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Sudan University of science and technology

College of Graduate Studies

Water Quality and Its Effect on some Fish Species Abundance and Weight at Up and Down of Jebel Aulia Dam

جودة المياه وتأثيرها في وفرة بعض الأسماك وأوزانها بأعلي وأدنى خزان جبل أولياء

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Summited by

Sulha khairalla bukhary dedan .

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Department of fisheries and wild life science

College of veterinary medicine and animal production

Supervision

Assistant Prof , Dr . Mubark Eisa Abdeelrahmn Tibin

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قال تعالي

(وَهُوَ الَّذِي سَخَّرَ الْبَحْرَ لِتَأْكُلُوا مِنْهُ لَحْمًا طَرِيًّا وَتَسْتَخْرِجُوا مِنْهُ حِلْيَةً تَلْبَسُونَهَا وَتَرَى الْفُلْكَ مَوَاخِرَ فِيهِ وَلِتَبْتَغُوا مِنْ فَضْلِهِ وَلَعَلَّكُمْ تَشْكُرُونَ)

سوره النحل الايه 14

DEDICATION

I Dedicated this work to my parents, Brother, Sisters, Teachers, and my steam friends who made the life wonderful.

ACKNOWLEDGMENT

All thanks and appreciation first to Allah, who gave me the strength to complete this study and great thanks also to my supervisor **Assistant Prof., Dr. Mubarak Eisa Abdelrahman Tibin**, director for Center of Human Development and Continual education, University of Bahri. For his guidance and provision of scientific knowledge. Also, I thank the staff of Department of Fisheries and Wildlife Sciences, Sudan University of Science and Technology. I also thank The Ministry of Agriculture, Irrigation and animal resources for providing me the equipment required for the study. Finally, I thank my family for their support and assist me to complete this study.

ABSTRACT

This study was conducted in the Jebel Aualia Dam, constructed on the White Nile near the capital of Sudan, Khartoum during the period from 1-21 MAY years 2017. The water were taken from Surface water from up and downstream of dam at depth of 10 cm and fish samples were taken from the up and down streams of the dam, 200 meters far from the dam. Use SPSS to analyze data with T independent test and use Excel (windows 2013). The water Samples analyzed to find out for some physiochemical characteristics. Fish caught from up and downstream at the same period and the available fish species in catch were determined and their weights were estimated. The results showed that most of the water properties such as temperature, dissolved oxygen, pH, ammonia and thermal conductivity had some changes in properties. The difference was not statistically significant. The most common fish species found were *Oreochromis niloticus*, *Chrysichusys auratus*, *Murmurs niloticus*, *Latess niloticus* , *Synodontis* , *Schilbeidae* , *Labeo niloticus*, up and down stream and also the results showed a difference in fish weights between the up and down of the dam, the average weights at the upstream of the dam ranged between 235-400 kg, and the average weights at the down of the dam ranged between 192-281 kg. In addition, there is a difference in the abundance of fish at the up compared to the down of the dam. This difference is attributed to a higher temperature at the down of the dam compared to the up of the dam, a decrease in the level of oxygen, and an increase in the pH, which in turn leads to an increase in the percentage of total ammonia in the water. All these changes in the quality of water are factors affecting the life of fish and thus play a direct role in their abundance.

ملخص البحث

اجريت هذه الدراسه في سد جبل أولياء الذي يقع على النيل الأبيض جنوب الخرطوم عاصمة السودان ، خلال الفتره 1-21 مايو 2017 تم اخذ المياه من المياه السطحيه للخزان اعلي وادني السد وعلي عمق 10سم, وتم اخذ عينات الاسماك من اعلي وادني السد وعلي بعد 200متر. . استخدم برنامج SPSS لتحليل البيانات بواسطه اختبار T independent و استخدم برنامج Excel(windows 2013) تم تحليل عينات المياه لمعرفه بعض الخصائص الفزيوكيميائيه للمياه . ايضا تم صيد الاسماك من اعلي واسفل السد في نفس الفتره لمعرفه الانواع المتوفره في المصيد وتقدير اوزانها. اظهرت النتائج أن معظم خصائص المياه مثل درجة الحرارة ، الأكسجين ، الأس الهيدروجيني ، الأمونيا والتوصيل الحراري بها بعض التغيرات في الخواص. ، الفرق لم يكن ذو دلالة إحصائية . وكانت الانواع الاكثر شيوعا هي البلطي ’ابوريالة ’ خشم البنات ’ العجل ’ القرقور ’ الشلبايه’و الدبس . وأظهرت النتائج ايضا اختلافً في اوزان الاسماك بين اعلي واسفل السد وكان متوسط الاوزان لاعلي السد يتروح بين 400-235كجم ومتوسط الاوزان لاسفل السد يتراوح بين281-192 -كجم . بالإضافة إلى انه يوجد فرق في وفره الأسماك في أعلى مقارنه باسفل السد. ،. يعزى ذلك الاختلاف إلى ارتفاع درجة الحرارة اسفل السد مقارنه باعلي السد ، وانخفاض في مستوى الأكسجين ، وزيادة الرقم الهيدروجيني الذي بدوره يودي الي زياده نسبه الامونيا الكليه في المياه كل هذه التغيرات في جوده المياه من العوامل المؤثرة في حياة الأسماك وبالتالي تلعب دور مباشر في وفرتها .

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CHAPTER ONE

1. INTRODUCTION

1.1Background of the study

Dams are inescapable structures of the world's riverine systems. All the way through history dams have watered farmland and prevented flooding by controlling water level. A hydropower dam often utilizes the potential energy of stored water to produce huge quantities of electricity (Francisco, 2004). Huge advantages made it easy to understand the importance of dams for our lives (Cumming, 2004) but everything about dams is not good. Dams act as barrier and consequently obstruct upstream and downstream migration of organisms (*e.g.*, fish) and thus alter the natural habitats. Hall *et al*., 2011). Dams create hindrance to the migration of fish for reproduction or feeding. The obstacle inhibits the function of upstream and downstream grounds due to varying water depths, water currents and patterns of sediment deposition leading to senescence before reaching to reproductive stage McLaughlin *et al*., 2006). Movement through hydropower dam turbines also causes death, particularly of adult fish. For local or potamodromous fish, race for reproducing sites and food can increase as dams disconnect and decrease the number and size of habitats (Cambray *et al.*, 1997).Genomic pools of occupying populations may also become less with the isolation created by dams (Nielsen *et al*., 1997). Sometimes, this separation may prove helpful for native biota by blocking the entrance of intrusive species (McLaughlin *et al*., 2007) or of toxins, parasites, or ailments into the habitat. The reduction in upstream migration is the most noticeable effect that occurs in areas with inadequate fish passage facilities left following construction of a dam (Holden, 1979; Ward and Stanford, 1987). Anadromous fishes are the ones that are affected most drastically and their populations' densities can greatly decrease (Brooker, 1981; Ward and Stanford, 1987). Dams also disturb downstream communities by altering physico-chemical parameters of water and habitat conditions. Tributaries-resident fish species are also affected by quality of water and river habitat. In short, dams set up great hazards to species diversity mainly that of fresh water throughout the world (Vorosmarty *et al*., 2010).

1.2 Problems of the study

There is rear data available in hand so far regarding effect of the dam on fish population since it`s construction. Since the construction of the dam did not considered aquatic livestock natural requirement. Therefore conducted study on the effects of dam on fish and the aquatic environments in the dam draw attention to conduct such type of studies.

Huge advantage made it easy to understand the importance of dams for our life, but not everything about dam s is good, when creating reservoirs, consider the ecosystem to minimize as much as possible its harmful effects. Providing information on the changes that the reservoir is making concerning water and fish life, to provide appropriate solutions when constructed

1.3 Objectives

In general, the study aimed to assess the impact of dam on fish population at jebel aulia dam. However, the specific objective are**:**

I. To compare some physio-chemical water characteristics up and down stream of jebel aulia

II. To evaluate fish diversity samples for composition and weight from up and downstream of Jebel Aulia dam.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Water Quality Changes

Dams can modify thermal and chemical characteristics of river water: the quality of dam-releases is determined by the limnology of the impoundment, with surface-release reservoirs acting as nutrient traps and heat exporters and deep-release reservoirs exporting nutrient and cold-waters (Petts, 1988). This can affect fish species and populations downstream. Water temperature changes have often been identified as a cause of reduction in native species, particularly as a result of spawning success (Petts, 1988). Cold-water release from high dams of the Colorado River has resulted in a decline in native fish abundance. (Holden and Stalnaker, 1975). The fact that *Salmo spp.* had replaced some twenty native species has been attributed to the change from warm-water to cold-water. Water-chemistry changes can also be significant for fish. Release of anoxic water from the hypolimnion can cause fish mortality below dams (Bradka and Rehackova, 1964).During high water periods, water which spills over the crest of the dam can become over-saturated with atmospheric gases (oxygen and nitrogen) to a level which can be lethal for fish. Mortality can result from prolonged exposure to such lethal concentrations downstream of the spillways. Substantial mortalities of both adult and juvenile salmonids caused by high spillway flows which produced high super saturation (120-145%) have been observed below the John Day dam on the Columbia river (Raymond, 1979). The Yacyreta dam on the Parana river generates supersaturated levels of total dissolved gases that can affect the health condition of fish: in 1994, massive fish mortality was observed in a 100 km reach below the dam (Bechara *et al.*, 1996).

2.2 Effect of dams on fish communities

The building of a dam generally has a major impact on fish populations: migrations and other fish movements can be stopped or delayed, the quality, quantity and accessibility of their habitat, which plays an important role in population sustainability, can be affected. Fish can suffer major damage during their transit through hydraulic turbines or over spillways. Changes in discharge regime or water quality can also have indirect effects upon fish species. Increased upstream and downstream predation on migratory fish is also linked to dams, fish being delayed and concentrated due to the presence of the dam and the habitat becoming more favourable to certain predatory species. FAO - Food and Agriculture Organization of the United Nations (FAO 2001)

2.3 Effect of dam on fish migration

Migratory fishes require diverse environments for their sexual maturation, growth, reproduction and production of juveniles that are the major phases of their life cycles (Fausch*et al*., 2002). On the other hand, non-migratory fish species also show the directional movements (Bunt *et al*., 2001). Dams are barriers to fish species that: interrupt their movement to complete their life cycle in large rivers (Larinier, 2001; Winter and Van Densen, 2001; Zigler*et al.*, 2004). A considerable decline in population of fishes occurs due to dam construction (Jackson and Marmulla, 2001). The unfavorable costs of dam obstruction in term of disturbance in movements of many fish species all over the world are well documented (Pringle *et al*., 2000). Dams can lessen short and long distance migratory species' diversity (Fernandes*et al*., 2009). The life cycle of diadromous species partly proceeds in sea and partly in river, whilst reverse situation has been recorded for catadromous species. On the other hand, potamodromous fish species migrate within the fresh water bodies for feeding and reproduction and do not migrate to sea. Mostly dams block access of fish species to their spawning destinations (GLLSWS, 2008). Mostly world's large rivers are disjointed by dams. Migration patterns among fish populations become interrupted to varying intensities by fragmentation of the ecosystem of the rivers as free flowing rivers are changed into reservoir habitats. Severity of fish migration interruption depends on the location and geoclimatic environment of dams in addition to rivers flows and several other associated factors. Moreover, habitat division has adverse genetic effects on populations that raises the hazards of species, extinction (McCauley, 1993).A single damming incident can separate neighboring river segments and block avenues of fish distribution (Schlosser and Anger Meier, 1995).The effect of dam construction on Salve Linus leucomaenis white-spotted char (stream dwelling fish) inhabitant of south western Hokkaido streams (Japan) was assessed and it has been reported that out of 52 upstream sampling locations from dams, S. leucomaenis specimens were present at only 35 sampling sites. Whereas the fish specimens were present throughout undammed upstream areas, it was suggested that the damming would cause negative impact on charr population. After dam construction, the five habitats' analyses showed the disappearance of S. leucomaenis (Morita and Yamamoto, 2002).In China, some fish species migrate between the upper reaches and the lakes adjacent to the middle and lower reaches of rivers for reproduction, overwintering and feeding. Due to the creation of Danjiangkou Dam on the Han River, links between the lakes and river became obstructed. This situation modified the fish behavior which continued living in the river. Among them, reproduced in river and their progeny survived (Yu et al., 1981).Whereas some rare fish species, like Myxocy prinusasiaticus (Chinese sucker), Psephurus glades (white sturgeon) and Chinese sturgeon Acipensersinensis were threatened as a result of Gezhouba construction on Changjiang river, China (Liu et al., 1992).Before dam construction, the sexual development of Chinese sturgeon was greater than those caught below the Gezhouba Dam (Hu et al., 1992). In addition, various Chinese sturgeons were observed rigorously dead or damaged beneath the dam which were apparently injured while trying to ascend the Gezhouba Dam (Yu et al., 1986a). In addition to these examples, migratory fish had vanished from the East river, a branch of the river (Pearl, by 1970), following building of numerous reservoirs in the superior parts of the river and five dams in the lower reaches. Upstream migrations Due to impoundments, the changes in fish population occur through several mechanisms (Ward and Stanford, 1987). The upstream migration of anadromous species may be prevented by dam from feeding to breeding zones. Diadromous species have been under an uninterrupted and ever-increasing decline in France since the 19th century: in majority of cases, the constructions of dams have been the chief causes of decline that prevent free upstream migration. The harmful effects of such impediments on anadromous species (mainly Allis shad and Atlantic salmon) have been much more significant than habitat destruction, overfishing, and water pollution in the main rivers. Obstructions have been the major reason for extinction of whole stocks of salmon in the Seine. Rhine, and Garonne rivers or for the confinement of certain species to a very restricted part of the river basin like salmon in the Loire, shad in the Garonne or Rhone etc. (Porcher and Travade, 1992).

The construction of hydroelectric dams on the Volga, Don and Caucasian rivers has been the major reason of depletion and extinction of Sturgeon stocks (Petts, 1988). Migrating species, mostly shad and salmon, in the Penobscott Connecticut, Merrimack Rivers, on the East Coast of the USA, have been predominantly threatened by dams (Baum, 1994; Meyers, 1994; Stolte, 1994). Reduction in fish diversity due to interruption in migration by Xinanjiang dam, China has also been reported (Zhong and Power, 1996) Victor et al. (2005) reported that, fragmentation by 15 dams on the Fox River, Illinois and the impoundment to the river's surface area influenced the distributions of about 30 species of fish by restricting their upstream movements.

2.3.1 Delays in Migration

Impoundments can have an effect on the timing of fish downstream migration. In the Columbia basin, during low flows, juvenile Chinook salmon reach the estuary about 40 days later than they did before the dams were constructed: impoundments of river flows by dams have more than doubled the time required for migration of juveniles to the sea. Such delays can have a rather drastic effect by exposing fish to intensive predation, to nitrogen super saturation and several other hazards such as exposure to disease organisms and parasites. The delay can also result in a significant portion of the juvenile population residual and spending several months in fresh water (Ebel, 1977).

2. Loss of Habitat

Dam construction can dramatically affect migratory fish habitat. The consequence of river impoundment is the transformation of lotic environment to lentic habitats. Independently of free passage problems, species which spawn in relatively fast flowing reaches can be eliminated. From a study of the threatened fish of Oklahoma, Hubbs and Pigg (1976) suggested that 55% of the man-induced species depletions had been caused by the loss of free-flowing river habitat resulting from flooding by reservoirs, and a further 19% of the depletion was caused by the construction of dams, acting as barriers to fish migration. About 40% of the spawning grounds in the Qiantang River above the Fuchunjiang dam were lost by flooding (Zhong and Power, 1996). On the Indus River, the construction of the Gulam Mahommed Dam has deprived the migratory *Hillsa ilisha* of 60% of their previous spawning areas (Welcomme, 1985). On the Columbia River and its main tributary the Snake River, most spawning habitat were flooded, due to the construction of dams creating an uninterrupted series of impoundments (Raymond, 1979).

The suppression of flood regime downstream from an impoundment by means of flow regulation, can deprive many fish species of spawning grounds and valuable food supply (Petts, 1988). This can lead to changes in species composition with loss of obligate floodplain spawners. Dam construction for industrial uses within the Rio Mogi Guassu Brazil has resulted in the progressive loss of flood plain wetlands (Godoy, 1975). The cumulative effect of diminished peak discharges, stabilized water levels, reduced current velocities and water temperature eliminated spawning grounds below the dams on the Qiantang and Han rivers: six migratory fish and five species favouring torrential habitats declined severely (Zhong and Power, 1996). The reaction of the fish communities of the Chari, Niger and Senegal rivers to flood failures provoked by natural climatic variations illustrates the highly detrimental effect of suppressing the flood (Welcomme, 1985).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Site of study

Study was conducted in Jebel Aulia Dam, in the White Nile near the capital of Sudan, Khartoum. Latitude: 15° 14' 10.20" N, Longitude: 32° 29' 10.79" E, Jebel aulia is a village in the north-central part of Sudan, about 40 km south of Khartoum. The Jebel Aulia Dam, Its constructed began 1933 and was completed in 1937.

3.2 Materials

Global Positioning System (GPS) used phone GPS determine the location, All devices used to measure the quality of water belong to a company Palin test a leading company in water analysis technology, made in England The devices used thermometer, dissolved oxygen meter, ph. meter, Ammonia meter, turbimeter and TDS (total dissolved solid). The used normal balance weighing fishes, made in china, used nets with mish size 2 cm and made of filaments, and fiberglass boat was used in the fishing process

3.3 Methods

The samples were collected for 18 days from up and downstream , Water samples were taken from near the dam and far to 200 meters , from surface at depth of 10 cm , water were collected from the river was using bottles. Used palin test device to measure water quality , the reading was done in the morning period at eight o'clock to nine o'clock daily.

The readings were recorded for six Characteristics (temperature, dissolved oxygen, pH, ammonia, turbidity and thermal conductivity). an average of three readings were taken to reduce the rate of error, and at the same time fish samples were taken using a boat and nets, and then weigh For each fish separately, the average weight of the fish was taken for each species and the abundance species were recorded from the up and downstream

3.4 statistical analysis

The data were analyzed using SPSS version 16, and T independent test to obtained means and standard deviation. Excel program (windows 2013) was used to convert tables to figures for easy viewing Results.

CHAPTER FOUR

4. RESULTS

4.1 The measurement of the water quality samples for six factors were, temperature, dissolved Oxygen, PH, turbidity , ammonia and conductivity the samples collected from upstream and downstream.

4.1.1 The temperature at the up of the dam is lower than at the downstream of the dam

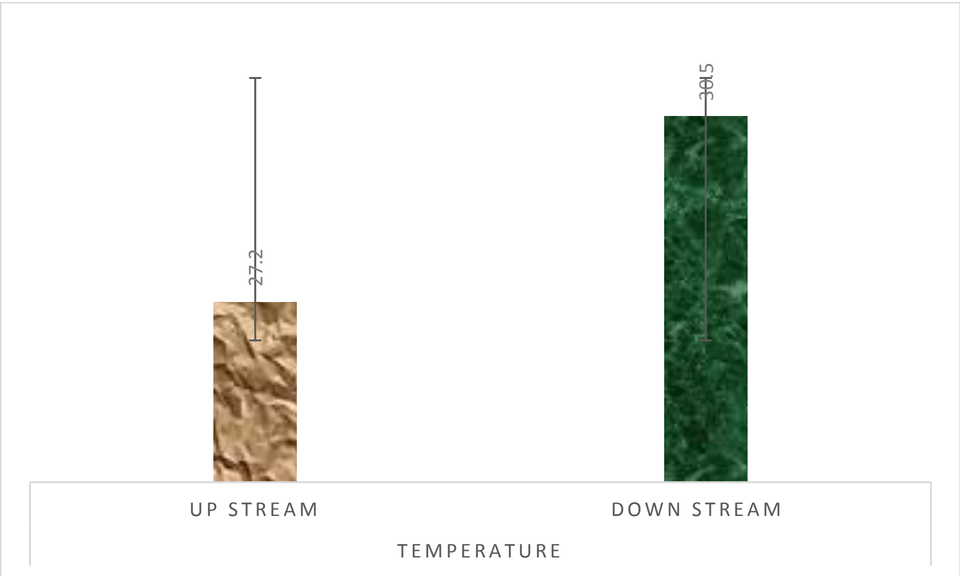

Figure 4.1.1 Shows measured about the means of temperature in up and downstream of dam jebel aulia

4.1.2 The results for the dissolved oxygen level in upstream was higher than in downstream

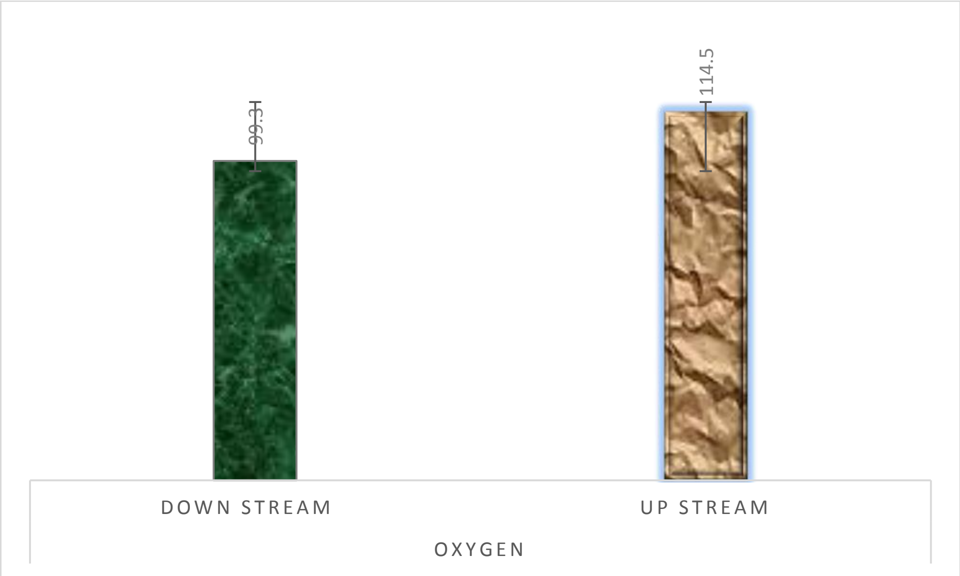

Figure 4.1.2 Shows measured about Oxygen levels in up and downstream of jebel aulia dam

4.1.3 The results for the Ph. in upstream was lower than in downstream

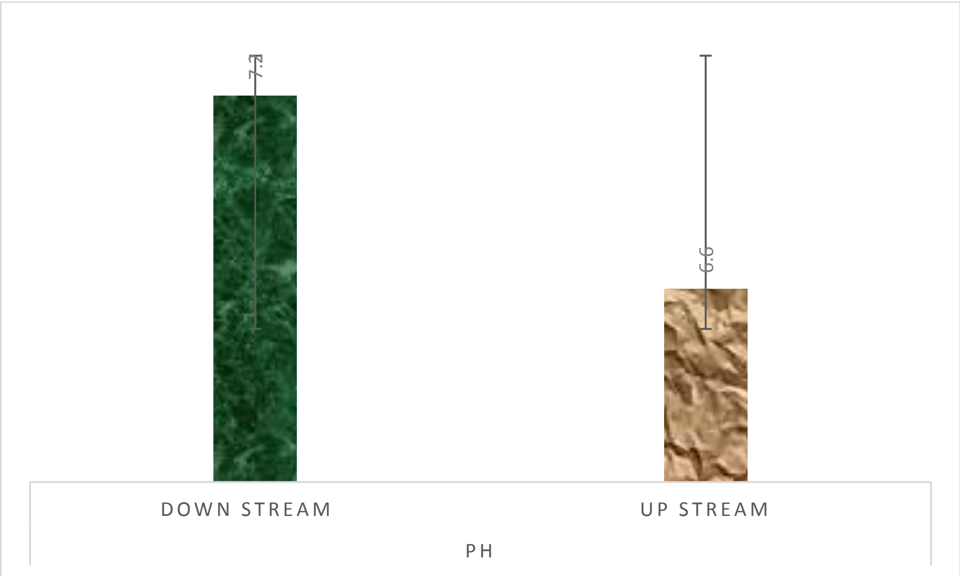

Figure 4.1.3 Shows information about Ph. in up and downstream

4.1.4 The results for the turbidity in upstream was lower than in downstream

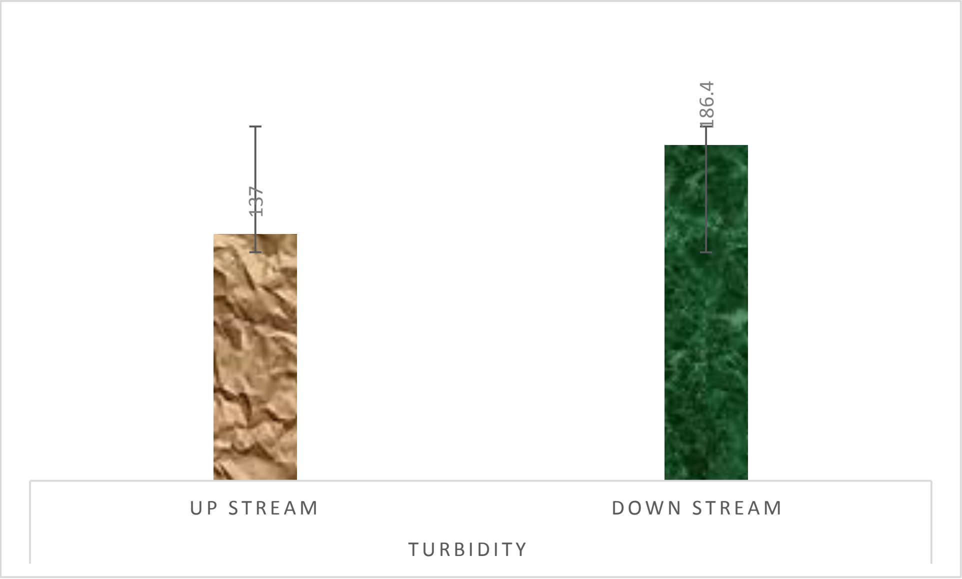

Figure 4.1.4 Shows information about Turbidity in up and downstream

4.1.5 The results for the Ammonia in upstream was lower than in downstream

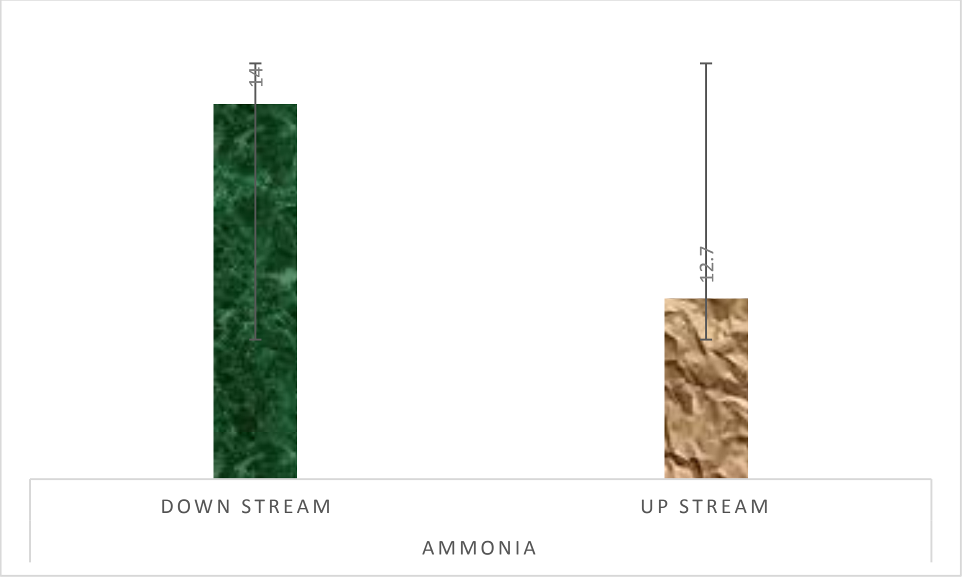

Figure 4.1.5 Shows information about Ammonia in up and downstream

4.1.6 The results for the Conductivity in upstream was higher than in downstream

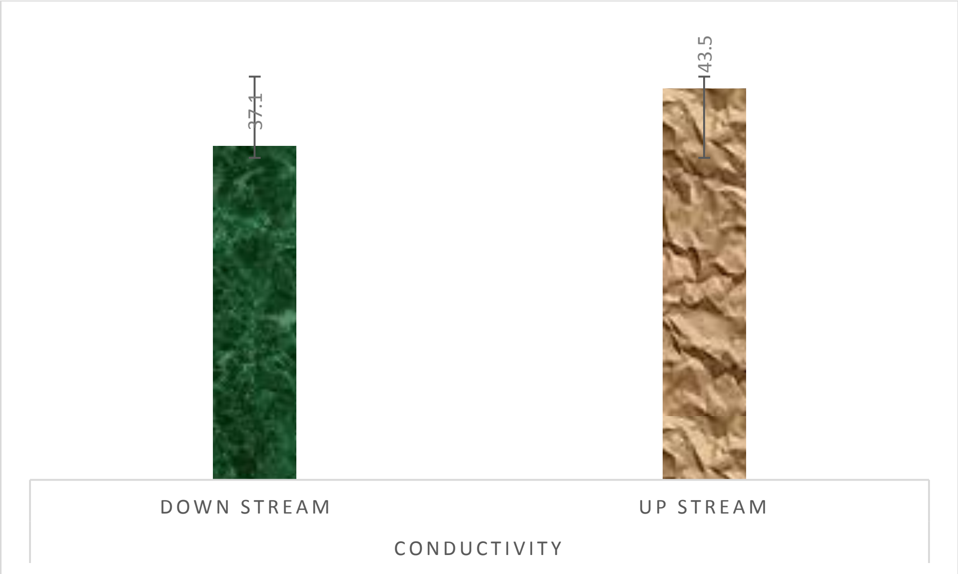

Figure 4.1.6 Shows information about Conductivity in up and downstream

4.2 Abundance of fish in up and down stream

Samples were taken to know the abundance of fish the fish weight were record, the study focused in six species which were dominant.

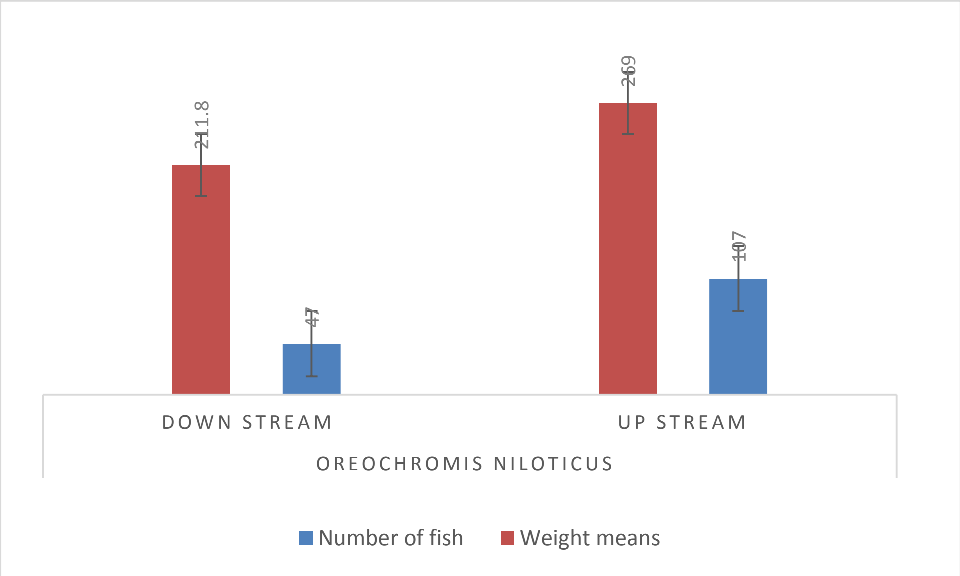

Figure 4.2.1 Shows information about the means of weight and number of *Oreochromis niloticus*

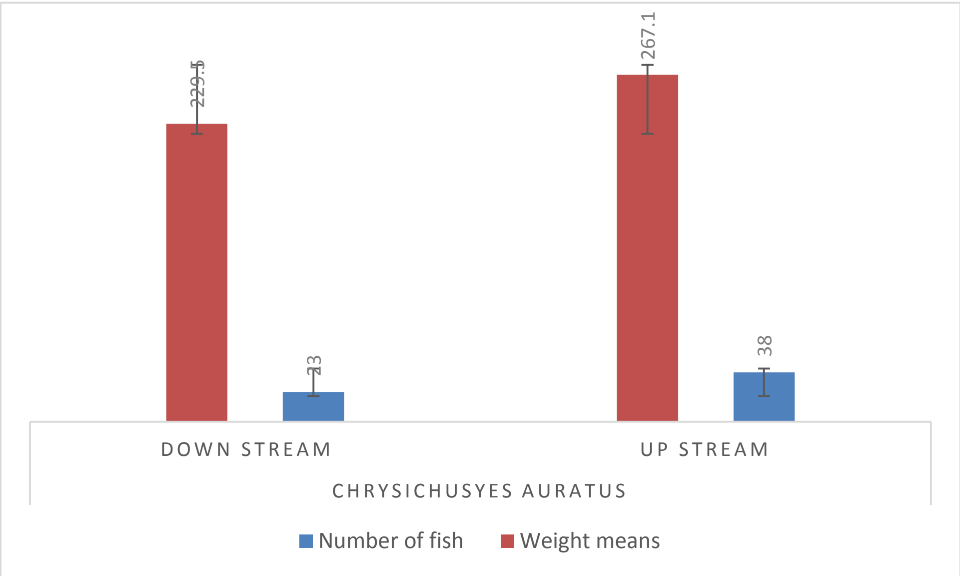

Figure 4.2.2 Shows information about the means of weight and number of *Chrysichusyes auratus*

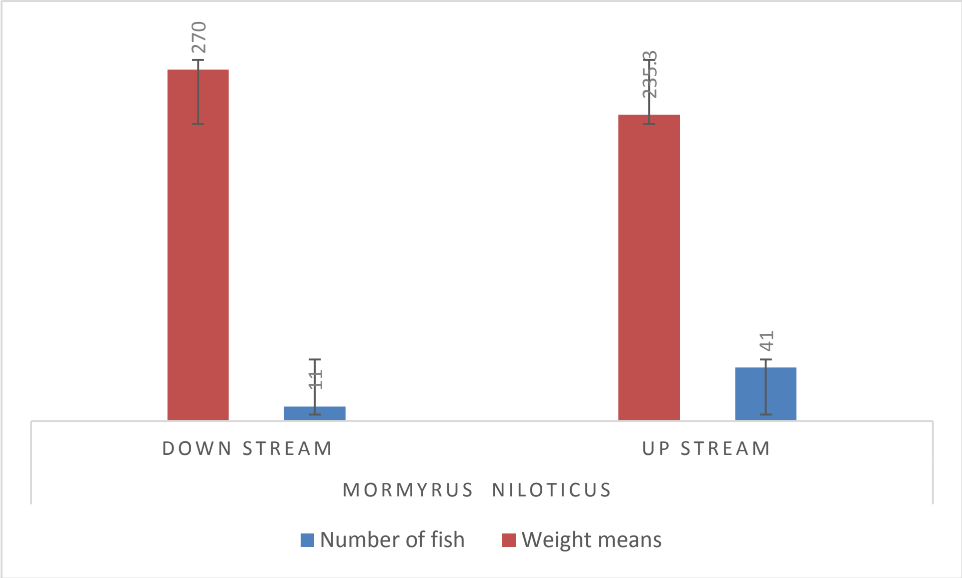

Figure 4.2.3 Shows information about the means of weight and number *Mormyrus niloticus*

Figure 4.2.4 Shows information about the means of weight and number *Lates niloticus*

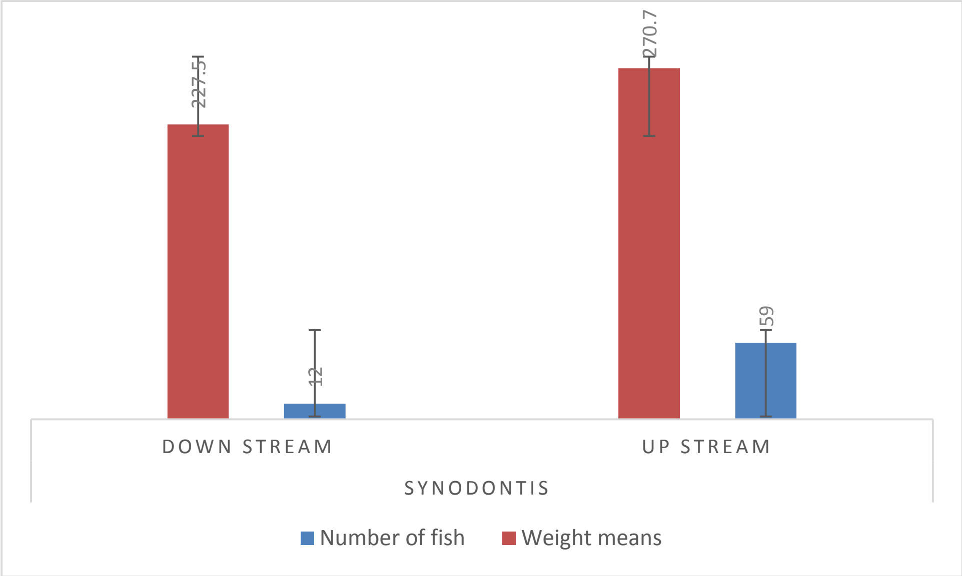

Figure 4.2.5 Shows information about the means of weight and number *Synodontis* schall

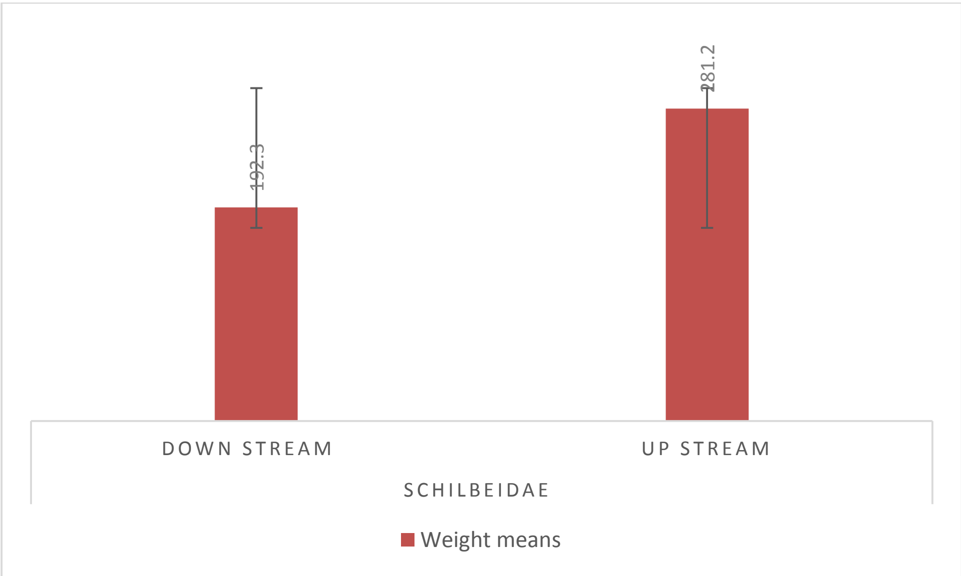

Figure 4.2.6 Shows information about the means of weight and number of *Schilbidae*

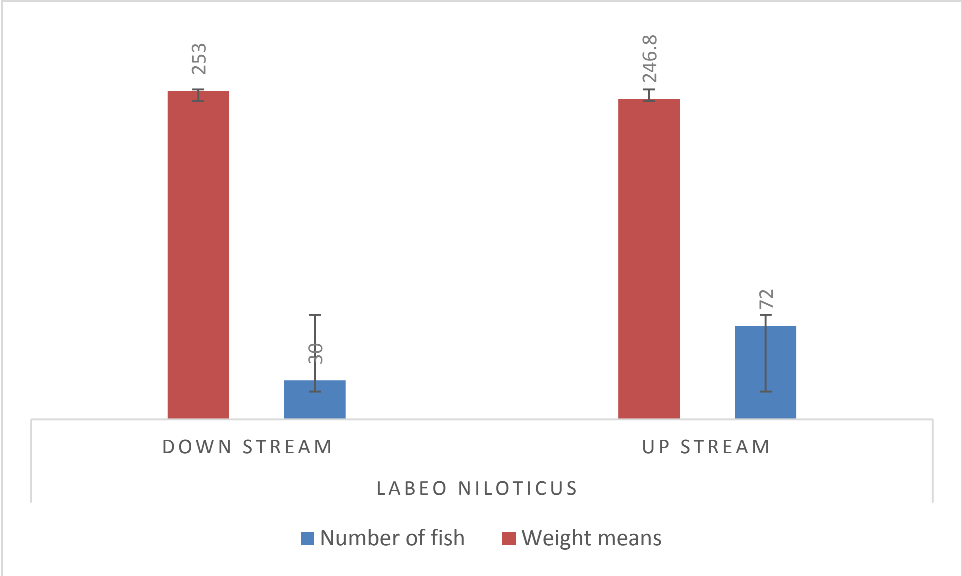

Figure 4.2.7 Shows information about the means of weight and number of *Labeo niloticus*

4.3 Found that there was significant differences in weight of fish species during the three study weeks.

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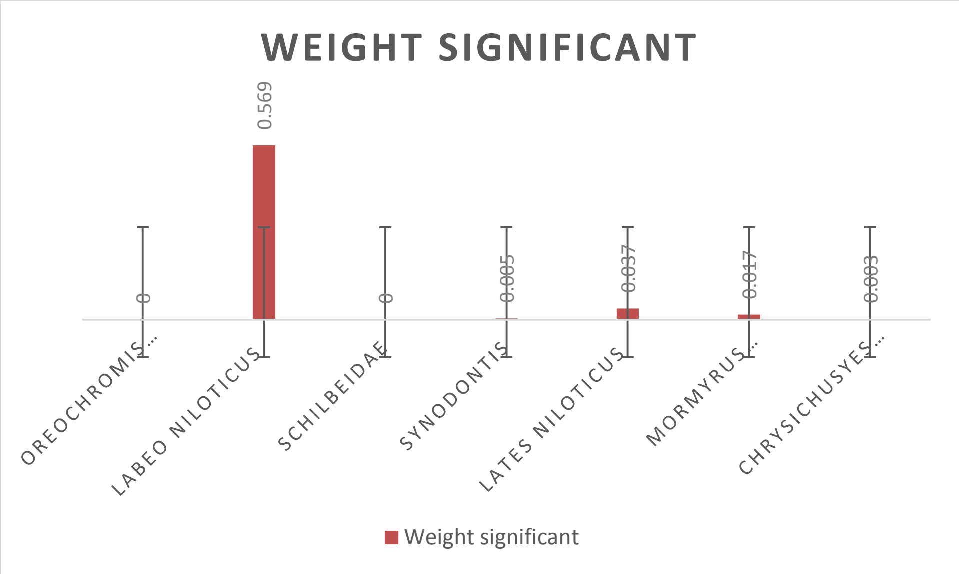

Figure 4.3 Shows information about the of weight significant P ≥0.5 of fish in up and downstream

CHAPER FIVE

5. DISCUTION

After the required measurements of water quality for a period of three weeks were made for both upstream and downstream, the quality of water in the up and downstream showed slight difference which was insignificant($P \geq 0.5$).The temperature in the downstream is higher than the temperature in upstream that disagree with Jackson and *etal* (2013), Water temperature on the other hand increased along the river course upstream throughout the sampling period and were observed to be higher upstream compared to the downstream although contrary to observations made by Moore and Miner(1997) that the rate of increase of water temperature slows as the water moves downstream. Temperature in the downstream is higher than the temperature in upstream this lead to higher percentage of total ammonia in water in addition to the increase in ph. (High alkalinity) which lead to an increase in the harmful ammonia levels that agree with Moore and Miner, (1997). The oxygen level in up higher than downstream this is due to the high temperature at the downstream it works to reduce oxygen.

From the results of the study, I found a difference in the up and downstream Ph. that agree with, Jackson and *etal* (2013) From this present studies, it is observed that the pH values for the water samples ranged from a minimum of 6.34 to a maximum of 7.43 were statistically insignificant ($P \geq 0.05$). Downstream values were generally higher than upstream in all the sampling periods that lead negatively affected of aquatic life.When the pH increases it indicate that the water alkaline is high and this leads to the reaction and the formation of toxic ammonia and thus affected fish life that agree with, Hynes (1970) , Abdul-Razak and *et al.*, (2009)

The result showed that the turbidity in downstream of dam is higher than upstream that agree with Bernacsek, Garry (2001) the turbidity of outflow water of the dam is usually low and there is no deposition of nutrient-rich sediment on the downstream floodplain or delta. This will reduce the fertility and productivity of downstream aquatic environments. The negative impact on fish production may in some situations be felt as far downstream as the estuary and adjacent sea The result showed that the ammonia in downstream of dam is higher than upstream that disagree with , Jackson Adiyiah1 and others (2013) Could not find any significant difference between the up and down streams ammonia ($p \geq 0.05$). There was significant differences in weight of fish species during the three study weeks, and the difference appears in fish abundance where it was less at the downstream. That agree with Bernacsek, Garry. "(2001) Dams with large storage reservoirs can produce abnormally low discharge flows in the downstream river channel, and reduce or eliminate inundation of downstream floodplains. The reduced water level and duration and area of inundation severely limit fish production. Fish biodiversity also generally suffers losses. The *Oreochromis niloticus* no significant differences in weight this is because of its high ability to withstand the changes that occur.

The study found that the weight of fish in the upstream is higher than downstream fish ,due to the temperature ,oxygen , ammonia and all of properties of water quality and another factor may be effected all of this lead to many changes in the life of fish .The result of catches caught in the Jebel aulia dam during the study period consist of *(Oreochromis niloticus, Chrysichusys auratus, Mormyrus niloticus, Lates niloticus, Synodontis schal, Schilbeidae, Labeo niloticus*) a comparison with a study Adam (1986). Over 95% of commercial catches from Jebel Aulia Reservoir consisted of seven families, according to Adam (1986). The family composition was as follows (Mormyridae, Mochokidae,Schilbeidae,Characidae,Cyprinidae,Bagridae,Citharinidae) Comparison with a study, found there is some difference in the fish families, and this indicates that the dam has a direct or indirect effect on fish.

CHAPFTER SIX

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Water quality is one of the important factors for fish life and aquatic organisms, and there is a great relationship between the changes that happen to water and the changes that motivate the life of fish. The upstream preserves the properties of natural water while the downstream contains some changes in the properties of water. The study showed a difference in fish weights between the up and downstream , the average weights at the upstream of the dam ranged between 235-400 kg, and the average weights at the down of the dam ranged between 192-281 kg, addition the fishs tilapia is the most abundant compare with another species .

6.2 Recommendation

- Due to the short period of the study, several studies must be carried out in the dam areas and at different seasons or during all season in order to collect the adequate of data.
- Conducting many studies in reservoir areas to provide more information
- A comparison of previous studies and current studies in order to know the extent of the changes that have occurred to the environment and aquatic neighborhoods in the area of dams
- To suggest studies on the impact of fishing at fish lader
- Official authorities should submit monthly reports on the dam area
- Appropriate fish pass should be designed for a sustainable development fishery

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8 . APPENDIX

The table 8.1: Shows the water quality measures which appears from figure 4.1.1 to figure 4.1.6

water quality measurement	Samples source	Means	Std deviation
Temperature	Up stream	27.2	1.54
	Downstream	30.5	1.10
Oxygen	Up stream	114.5	8.00
	Downstream	99.3	3.8
PH	Up stream	6.6	.249
	Downstream	7.2	.486
Turbidity	Up stream	137.0	26.9
	Downstream	186.4	33.8
Ammonia	Up stream	12.7	1.03
	Dow stream	14.0	.91
Conductivity	Up stream	43.5	3.3
	Downstream	37.1	4,87

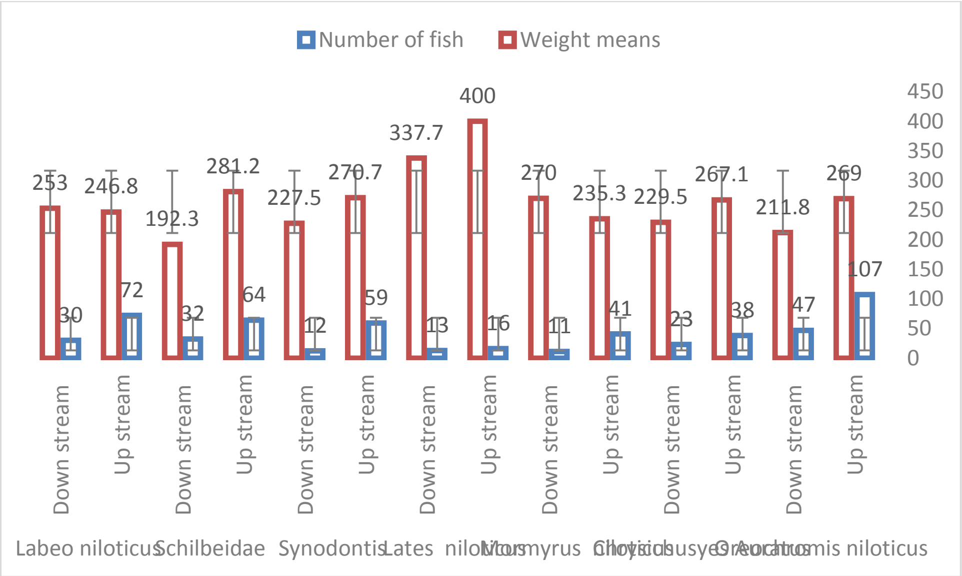
The table 8. 2: Shows means of fish weight and number of fish in up and down stream which appears from figure 4.2.1 to figure 4.2.7

Fish species	Samples source	Number of fish	Weight means	Std deviation
Oreochromis niloticus	Up stream	107	269.0	53.8
	Downstream	47	211.8	28.9
Chrysichusys Auratus	Up stream	38	267.1	48.8
	Downstream	23	229.5	37.8
Mormyrus niloticus	Up stream	41	235.3	57.2
	Downstream	11	270.0	34.05
Lates niloticus	Up stream	16	400.0	89.44
	Downstream	13	337.7	54.4
Synodontis	Up stream	59	270.7	49.6
	Downstream	12	227.5	28.3
Schilbeidae	Up stream	64	281.2	61.5
	Dow stream	32	192.3	16.6
Labeo niloticus	Up stream	72	246.8	53.1
	Downstream	30	253.00	40.6

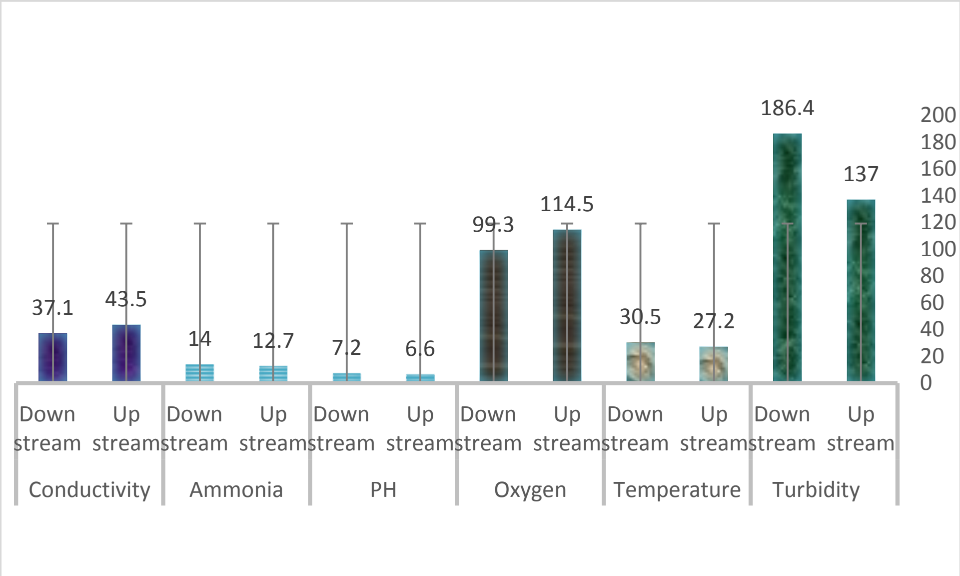
Table 8.3: Show significant of fish weight

Species	Weight significant
Oreochromis niloticus	0.00
Labeo niloticus	0.569
Schilbeidae	0.00
Synodontis	0.005
Lates niloticus	0.037
Mormyrus niloticus	0.017
Chrysichusys Auratus	0.003

8.4: The figure shows measurements of fish weights and the number of fish for six species of fish, which are *Oreochromis niloticus*, *Labeo niloticus*, *Schilbeidae*, *Synodontis scall*, *Lates niloticus*, *Mormyrus niloticus*, and *Chrysichusys auratus* in a up and downstream.



8.5: The figure show measured means of water quality, temperature, Oxygen, PH, turbidity , ammonia and conductivity the samples collected from upstream and downstream for eighteen days



Company of water quality

Dissolved oxygen meter

Ammonia meter

Turbimeter

Fish weight