlands, where the rocky underground does not hold large bodies of water. Water stored in reservoirs is used for irrigation of agriculture, and ensures a constant supply for domestic use, industry, and services. However, there is a lack of updated information on the volume of water stored in these reservoirs (Abraham et al. 2009). In addition, water is often wasted, especially in small-scale irrigation.

ESAPP's response

Sustainable water management requires an integrated approach that takes into account land use planning and agricultural production. In semi-arid contexts adapted cropping techniques such as conservation agriculture, suitable crops, and rain water harvesting can help reduce the pressure on water resources. A sound assessment of how much water is available and when, is crucial for planning and management. ESAPP supported projects that inventory resources and prepare the necessary baseline information for sustainable water management.

With a view to promoting good practices, ESAPP partners engaged in a project to provide an inventory of reservoirs, assess the potential for further surface water storage development, and document current water management approaches. This project focus was chosen to help bridge the information gaps faced by the Government of Eritrea in its efforts to overcome seasonal water shortages by building more reservoirs. The project was conducted in one of Eritrea's major watersheds: the Upper Anseba catchment, in the country's central highlands.

Main messages

- Creating awareness of the increasing gap between water supply and water demand is important in many development contexts. An inventory of reservoirs is crucial for realistic planning and proper management.
- Alleviation of future water shortages requires concrete measures. As irrigated farming often accounts for a major share of water use, more efficient irrigation practices are key to sustainable water management. More crops per drop can be achieved through improved irrigation scheduling, lined conveyance systems, and extensive training of farmers – especially those who are new to irrigated farming.
- Water is indispensable for development. Accordingly, plans for regional development, based on negotiated outcomes, should define future water allocations for all major user groups.

The Mekerka reservoir near Serejeka, north of Asmara. The survey inventoried all 49 dams in the Upper Anseba catchment. Seventy per cent of the available rainwater is already channelled into these reservoirs, so the potential for building new ones is low. Motorized pumps such as the one shown on the picture are often used by farmers to irrigate fields. (Photo: Ministry of Agriculture, Maekel Region Branch, Eritrea)

The project story

Upper Anseba is Eritrea's hotspot in terms of sustainable water management challenges. Located at 2,000 to 2,500 metres above sea level and extending over 633 square kilometres, it is the most densely populated area in Eritrea. It comprises small-scale farming villages as well as by far the largest urban area in the country: the capital city Asmara with its expanding suburbs (Gurtner et al. 2006). Demand for water – already high – is increasing, fuelled by a growing urban population, industry, and services. Demand is also rising for agricultural products such as horticultural crops, a sector in which numerous villages with access to reservoir water now participate. Reservoir water enables off-season production by irrigation, fetching higher prices but also increasing water demand when water is most scarce. Gold mining, a recent development, will further exacerbate pressure on water resources.

This was the background against which ESAPP and its partners carried out their assessment of the catchment's surface water potential. Given the diversity of actors with a stake in water use, the project was set up as a transdisciplinary undertaking. It involved scientists, experts from the Ministry of Agriculture and the Ministry of Land, Water and Environment, as well as villagers and local administrators. The main aim of the project was to provide decision-makers and planners with an overview of the water resources currently available, and the potential for their development to satisfy growing regional water demands. The project focused on reservoirs, the most important source of water.

The first step was to create a spatial database. A geographic information system (GIS) and satellite imagery were used to locate reservoirs, resulting in an inventory of 49 reservoirs in Upper Anseba. These reservoirs store 70 per cent of the estimated annual run-off from rainfall, which shows that the potential for increasing storage is reaching its natural limits. A survey of nine reservoirs revealed annual storage capacity losses of 0.5 to 2 per cent due to siltation, pointing to the need for more sustainable land management upstream. Workshops in villages showed that farmers maximize rather than optimize water input, a waste untenable in a semi-arid environment: with efficient use, the irrigated area could be increased by almost 40 per cent. The reason for this poor practice is that small-scale farmers in Eritrea are mostly new to irrigation. While the main output of the project was the spatial database with the reservoir inventory, important additional outputs consisted in providing farming communities and extension workers with an updated irrigation schedule for key crops, and improving existing water by-laws.

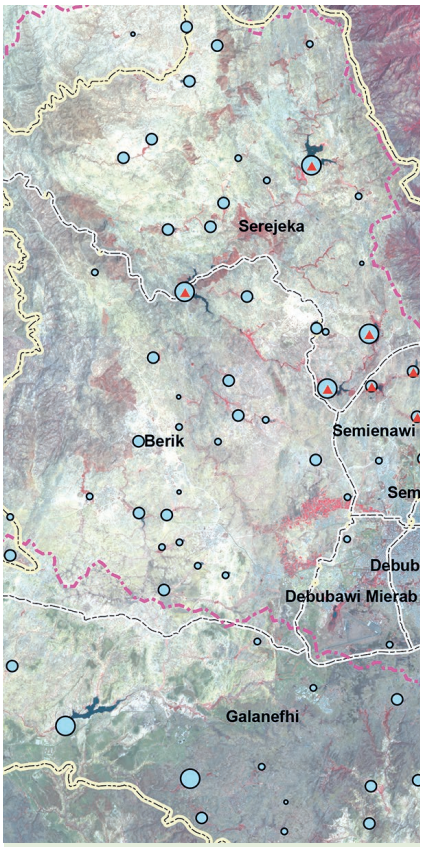
Top: Eritrean project partners conducting a bathymetric survey of one of the reservoirs in the Upper Anseba catchment. Such surveys are used to measure the depth and volume of a waterbody. When carried out at intervals, bathymetric surveys also provide information on sedimentation rate. (Photo: Ministry of Agriculture, Maekel Region Branch, Eritrea)

Bottom: These farmers in the project area are taking part in a participatory rural appraisal exercise organized by the Maekel Region Branch of the Ministry of Agriculture. (Photo: Ministry of Agriculture, Maekel Region Branch, Eritrea)

Innovation and relevance

The project included a number of elements that were innovative in the Eritrean context. One was the project's transdisciplinary set-up involving different levels from the national to the local – importantly, local farming communities and key water users. Another was the combination of various tools and technical approaches (GIS and satellite imagery interpretation) alongside local workshops as well as water use and irrigation assessments with local farmers. Yet another innovative element was the preparation of different outputs tailored to the stakeholders' needs: (1) a book was prepared in English as a baseline reference for decision-makers in policy and administration; (2) a series of three leaflets was produced in the local language Tigrigna to disseminate important findings to village extension workers, village development committees, and interested farmers; and (3) the study team was invited to present and discuss their results at fairs and exhibitions in Asmara in order to sensitize the wider public to the challenge of water supply and the need for proper management of this scarce resource.

The project was highly relevant. First and foremost, it made it clear that the potential for additional storage is more limited than planners expected, and that it is constrained above all by low amounts of rainfall. The project also revealed considerable storage loss due to reservoir siltation, and a massive waste of water due to inefficient irrigation practices. As an additional – unplanned – output, it provided simple tools to improve water use efficiency (model irrigation schedules, improved water by-laws). It also highlighted the need for a regional water master plan that focuses less on supply and more on demand management and allocates negotiated shares of water to the different actor groups. Not least, the project demonstrated the usefulness of spatially explicit information, including maps, in locating issues and providing an agenda for negotiation. The project also led to various GIS training courses and establishment of a GIS infrastructure for mapping exercises at ministerial level.



Top: Excerpt from map showing the design capacity of reservoirs in the Upper Anseba catchment (and the rest of Maekel Region, or Zoba Maekel in Tigrinya). Large blue dots indicate reservoirs with a capacity of above 1 million cubic metres. The smallest blue dots represent the smallest reservoirs inventoried, with capacities of below 50,000 cubic metres. Reservoirs in the Upper Anseba catchment that are marked with a red triangle in addition to the blue dot are used for urban water supply.

Bottom: Most farmers in the Upper Anseba catchment are new to irrigation practices. As a result, they often use irrigation methods that are not appropriate to a semi-arid climate with severe water constraints. Furrow irrigation, pictured, has a very high evaporation rate. (Photo: Ministry of Agriculture, Maekel Region Branch, Eritrea)

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Highlight profile

This highlight is based on the achievements of 1 ESAPP priority action project.

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Main beneficiaries:
Ministry of Agriculture and Ministry of Land, Water and Environment, as well as the population of the Upper Anseba catchment and Zoba Maekel (Maekel Region) in the central highlands of Eritrea

References and further reading

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What is ESAPP?

The Eastern and Southern Africa Partnership Programme (ESAPP) is a research implementation programme funded by the Swiss Agency for Development and Cooperation (SDC), coordinated by the Centre for Development and Environment (CDE) of the University of Bern, Switzerland, and implemented jointly by CDE and a network of partner institutions in Eastern and Southern Africa. Launched in 1999 and completed in 2015, ESAPP implemented over 300 priority action projects in the programme region, which included Eritrea, Ethiopia, Kenya, Tanzania, Mozambique, and Madagascar.

What are ESAPP Highlights?

ESAPP Highlights are a series of 24 project descriptions providing insights into ESAPP's research and implementation partnerships. Each Highlight describes a succession of demand-driven priority action projects addressing local and regional sustainability issues. The 24 Highlights are collected in a publication that includes additional background information on ESAPP (see citation above). The individual Highlights and the entire publication are also available for download on CDE's website: www.cde.unibe.ch (keyword search: "ESAPP").

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