International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 12 | Dec 2021 www.irjet.net p-ISSN: 2395-0072

Sustainable Flood Retention Basin in Beledweyne City Somalia

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Abstract - Beledweyne is a city in Somalia's central region. It is located in the Beledweyne District and serves as the capital of the Hiran region. The town is located near the Ethiopian border on the Shebelle River, about 210 miles (338 kilometers) north of Mogadishu. The Shebelle River divides it between eastern and western portions. Heavy rains pounded Beledweyne ten months ago. Flooding destroyed on homes, crops, and roadways, as well as displacing thousands of people. In 2020, the city's population was 193,529 and the population after one decade using Arithmetical increase method of population forecasting is expected to be 217,971. It is one of Somalia's 20 most populous cities. Data on the population of Beledweyne was gathered from public sources and reliable websites. The main Aim of this study is to obtain all required information for the construction of flood retention basin to store excess water of the river. This study will also use satellite data for maximum and average monthly Precipitation in Beledweyne and Geographic information system for determination of appropriate site of the retention basin.

Key Words: Retention basin, Juba and Shabelle Rivers, Sedimentation, Storm water, Runoff, High risk level.

1. INTRODUCTION

Flood risk is expected to rise in the future as a result of a mix of meteorological and socioeconomic factors. As a result, many floodplains are barred from long-term development. Flood prevention has become one of the most pressing environmental issues in modern society. New adaptation techniques must be established to limit the impact of river floods on people and property while also considering the environment. Retention basins are one of the most commonly used storm water management techniques. They collect surface runoff and employ natural processes like sedimentation and soil filtration to improve the water quality. In contrast to dry ponds (which store runoff for a limited time before releasing it all at once), retention basins keep standing water all of the time, allowing for the establishment of new habitat. The water from the retention basin can later be used for agriculture, community water supply, and other purposes. The Shebelle River is one of Somalia's permanent rivers, however it receives 90% of its water from Ethiopia, a neighboring nation.

The river supports agricultural output not just by supplying much-needed irrigation, but also by providing a very fertile flood plain where a range of crops for domestic and international markets are cultivated. The population of Beledweyn is mostly a combination of riverine and pastoral livelihoods, with a focus on the raising of goats and camels for meat and milk. Pastoralism, however, remains the most common source of income in this district.

1.1 Problem statement

The Melka Waken dam was erected on the upper sections of the Shebelle River in the Bale Mountains in 1989 with the assistance of Soviet engineers. This dam is Ethiopia's greatest hydropower generator, producing 153 megawatts. The Shebelle's recent past is littered with devastating flash floods. Prior to the 1960s, the Shebelle is reported to have flooded every other year; only two disastrous floods occurred during that decade, one in 1965 and the other in 1966. Floods wreaked havoc on three areas of Beledweyne in 1996. The river unexpectedly overflowed in the middle of the night on October 23, 1999, destroying homes and crops. According to local authorities, 34 humans and an estimated 750 animals killed in the floods, which left 70,000 people in need of aid. In June 2020, the river level in Beledweyne rose to 6.75 meters, above the moderate threshold of flooding in the area. At least ten people went missing after their boat capsized after the river breached its banks, and at least 22 people were killed in all.

1.2 Objectives

The overall objective of this study is to prepare all information needed to determine the flood retention basin in Beledweyne to:

Protect people and property along the riverbank, especially Beledweyne and its agricultural settlements, houses, and other economically important places. Excavate flood retention basins to hold excess water in the river, provide safe and fresh water to the communities in the surrounding region. To look into long-term solutions for making Beledweyne, particularly it's most vulnerable populations, more resilient to floods and other natural disasters. Farmers will benefit from improved water quality, and downstream erosion will be reduced.

2. Methodology

Recognizing the collapse of Somalia's government and the lack of governmental organizations in charge of data archiving and storage this has resulted in the loss of data and information, including data and information on natural and physical resources. In 2001, the international community, specifically the E.C., decided to fund a number of projects and programs aimed at reviving information collection and archiving. One of these is the Somalia Water and Land Information Management System (SWALIM), which has 1 million users. Situational Analysis, SWALIM Technical Report No. W-11

Satellite data: There has been a growing interest in using satellite data in numerous projects. This is because satellite data is available for any point on the earth, delivers consistent data over time, is growing more economical, And is becoming more widely used. Is becoming more manageable. On the other hand, satellite data has the potential to be a significant resource. The numerical values for finding reservoir volume utilizing Contours, which are the lines that connect points of identical value in a raster dataset, this is one of the most essential physical aspects of Retention basin capacity. This study will use a variety of input data, including contour data and elevation measurements, to calculate retention volume. The area of a single cell and the count, which specifies the number of cells with the same depth value, are required to calculate the volume. In this scenario, I used 10m for each cell size, resulting in a single cell with a 10*10 area. As a result, the area of one cell is 10*10. When you multiply it by count, you get the total area of the same depth level. The volume is calculated by multiplying 10*10*count by the depth value. 1794100m3 is the total volume of this retention basin.

ID	VALUE	COUNT	VOLUME
0	0	83	0
1	1	136	13600
2	2	120	24000
3	3	110	33000
4	4	119	47600
5	5	133	66500
6	6	128	76800
7	7	106	74200
8	8	102	81600
9	9	93	83700
10	10	75	75000
11	11	70	77000
12	12	59	70800
13	13	50	65000
14	14	50	70000
15	15	51	76500
16	16	45	72000
17	17	47	79900
18	18	56	100800
19	19	59	112100
20	20	163	326000
21	21	80	168000
			Sum=
			1794100

Table-1: summery of GIS work in Excel

3. Significance of the study

This study will benefit the residents of Beledweyne city and other areas where there have been no previous retention basins by preventing flood fatalities and providing water supplies for irrigation. The basins will be critical for storing and delaying storm water runoff from neighboring communities, particularly those in low-lying areas. Storm water runoff from these surfaces is faster than in natural environments, and it must be channeled to guarantee that the runoff happens at the proper rate.

The amount of water that can be cleaned and treated is restricted. These Retention Basins are used to manage flood flows and store water for home and agricultural use. By lowering pollutants and sediments, retention basins can help to improve water quality. (By Bill Leber on April 30, 2015)

4. River levels

This table Shows river levels throughout the year; when river levels are moderate, no flooding occurs; when river levels are at high risk, flooding occurs rarely. Flooding happens when the river level reaches its maximum capacity, and this is where we must concentrate our efforts. Shabelle reaches a maximum depth of 8.3 meters and an average depth of 6.0125 meters, therefore subtracting these figures gives us the depth of water that causes floods and necessitates storage, which is 2.2875 meters. In the eastern Ethiopian highlands, the river and its tributaries are severely incised, and the slopes are steep. The Juba River is joined by the Shabelle and Lag Dera rivers before it reaches the sea, however most of the water does not make it to the sea with the exception of excessive rains, whatever is left in the two rivers is lost in the wetlands before reaching Juba.

River	Station	Observed River-level (m)	Moderate risk levels(m)	High-risk levels (m)	Bank full (m)	Average
Shabelle	Beledweyn	1.95	6.5	7.3	8.3	6.0125
Shabelle	Bulo burte	1.6	6.5	7.2	8	5.825
Shabelle	Jowhar	3.2	5	5.25	5.5	4.7375

Table -2: River levels

The current floods along the Shabelle are the result of unusually strong rains in Ethiopia's highlands. As a result, river levels in Somalia have risen, resulting in floods.

At Beledweyne, the river level is 7.3 meters, one meter below the bankful level. In the area, there is a High Risk of Flooding.

River levels in Jowhar and Bulo-burte have dropped marginally in the recent week, although they are still well above typical for this time of year.

5. Population forecasting

Using Arithmetical increase method of population forecasting ,Population after one decade is expected to be P_{2030}=193529+1(24442) =217,971 This means that the population after one decade will increase 11.2% which will also increase the amount of water demand in The Beledweyne city.

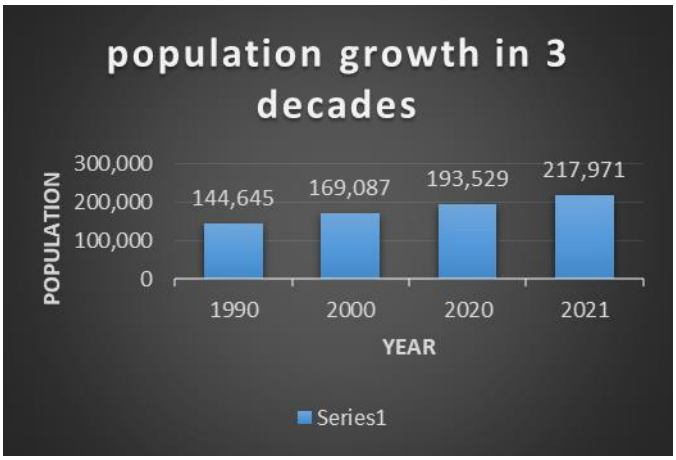

Fig -1: Population growth

6. Results

Selected site: After using GIS data for the selection of appropriate site for the basin this study found a catchment area that most of water accumulates. The Longitude of the site is 45.193435° and Latitude is 4.762392°. Ever though the study did not check the soil type of this site but most of Beledweyne and its surroundings have such geological conditions that percolation and absorption losses are minimum.

Capacity of the Retention basin: In this scenario, I used 10m for each cell size, resulting in a single cell with a 10*10 area. The volume is calculated by multiplying 10*10*count by the depth value and 1794100m3 is the total volume of this retention basin. Temperature: In the case of temperature, all it showed an increase in minimum and maximum temperatures in all seasons and sub-periods, similar to what has been observed in other regions of the world by temperature projections. Rainfall: Analysis of the rainfall indicated fluctuations in rainfall leading to cause unawareness of flooding or water supply scarcity during periods of decline.

7. CONCLUSIONS

In the city of Beledweyn, a retention basin needs to be built to lower the peak of floods. In this work, the approach for obtaining an effective retention basin is discussed. The building of the flood retention basin is expected to take about three and a half months. The structures and installations will be built in accordance with the approved standards and in compliance with the norms. The project will achieve its primary goal, which is to minimize flooding and meet the supplemental drinking water needs of the town of Beledweyn and adjacent areas. The project would also assure a steady flow of raw water to the river treatment facility, which formerly only operated during the rainy season and was interrupted by days of high turbidity water. The flood retention basin will allow Beledweyn to manage its water resources more efficiently.

Crop production accounted for little over 20% of pre-war foreign exchange, according to pre-war figures. In the Shabelle basin, 150,000ha of land was spate irrigated, with another 50,000ha under full control irrigation projects. Civil strife, along with El Nino floods in 1997/98, resulted in the utter collapse of all big irrigation facilities, and agricultural exports are now virtually non-existent due to flooding.

ACKNOWLEDGEMENT

This work would not have been possible without the full support of Prof. Dr. Hüseyin Gökçekuş, Head of the Department of Civil Engineering at Near East University, and Assoc. Prof. Dr. Youssef Kassem, Board Member of the Energy, Environment, and Water Research Center, who have been supportive of my career goals and actively worked to provide me with protected academic time to pursue those goals. They have taught me more than I could ever give them credit for as my professors and mentors. I'm grateful to everyone with whom I've had the pleasure of collaborating on this and other projects. My University Lecturers have all supplied me with substantial personal and professional mentoring and have taught me a lot about scientific research and life in general. The members of my family have been more significant to me in the pursuit of this undertaking than anyone else. I'd like to express my gratitude to my Uncle, who has always been supportive and encouraging of me in my endeavors. He is the ultimate role models.

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