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INTEGRATED FLOOD MANAGEMENT

CASE STUDY

ETHIOPIA: *INTEGRATED FLOOD MANAGEMENT*

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ETHIOPIA: *INTEGRATED FLOOD MANAGEMENT*

Kefyalew Achamyeleh [1]

1. Introduction

Ethiopia is located in northeast Africa between 3° and 18° North latitude and 33° and 48° East longitude. Elevations range between 100 meters below and 4600 m. above sea level.
It has a land area of about 1,100,000 sq. km. and a population of 65,000,000.
Ethiopia has an annual flow from its rivers amounting to 122 BCM. All of this is generated within its borders. Most of this goes across to other countries. Of this flow only about 1% is utilized for power production and 1.5% for irrigation. The total irrigation potential is in the order of 3.7 Million ha. Of this only 4.3% has been developed. Exploitable hydropower potential is in the order of 160 Billion KWHRS/Year.

Water Resources Assessment:
***Hydrology*:** Presently hydrological data are collected and processed on a regular manner covering all the river basins. The hydrological network consists of about 500 gauging stations in 12 river basins of which about 400 are operational.
***Meteorology*:** Data collection network for meteorology is fairly satisfactory for climatological purposes. There are a total of 795 weather stations including those operated by organizations outside NMSA. Data processing is mainly manual except climatological data, i.e. rainfall and temperature, which are processed by computer.

2. Flood Prone Areas

Introduction
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 down pours are common in most parts of the country. As the topography of the country is rather rugged with distinctly defined watercourses, large scale flooding is rare and limited to the lowland areas where major rivers cross to neighbouring countries. However, intense rainfall in the highlands could cause flooding of settlements close to any stretch of river course. A major river basin that has serious flood problems is the Awash River basin located in the Rift Valley. Irrigation development in the river basin is quite advanced and is located in the flood plains on either side of the Awash River. High economic damage occurs during flooding along this river basin. Therefore, flood protection practices and river training are limited to this river basin. It is estimated that in the Awash Valley almost all of the area delineated for irrigation development is subject to flood. An area in the order of 200,000-250,000 ha. is subject to be flooded during high flows of the Awash River.

The other rivers where significant floods occur are 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, (known as Gambella Plain) an area of about 300,000-350,000 ha.is prone to flooding during the wet season and in the Wabi-Shebelle Basin not more 1han 100,000 ha may be flooded.

The areas commonly flooded annually in the country are the following:

[1] Water Resources Consultant, Ethiopia

2.1 Baro-Akobo Basin: Of the Gambella plain well over 35% is subject to annual flooding. Future construction of identified dams upstream especially on the Baro River can mitigate the intensity of flooding in the area. It is from this river system that the Machar Marsh in Sudan is fed.

2.2 Awash River Basin: (Map # 2)

***Lower Awash*:** The Lower Awash area comprises a flat plain of over 100,000 ha. Of this about 70,000 ha is earmarked for irrigation. Currently, flooding is caused by river Mille and Logiya. A dam at Tendaho, is required for irrigation development down stream. Construction of a dam at Tendaho would absorb any flooding from Mille and River Awash itself. Logiya being down stream from Tendaho dam site will continue to cause flooding. If proper river training is maintained, the Awash river channel can manage to contain any flow from Logiya river within its banks assuming that Tendaho Dam is constructed.

***Middle Awash*:** Flooding in this stretch of the Awash River is mainly caused by rivers Kessem and Kebena which are tributaries to the Awash from the western highland drainage. This may be aggravated by high flood spill from Koka Reservoir. Because of the weakening of Amibara Project Control Center which is responsible for protecting the development from flooding by maintaining dikes, repeated flooding has caused substantial economic losses in the last couple of years.

***Upper AwashCatchment*:** Becho Plain, located about 30 km west of Addis Ababa on the Jimma road is annually flooded during the rainy season with overflow from the Awash River. The flood covers both sides of the Addis Ababa-Jimma highway. The surrounding area is densely populated and there is farm land scarcity. The flood exasperates the land scarcity and in some years even standing crops are lost to flooding.

2.3 Wabi Shebelle:

The Lower Part of Wabi-Shebelle from Kelafo on to the Somali border is frequently flooded during the rainy season. Implementation of the planned Kuldash Dam on the Wabi Shebelle River as it enters the low land area would provide full control of the river flow.

2.4 Ribb and Gumara Area (Foggera Plain):

This area is yearly flooded mainly when the two rivers Ribb & Gumara have high flows. But recently after the Tana outlet work (Chara-Chara Dam) was built, raising of the Tana water level has been causing more intensive flooding of this area. Though previous designs of the weir had made sure that historic flood levels are not exceeded, it appears that actual construction of the weir did not conform to the original designs. Flood levels are also affecting the city of Bahr Dar, which lies at the southern shore of the lake.

2.5 Localized Flooding Risks

2.5.1 Lake Awassa:

The level of Lake Awassa has been gradually increasing causing damage to infrastructure in the town of Awassa. Attempts to contain the lake with the construction of a dike between the lake and the town have so far not brought about tangible results.

Detailed technical and environmental studies to fully understand the nature of the continued growth of the lake have been carried out and proposals of effective measures to be taken to protect Awassa town from further flooding are being prepared by a consultant.

2.5.2 Lake Besseka*:* Lake Besseka which is located near Metahara town has been growing in size and causing problems on the Addis Ababa-Djibouti railroad and the Assab/Djibouti highway. It has also inundated some area in the sugarcane plantation and grazing areas in the neighborhood. The water of the Lake is highly saline. A scheme aimed at controlling the rising level of the lake and to reclaim the inundated farmland and grazing area is being implemented.

According to the plan the lake is to be pumped to the Awash River and the lake level will be controlled so as not to affect the railway track and the highway.

No clear indication existed for a long time, why these two lakes kept growing. Recently, however, a study by a consultant has come up with reasonable explanations (as given below) for the enlargement of the two lakes. Incidentally, both of these lakes are situated in the Rift Valley.

2.5.3 Enlargement of Lake Awassa:
This lake has a drainage area of 80-130 km2. There are some streams feeding it. The major stream feeding the lake comes from a nearby swamp at a higher elevation than Awassa. This swamp has been acting as retention reservoir for water flowing to Lake Awassa. The watershed area of the swamp has been losing vegetation over the past few decades causing soil erosion and land degradation. Runoff from this eroded area carried heavy silt which is deposited in the swamp reducing its water retention capacity substantially. Thus inflow to Lake Awassa comes immediately after rainfall events causing increase in the level of the lake.

The other reason given for the continued growth of the lake is that there is a micro-climatic change causing increased precipitation on the lake itself.

2.5.4 Enlargement of Lake Besseka:
Lake Besseka has an area of about 40km2. The current explanation given by the experts studying this lake is that the growth of the lake is due to a subterranean water flow from a neighboring aquifer. On the downstream side of this lake there is a large irrigated sugar cane plantation. Excess irrigation water from this plantation has been causing raising of the ground water level denying free passage of the subterranean flow under the lake. Thus water from this subterranean flow rises and enters the lake raising its level.

2.5.5 Addis Ababa :
Metropolitan Addis Ababa, sprawling at the foothill of Entoto mountain range is traversed by several small streams originating from the mountain range. Torrential rains which are common during the rainy season in the city, cause sudden rise in flow of these streams which bring about flood damages to settlements along the bank of these streams. Such damages have often caused losses of property. Recently a study of flood risks and measures of intervention along these streams has been carried out by the municipality and an implementation program over a 15-year period to contain flood waters within their banks have been drawn out.

2.5.6 Dire Dawa:
This town like Addis Ababa lies at the foothills of a mountain range. There is a large waterway often dry with no water, which divides the town into two. This waterway during the rainy season suddenly grows to a large river threatening the loss of property and human life. The damaged is reduced substantially with the construction of a bridge and enforcement of zoning regulations.

(Refer to Map # 1 for sections 2.3-2.5)

Flood Management in Ethiopia

Integrated Water Resources Management in Ethiopia is not at an advanced stage. While the country's water and land resources endowments are abundant, very little has been accomplished in the way of proper exploitation for the economic benefit of the people. In fact it is paradoxical that the country has been the victim of food insufficiency and famine in recent years. Flood management being an integral part of integrated water resources management, has not been treated separately on a sustainable manner in the country. The only flood control and management activity being carried out in the country is in the Awash River Basin. In what follows, a brief explanation of the developments and flood management in the basin will be provided.

3.1 Awash River Basin and Integrated Flood Management:

The most highly developed river basin with improved economic infrastructure is the Awash River Basin. The basin lies between 8^{o} and 12^{o} latitude and 38^{o} and 43^{o} longitude, on north-east Ethiopia. It has a surface area of about 113,000 sq.km.

Close to 70% of the country's large-scale irrigated agriculture is located along the Awash River. Before the construction of the Koka Dam on the Awash River in the late fifties, wide spread flooding along the river was common. The creation of the Koka reservoir with an initial capacity of 1.8 billion cubic meters 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 by retaining incoming floods. As a result, irrigation development downstream was expanded safely with minimal flood protection works by individual farms.

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

All other smaller farms on the Awash and on Kessem and Kebena rivers had to make their own flood protection structures.

The floods created in the upper and middle Awash are absorbed in the Gewani area where Lake Gedabassa acts as a receiving reservoir and what is left from evaporation is released slowly to the Lower Awash.

In the Lower Awash Area, flooding is caused by a different source. There are two river systems Logiya and to a lesser extent Mille draining from the western highland. These two rivers, especially Logiya (which is downstream of Mille) cause huge floods threatening settlements and farms with flooding. The Awash River in the Lower Plains has a very unstable course. The river at this stretch has a very flat slope tending to change its course with raising of its bed with silt deposition. As a result the river branches out into defluents reducing flows in the original river and denying supply to existing farms downstream.

To control such phenomena, the Government had established a "River Training Unit" for the Lower Plains area, with appropriate supply of equipment such as draglines dozer and dump trucks. It is the duty of this Unit to remove silt from the river and maintain its original depth and width to enable it to carry floods coming from tributary rivers. It constructs and maintains flood protection dikes along side the river to protect the farms from flood.

The Government had built a control weir at the junction of two defluents to keep maintain a balanced flow to each defluent to ensure adequate water supply to developments along both

branches. This weir, known as Boyahle Weir, assured a constant supply to the Dubti farm and Awssa area farms. Maintenance of this weir was carried out by the River Training Unit.

Proper functioning of this unit also ensured water release from the river to the nomadic population in the area who depended on the river for their water supply.

At both Middle Awash and the Lower Plains the two establishments responsible for flood control purposes, are receiving less support from the government. For the past several years no substantive replacement of maintenance equipment has been made. Consequently, aging equipment owned by these units could not provide the required output in the maintenance of dikes and in river training activities.

During an interim period of change of economic policy it appeared that less attention was being given to water resources administration with the view of reducing the role of the government in the sub-sector.

As a consequence flood damages have been repeatedly occurring at both the Middle and the Lower Awash causing huge economic losses. In one of the recent rainy season flooding phenomena the whole 10,000 ha farm of Amibara Project has been inundated with crops standing in the farm land.

In the Lower Plains, the Dubti area plantation and most of Dubti town have been inundated with flood, mainly coming from Logiya and Mille rivers. Such floods have also caused damages to the Afar pastoralists in the area between Dubti and Assaita isolating them and their livestock. Emergency food and clothing assistance have often been supplied by military helicopters with the sponsorship of the Disaster Prevention and Preparedness Commission (DPPC).

These flood damages being witnessed both at the Middle and Lower Awash are a result of weakening of the previously existing entities established to ensure with proper management of the flood dikes and river courses in these areas so that such flood occurrences of disastrous proportions should not take effect.

As stated above the construction of the Koka dam had provided flood protection for the farms and other economic infrastructure in the valley by absorbing flood coming from the upper part of the Awash watershed. This part of the watershed is densely populated and has intensive agricultural activity. It also includes metropolitan Addis Ababa. Uncontrolled deforestation and expansion of farmlands have induced soil erosion and land degradation causing irreparable damage to the environment. This phenomenon 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, the capacity of the reservoir 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 about1 bill m^3. This capacity is incapable of withholding a major flood coming in during the rainy season. As the reservoir is not purely a flood retention reservoir but basically 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.

3.1.1 Koka Reservoir Operational Committee: Koka Reservoir operation has traditionally been in the hands of the national electric authority. Downstream of the dam there are three hydroelectric power plants built in a series with a combined installed capacity of about 100 MW. As these plants were the main source of electric supply for the country, responsibility of operation of the dam and reservoir was given to the power authority. In the Awash Valley below the dam there is irrigation of close to 70,000 ha. depending on water supply from the Koka

reservoir. But operation of the reservoir only for power generation had always created inconveniences for the irrigation entities because they were not getting water at the time they needed it. In addition the flood mitigation capacity was not being utilized to protect downstream development from flood damages. As additional other power sources were built the dependence of the power agency on Koka plants has been reduced.
A committee of engineers and hydrologists, composed of representatives from the Electric Board and MoWR carefully draws out operation schedules to be followed for each rainy season for the reservoir. This schedule takes into account irrigation water requirement, flood security for developments downstream as well as power generation. With a substantively reduced reservoir capacity, Koka reservoir has been incapable to absorb incoming flood of significant magnitude. Close follow up of the operation by this committee has made it possible to avert significant damages by flood and has rendered improved water supply for developments.

3.1.2 Raising of Koka Dam: As stated above the initial reservoir capacity of the Koka Reservoir has been reduced substantially. As a result its flood holding capacity has been reduced too. This situation has created the problem of increased flooding risk downstream and shortage of water supply for irrigation and power generation. A previous study has proposed raising of the dam to restore its initial capacity. This is being considered by the Government, and a more detailed study is to be conducted before a final decision is made.
The inflow into the reservoir coming from the upper catchments of the Awash basin is heavily loaded with silt as this part of the basin is highly eroded. For the reservoir to have a longer life and to make developments in the valley to be sustainable, improvement of the environmental condition of the upper catchments is essential. Programs of reforestation, improvement of farming methods, and other watershed management activities will be needed to be carried out in the upper catchment on a massive scale.

3.1.3 Awash Valley Agency: To guide the Integrated Water Resources Development of the Awash River Basin, a semi-autonomous body named Awash Valley Agency has been established by government proclamation. It is the responsibility of this organization to collect water resources data, plan, design implement and oversee operation of all water projects within the basin. In the context of the Ethiopian Water Policy, flood management is viewed as an integral part of an Integrated Water Resources Management.

This Agency has been created by proclamation No. 129/1998. In fact, its full name is “Awash Basin Water Resources Administration Agency” with the purpose of coordinating, administering, allocating and regulating the utilization of the surface water resources of the Awash Basin/Valley. 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 Awash watershed.

The Ethiopian Water Resources Management Policy has been adopted by the government only recently. The government has heavily committed itself in the development of water resources infrastructure in the building of dams for hydropower plants and irrigation going down to the construction of main canals to encourage private business participation in irrigation development. In addition government has also committed itself towards an intensive watershed management to protect the environment and arrest soil erosion and land degradation. As sequel to these commitments, government is progressively carrying out master plans of all the river basins of the country. Implementation will follow when these Master Plans are completed. Incidentally, as the electricity supply of the nation is hydro-based two major hydropower plants; one on the Tekeze/Atbara river, tributary to the Nile and another on a tributary of the Omo River are currently under construction. The dams of the two hydropower plants will also serve as

means of flood retention, especially the Tekeze dam from which the Sudan will also be beneficiary in flood protection and in getting controlled flow regime for its developments along this river.

The other positive action by the government on implementing its water policy is its active participation in the Eastern Nile Cooperative program known as the Eastern Nile Subsidiary Action Program. This program includes the three riparian countries of Ethiopia, Sudan and Egypt. (Eritrea is not now a member but will join eventually).

For the Eastern Nile Subsidiary Action Program, (ENSAP), Ethiopia has submitted a list of specific projects of irrigation and hydropower on sub-basins to the Nile river. These projects, which are also expected to benefit the other two downstream riparian countries, are to be implemented if agreement is reached among the riparians and funding is forthcoming from financing agencies sponsoring the ENSAP.

Reservoirs to be created upstream of developments are also meant to absorb floods and protect such developments from damage. Individual projects built on flood routes are expected to include their own flood protection structures too. 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 re-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 purpose of the creation of this agency is to bring the full responsibility of the Integrated Water Resources Development and administration including flood management of the basin under one body. This would facilitate rational action on giving priority of water use in case of water shortage and possible use of the Koka Reservoir for managing incoming flood in a manner not harmful to downstream developments.

Eventually, government may hand over the Koka operation to this agency to bring about a fair operational schedule on an evenhanded manner taking the interests of all purposes and activities.

There is no flood forecasting and warning mechanism in Ethiopia. Concerning Koka Dam releases there is a committee of technical personnel from the Power Authority and Ministry of Water Resources that advises downstream developments of required releases from the reservoir during high inflow to the reservoir to prepare them to protect their farms and infrastructure. But this committee does not operate outside the Awash basin.

The “Regional Flood Preparedness and Early Warning System” is a sub-project of the Eastern Nile group of countries under the Nile Basin Initiative. These countries, have established a secretariat called ENSAP (Eastern Nile Subsidiary Action Program) which plans and implements projects selected by individual countries and supported by the other member countries. The Eastern Nile sub-basin covers the Nile tributaries from Ethiopia, Eritrea, Sudan and Egypt. The three major tributaries in the region, Blue Nile, Tekeze and Baro-Akobo cause riverine flooding especially in the flood plains of Ethiopia and Sudan. Since 1988, there have been a number of high floods along these rivers with extensive damage to property and infrastructure and displacing a large number of people especially in Sudan. As part of the ENSAP project identification, Sudan, which suffers the largest flood damage in the region, submitted the development of a ‘Nile Flood Early Warning System’ as a potential project. This proposal was expanded to include a more comprehensive approach to flood management, which would also address institutional and capacity building issues related to flood preparedness and mitigation as well as technical issues concerning flood forecasting and early warning.

The sub-project focuses on the regional aspects of flood management including strengthening national capacity. This project is an important first step in establishing the technical infrastructure for gaining operational experience in pursuing joint action during critical flows. Technical infrastructure includes gauging network, communication systems, information management systems, modeling 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.

3.2 Urban and Infrastructure Flooding

3.2.1 Addis Ababa: Torrential rains in Addis Ababa cause flooding in the several streams coming from the nearby mountain range causing damages to houses close to the banks of the streams. This has been the cause for substantial loss of property during the rainy season.
The City Administration has prepared a detailed survey of the flood prone zones. Based on these surveys a flood protection scheme including structural and non-structural activities have been planned to be implemented over a 15-year period. The structural intervention covers construction of retaining walls and dikes and improvement of river channels to provide adequate waterway for floods. Building of weirs with the creation of ponds for retention of rain runoffs is also part of the planned intervention. The non-structural plans include reforestation and proper zoning concerning settlements close to the streams and adequate early warning.

The City Administration estimates that this15-year development plan which coincides and is part of the national Water Sector Development Program (WSDP) would require a financial outlay of about US$ 90 Million. This has been incorporated with the financial plan of the WSDP.

3.2.2 Awassa Town:
Lake Awassa, at the shore of it the town of Awassa is located has been increasing in size and encroaching on to the town flooding developed areas and incurring economic damage. A dike has been constructed to protect the town. However, continued growth of the lake level has threatened to over-top the dike even after repeated heightening. The cause for the continued rise of the lake is not clearly known. At this stage, a study of the situation is being carried out by a consultant. To arrest further growth of the lake and encroachment to the town, the consultant has proposed utilization of the lake water for irrigation and to pump out water from the lake and recharge it into boreholes the aquifer of which is connected to other drainage systems linked to neighboring lakes lower than Lake Awassa. Details of the irrigation system are being worked out and pilot boreholes are being drilled and tests being conducted. This scheme is also part of the national WSDP as proposed by the regional government.

3.2.3 Dire Dawa:
Dire Dawa lying at the foot of a mountain range is subjected to annual flooding by runoff from the mountain during torrential rains. The administration of the city in collaboration with neighboring regions has plans for watershed management programs to be implemented during the national water sector development program. This intervention is expected to reduce flood risks in the city.

The planned watershed management programs comprise construction of check-dams and weirs for water conservation and retaining floods, construction of terraces along mountain slopes to reduce runoff and encourage ground water recharge, and re-afforestation along the slopes draining towards Dire Dawa. As most of these slopes are part of neighboring regional states, the planned projects will be jointly implemented by these states and Dire Dawa administration. These plans are to be implemented during the period of the WSDP, which started in 2002 and will continue for 15 years.

3.2.4 Lake Tana Shores/Foggera Plain:

A low weir has been constructed at the outlet of Lake Tana known as Chara-Chara. The weir has been built to serve as control system of the outflow of the lake to ensure adequate water release for the newly built hydropower plant at Tsis Issat downstream of the outlet. Designs of the weir prepared as part of the Blue Nile Basin Study and later as part of Tana-Beles project, had made the maximum level of the Lake not to exceed the highest historical record flood level inorder to protect historical churches on the island of the Lake, and the city of Bahr Dar from being flooded.

However, after the completion of the weir, the level of the Lake rose above the intended level and caused severe flooding along its shores especially on the eastern and southern part including Bahr Dar. This occurrence has created strong suspicion that actual construction of the weir may not have been in conformity with the original design.

The WSDP includes a study of the cause of flooding and implementation of corrective measures to avert future flooding of the shores of the lake including Bahr Dar.

There are plans to build dams for irrigation on the two rivers of Ribb and Gumara which when built would provide security from flood caused by the two rivers.

3.2.5 Lake Besseka

Lake Besseka is located near Metahara along the Addis Ababa-Assab and the Addis-Djibouti railroad. This Lake has been increasing in area with increased elevation and covering both the highway and the railroad. A neighboring irrigation farm has also been partially covered by this lake. Relocation and raising of the roadway and railway did not help as the lake kept growing. After a detailed study of the phenomena, a proposal has been put forward by a consultant to pump water from the lake to the Awash River. As the Lake water is highly saline, mixing of the salty water is to be carried out in a controlled manner so that the salt content of the river water is not raised to a level making it unsuitable for irrigation downstream. Construction of the scheme has been started and is expected to be completed within the year 2003.

3.2.6 Becho Plain Flooding:

The regional government of Oromia has prepared detailed plans for improved watershed management with the construction of small dams on the tributary streams of Awash River where the floods originate. These dams are also to be used for small-scale irrigation and fishery development. Reforestation of the mountain slopes that are the catchments contributing flood flows are also part of the plans. Some of these schemes have been proposed for implementation as part of the WSDP.

3.2.7 Other Flood Prone Areas:

There are low land areas close to international borders along Somalia and Sudan at the mouth of the major rivers of Wabi Shebelle and Baro where annual flood occurrences cause damages to settlements. In some seasons these floods attain disaster levels requiring food and shelter assistance to the victim population.

Upstream on these rivers on all the rivers there are plans for the construction of dams mainly for the purpose of irrigation and hydropower development. The construction of such dams also serves the purpose of flood retention at the same time. Therefore, flood management in such cases is considered as part and parcel of the Integrated Water Resources Management of the country.

The national Water Sector Development Program, drawn out for a 15-year period, is primarily for the development of irrigated agriculture, hydropower generation and drinking water supply & sanitation.

Implementation of the existing plans for the construction of dams upstream of these flood prone areas are included in the program. Thus the creation of reservoirs with the construction of the dams will serve as means of retaining incoming flows which otherwise would go down to flood

the plains. The question of flood management for such areas is thus solved as part of the integrated water resources development.

4. Flood Management and the Pastoralist:

In the lowland areas where there is little settlement, the population is a pastoralist one. Livestock and the population 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.

In the Awash Valley where the population is mostly Afar pastoralists controlling of floods to avoid flooding of the grazing areas is not appreciated by these people. In fact flood control dikes are often tampered with and broken to induce flooding. Therefore, any development such as large-scale irrigation which takes up grazing land has to provide alternative grazing area for the livestock displaced from the developed area. In addition, the local population should also, at least partially, be beneficiary of the development intervention. No development that ignores the local population should be expected to succeed.

These pastoralists are nomadic. They move following the presence of grazing and water. The problem was mainly in the lower Awash at earlier times where irrigation development was dominated by two major cotton plantations. The 'River Training Unit' did mainly concentrate on ensuring uninterrupted supply of water to these entities. This required building of dikes at low stretches of the river bank of the Awash river. Controlled releases of Awash River flows through defluents to the pastoralists were made. But it was not possible to satisfy them all as their temporary settlements were scattered. When grazing becomes scarce where there is water they move in search of grazing and that may be behind a dike in which case they try to break it and induce flooding. Therefore, the easiest way for them to get water where they wanted it was to breach the dikes.

In the Middle Awash, where an area of 10,000 ha irrigation development was made relatively recently, a certain portion of the developed land had been allotted for the displaced pastoralists. Those not included in the development were to benefit from a program where water wells were drilled in an area allotted for rotational grazing. Water wells were to be operational as long as grazing is available in the vicinity. However, as this was not implemented fully as planned, the disgruntled group did create problems on crops on the newly developed area.

The Water Resources Management Policy gives priority to grassroot participation in integrated water resources development and management.

The policy states:

"…..promote participation of stakeholders, user communities; particularly women's participation in..water resources development.."

" water resources development shall be underpinned on rural centered, decentralized management, participatory approach as well as integrated framework, etc…"

The WSDP which based on the principles of the Water Resources Management Policy was in fact prepared with input from regional representatives. At various stages of the preparation, 'national workshops', to introduce the draft plan and incorporate regional requirements had been conducted. During detailed planning and implementation communities will have decisive roles especially in drinking water supply. Future water and flood management projects will therefore have better acceptance by the communities.

5. Lessons Learned in Flood Management in Ethiopia

5.1 Soil Erosion and siltation

For Ethiopia, the most important river basin in terms of existing developments and associated flood management is the Awash River basin. 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 from flood damage.

The severity of sedimentation on the life of the reservoir was underestimated by the designers of the dam. Sufficient allowance for dead storage to accommodate silt deposition has not been provided. As a result silt deposition has reduced the flood retention capacity of the reservoir by taking up part of the live storage capacity for silt. The situation of the Koka Reservoir is also a reminder of the essential activity of watershed management to reduce soil erosion in the catchments of the Awash River. In the last forty years since the commissioning of the Koka Dam very little activity for the prevention of soil erosion has been carried out in the upper basin of the Awash River. Such an activity should be continued in the future on a massive scale. The planned heightening of the Koka Dam would reinstate the reservoir's initial capacity. Unless this is followed with necessary measures for the reduction of soil erosion in the catchments, the impounding capacity of the reservoir could be lost again.

The experience in the Awash Basin related to silting up of Koka dam should also serve as a stark demonstration for what may be in store for the planned large dams on the Nile tributary rivers from Ethiopia. The drainage areas of the Blue Nile and the Tekeze rivers are highly eroded and silt content in the flows of the two rivers and their tributaries has been known to be very high. This problem should be recognized and advance remedial measures taken to ensure long life of reservoirs to be built on these rivers. In this connection, the long-term watershed management project planned to be implemented by the Eastern Nile countries is a welcome development for sustainability of the water resources management in the Nile Basin.

5.2 Flood Management Units in the Awash Basin

Two flood management units had been established by the Government in the Awash Basin. One is for the Middle Awash Irrigation Projects and the other for the Lower Awash area. Their respective responsibility is to maintain protection dikes and water courses to avoid flooding of irrigation areas and to ensure continued supply of water to farms. But these units have not been obtaining proper support in recent years to be able to discharge their duties effectively. Replacement of aging equipment is well overdue for both units. There is need for strengthening their capacity with equipment, motivated staff and required facilities. The annual economic loss due to flooding of farms has been so huge that there is no question of the advantage derived from well supported flood management units.

5.3 Nile Basin Initiative

Until now water resources development and management in the Nile Basin has not been on a comprehensive manner. The only riparian countries that synchronized their water resources management activity on the Nile waters have been Sudan and Egypt. Recently a basic agreement by all the Nile riparian countries to establish an organization to oversee the development of the Nile Basin has been reached. Projects benefiting more than one riparian are being identified. In this manner the "Regional Flood Preparedness and Early Warning System" for the Eastern Nile countries, mainly to benefit Sudan, Ethiopia and Egypt is to be started soon. Successful completion of this project will enable these countries improved flood management and reduced 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.

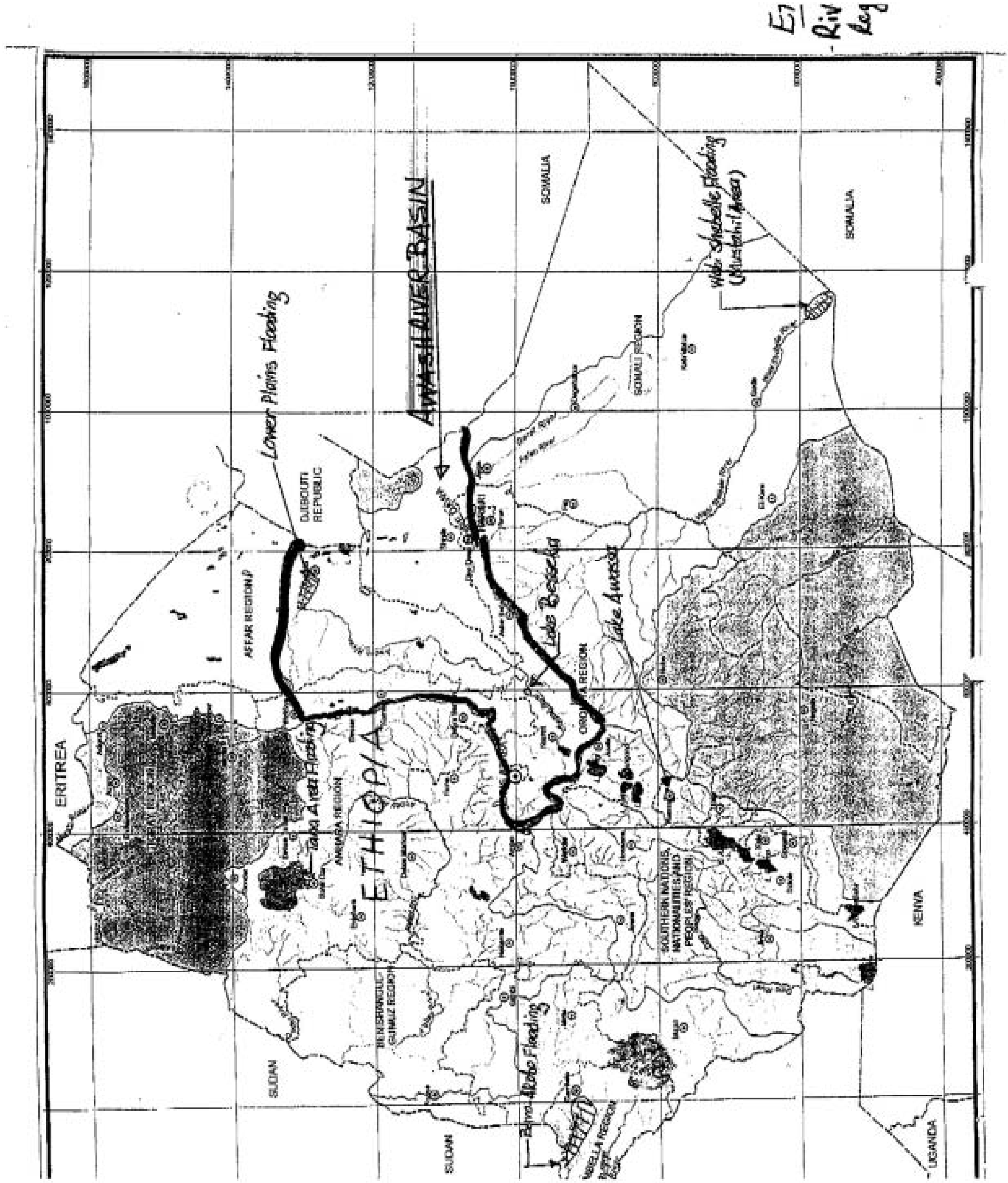
This project may lead towards implementation of some of the border dams planned by Ethiopia on the Blue Nile and Baro rivers. These dams will serve as means of flood retention and to provide controlled flow for irrigation and power generation at the same time.

Such regional cooperation will also lay the foundation for similar cooperative action on the Wabi-Shebelle and Genale-Dawa rivers with Somalia when the political situation in that country subsides.

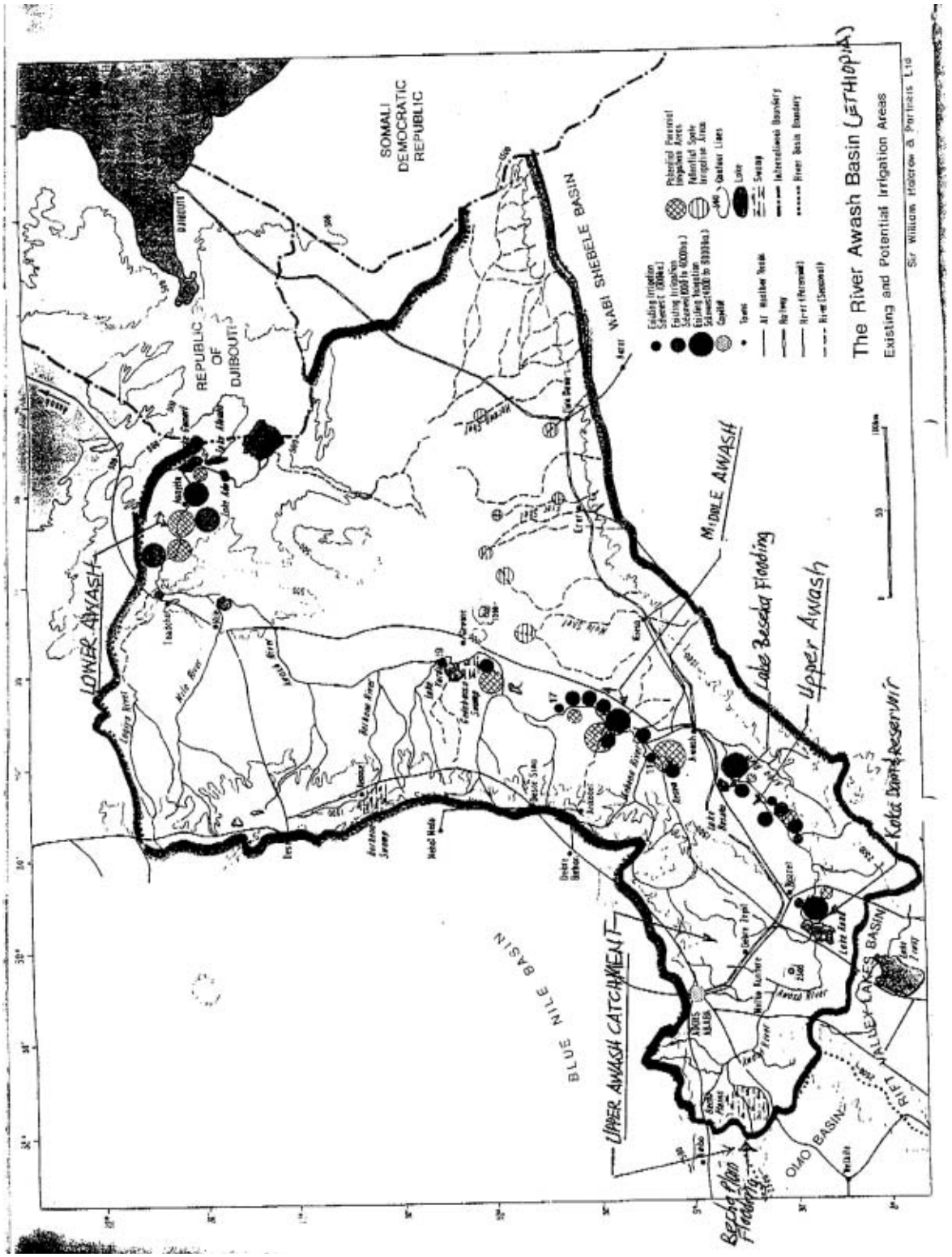
5.4 Urban Flooding

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 river banks from obstructive structures to allow flood passage can curtail unnecessary damages of property due to floods.

Map # 1


AWASH RIVER BASIN
Lower Plains Flooding
Lake Beseka
Lake Awassa
Wabi Shebelle Flooding (Mustahil Area)
ERITREA
DJIBOUTI REPUBLIC
AFFAR REGION
AMHARA REGION
SOMALI REGION
ETHIOPIA
SOMALIA
SUDAN
KENYA
UGANDA
Baro Akobo Flooding

Map # 2


The River Awash Basin (ETHIOPIA)
Existing and Potential Irrigation Areas
Sir William Halcrow & Partners Ltd
SOMALI DEMOCRATIC REPUBLIC
REPUBLIC OF DJIBOUTI
WABI SHEBELE BASIN
LOWER AWASH
MIDDLE AWASH
Upper Awash
Lake Beseka Flooding
Koka Dam & Reservoir
UPPER AWASH CATCHMENT
BLUE NILE BASIN
RIFT VALLEY LAKES BASIN
OMO BASIN