



ETHIOPIA: *INTEGRATED FLOOD MANAGEMENT*

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Abstract. The study contains information on approaches and structural measures for flood management in Ethiopia, and on future plans to strengthen these activities. A detailed description is provided on flood damages and management in the country's most developed basin, as well as in the most important urban areas. This is complemented with information on institutions and policies with responsibility in this field. Of interest is also the information on the Ethiopian Water Resources Management Policy and the national Water Sector Development Program.

1. Location

Ethiopia is located in northeast Africa. The country has a land area of about 1,100,000 km² and a population of 65 million. The annual flow from its rivers amounts to 122 billion m³. All of this is generated within its borders and goes across to other countries.

As the topography of the country is rather rugged with distinctly defined watercourses, large scale flooding is limited to the lowland flat parts of the country. However, intense rainfall in the highlands causes flooding of settlements in a number of river basins. One of these is the Awash River Basin located in the Rift Valley and with a surface area of about 113,000 km², which has the largest level of development. On the other hand, the level of the waters of two main lakes has been gradually increasing causing damage to infrastructure in a number of areas. Finally, torrential floods are also produced in Addis Ababa and in another main city.

In the lowland areas there is little settlement; the population (pastoralists) and livestock move following the presence of grazing and water. Flood spates in these areas are welcome by the population as such floods improve grazing and water supply for livestock and people.

2. Nature of floods

The rainy season in the country is concentrated in the three months between June and September, when about 80% of the rains are received. Torrential downpours are common in most parts of the country. Large scale flooding is rare and limited to the lowland areas where major rivers cross to neighbouring countries. However, intense rainfall in the highlands causes flooding of settlements close to any stretch of river courses.

The most serious flood problems are found in the abovementioned Awash River basin. Irrigation development in this basin is quite advanced and is located in the flood plains on either side of the river, with close to 70% of the country's large-scale irrigated agriculture; thus, high economic damage occurs during flooding. It is estimated that in the Awash Valley almost all of the area delineated for irrigation development is subject to floods; this amounts to an inundated surface of some 200,000-250,000 ha during high flows.

The other rivers where significant floods occur are the Wabi-Shebelle River in southeastern Ethiopia near the Somali border and Baro-Akobo/Sobat River in western Ethiopia, near the Sudanese border. In the Baro-Akobo Plain an area of about 300,000-350,000 ha is prone to annual flooding and in the Wabi-Shebelle Basin some 100,000 ha may be inundated.

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The level of the waters of two main lakes (*Awassa* and *Besseka*) has been gradually increasing for some reasons yet to be determined, causing damage to infrastructure in a number of areas. Both of these lakes are situated in the Rift Valley.

Several small streams originating in the mountain range at the foot of which the city lies traverse metropolitan Addis Ababa. Torrential rains, common during the rainy season, cause sudden rise in the flow of these streams, which bring about flood damages to settlements along their banks. A similar situation affects the town of *Dire Dawa*.

3. Flood management and mitigation measures

Integrated water resources management in Ethiopia is not at an advanced stage. In this regard flood management, being an integral part of integrated water resources management, has not been treated separately on a sustainable manner in the country. The main flood control and management activity being carried out in the country is in the Awash River Basin.

Before the construction of the Koka Dam on the Awash River in the late fifties, widespread flooding along the river was common. The creation of this reservoir, with an initial capacity of 1.8 billion m³ provided, in addition to the primary purpose of irrigation water and the production of electric energy, flood protection to the upper and middle Awash areas. As a result, irrigation development downstream was expanded safely with minimal flood protection works by individual farms.

At the Middle Valley two major tributary rivers draining the western slopes of the drainage system join the Awash River introducing further flood risks. With the implementation of a major irrigation scheme of 10,000 ha, the *Amibara Irrigation Project*, a flood protection scheme of dykes was constructed around the project to protect the development. With the establishment of a *Project Control Center*, equipped with adequate maintenance equipment, the flood protection dykes were maintained keeping the farms safe from flood damages.

The Awash River in the Lower Plains has a very unstable course and reduced slope, tending to change its direction with the raising of its bed due to silt deposition. As a result it branches out into effluents reducing flows in the original channel and denying supply to existing farms downstream. To control this situation, Government established a *River Training Unit* for the Lower Plains area, with equipment to remove silt from the river and maintain its original depth and width, so as to enable it to carry floods coming from tributary rivers. The Unit also constructs and maintains flood protection dykes along the river to protect the farms. A control weir was built to maintain a balanced flow to each effluent to ensure a constant water supply to developments along both branches, also to the nomadic population in the area who depend on the river for their water supply.

Uncontrolled deforestation and expansion of farmlands have induced soil erosion and land degradation causing irreparable damage to the environment. This has been the root cause for constantly increased sediment load over the years on Awash River flows. With most of the sediment load brought in by the river inflow to the Koka reservoir being deposited there, its capacity has gradually been reduced over the more than forty years of its existence. At this time estimates are that the reservoir volume, having lost more than 40% of its capacity, does not have a remaining capacity of more than about 1.0 bill m³, which is incapable of withholding a major flood. As it is not purely a flood retention reservoir but basically a supplier of water for power generation and irrigation downstream the reservoir operation schedule, geared to retaining as much water as possible during the rains, will necessarily reduce its flood retention capacity substantially.

As regards urban and infrastructure flooding, the city administration of Addis Ababa has prepared a flood protection scheme including structural and non-structural activities to be implemented over a 15-year period. The structural intervention covers construction of retaining walls and dykes and improvement of river channels. The non-structural plans include reforestation and proper zoning



concerning settlements close to the streams and adequate early warning. Similar plans have been developed for the city of Dire Dawa.

Finally, there is no flood forecasting and warning mechanism in Ethiopia. As regards Koka Dam releases, the *Reservoir Operational Committee* (see below) advises downstream developments of expected outflows from the reservoir during high inflows, so that they can prepare themselves to protect their farms and infrastructure. But this committee does not operate outside the Awash basin.

4. Institutions responsible for flood management

In 1998 the *Awash Basin Water Resources Administration Agency* (in short *Awash Valley Agency*) was established by Government. The purpose of its creation is to bring the full responsibility of integrated water resources development and administration of the basin, including flood management, under one body. It has the purpose of coordinating, administering, allocating and regulating the utilization of the surface water resources of the Awash Basin/Valley. Its responsibilities are to collect water resources data, plan, design implement and oversee operation of all water projects within the basin.

The Agency is a semi-autonomous government organization. It has a board, a General Manager and the required staff. The General Manager is appointed by the *Ministry of Water Resources* with the recommendation of the board. Members of the board are appointed by the Government from pertinent government institutions having a stake in water resources of the Awash River basin. Communities are represented by regional government water units sharing the Awash watershed.

The somewhat precarious situation of flood management in the river basin is expected to improve substantially with the intervention of the Awash Valley Agency with the strengthening of the previously existing flood management units stated above; i.e. the *Project Control Center* in the Middle Valley and the *River Training Unit* in Lower Awash.

The Koka Reservoir operation has traditionally been responsibility of the national electric authority. Downstream of the dam there are three hydroelectric power plants, which are the main source of electric supply for the country. In the Awash Valley below the dam there also is irrigation of close to 70,000 ha depending on water supply from the reservoir. A *Koka Reservoir Operational Committee*, composed of representatives from the *Electric Board* and *Ministry of Water Resources*, establishes operation schedules for the reservoir to be followed for each rainy season. This schedule takes into account irrigation water requirement, flood security for developments downstream as well as power generation. A close follow-up of the operation by this committee has made it possible to avert significant damages by floods and has rendered improved water supply for developments.

5. Policy

The *Ethiopian Water Resources Management Policy* was adopted by Government only recently. Its main thrust shows a heavy commitment for the development of water resources infrastructure, the building of dams for hydropower generation and irrigation including the construction of main canals, so as to encourage private business participation in irrigation development. There is also a strong call for an intensive watershed management to protect the environment and reduce soil erosion and land degradation. In the context of the Ethiopian Water Policy, flood management is viewed as an integral part of an integrated water resources management. As sequel to these commitments, Government is progressively carrying out master plans for all the river basins of the country. Implementation will follow when these plans are completed.

The Water Resources Policy gives priority to grass root participation in integrated water resources development and management. It states specifically that: (i) participation of stakeholders, user communities; particularly women's participation in water resources development should be



promoted; and (ii) water resources development shall be underpinned on rural centered, decentralized management, participatory approach as well as integrated framework, etc.

The national *Water Sector Development Program (WSDP)* is based on the principles of the Water Resources Management Policy; it was started in 2002 and will continue for 15 years. It was prepared for the development of irrigated agriculture, hydropower generation and drinking water supply and sanitation. Implementation of the existing plans for the construction of dams upstream of flood prone areas in the country are included in the program. The WSDP was prepared with input from regional representatives; at various stages national workshops were conducted to introduce the draft plan and incorporate regional requirements. During detailed planning and implementation communities will have decisive roles especially in drinking water supply. It is expected that future water and flood management projects will therefore have better acceptance by the communities. This is particularly the case in the Awash Valley, where the population is mostly pastoralists, and where the controlling of floods to avoid flooding of the grazing areas is not appreciated. In fact, flood control dykes are often tampered with and broken to induce flooding.

Another action by Government in implementing its water policy is the active participation in the Eastern Nile Cooperative program known as the *Eastern Nile Subsidiary Action Program (ENSAP)*, which includes the three riparian countries of Ethiopia, Sudan and Egypt (Eritrea is not a member but will join eventually). Ethiopia has submitted a list of specific irrigation and hydropower projects on sub-basins of the Nile. Reservoirs to be established upstream of developments are also meant to absorb floods and protect such developments from damage. These projects are to be implemented if agreement is reached among the involved countries and funding is forthcoming from financing agencies sponsoring the ENSAP.

The *Regional Flood Preparedness and Early Warning System* is a sub-project of the Eastern Nile group of countries under the Nile Basin Initiative. This sub-project focuses on the regional aspects of flood management including strengthening of national capacity. It is an important first step in establishing the technical infrastructure for gaining operational experience in pursuing joint action during critical flows. This includes gauging network, communication and information management systems, modelling capability and procedures for information exchange, as well as training of staff and strengthening institutional capacity. All the member countries of the Eastern Nile sub-basin will be beneficiaries from the project.

6. Main lessons learned

- For Ethiopia, the most important river basin in terms of existing developments and associated flood management is the Awash River. Uncontrolled soil erosion and land degradation resulting in heavy sediment transport in streams and rivers has caused significant reduction of the capacity of the Koka reservoir, which serves as the only impounding reservoir for Awash flows. Water supply for irrigation and hydropower generation downstream depends on releases from this reservoir. The reservoir also serves as means of flood retention to protect downstream developments.
- Flooding in urban settlements, especially in Addis Ababa, annually causes damages to property along streams coming down from the nearby hills. In most cases such damages occur on illegal settlement at the banks of the streams. Proper zoning and protection of riverbanks from obstructive structures to allow flood passage can curtail unnecessary damages of property due to floods.
- The *Regional Flood Preparedness and Early Warning System* for the Eastern Nile countries under the *Nile Basin Initiative*, mainly to benefit Sudan, Ethiopia and Egypt, is to be started soon. Successful completion of this project will enable these countries to improve flood management and reduce flood damages to life, property and infrastructure, as well as to the



environment. This is in sharp contrast to the previous situation of non-existence of exchange of advance information for early warning of flood occurrence.

- The experience in the Awash Basin related to silting-up of the Koka dam should also serve as a undeniable demonstration for what may be in store for the planned large dams on the Nile tributary rivers from Ethiopia.