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Characterization of Water Use Pattern among Rural Dwellers in Anambra-Imo River Basin of Nigeria

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ABSTRACT: This research concentrated on investigating the pattern of water use among rural dwellers in Anambra-Imo River Basin area in Nigeria. The study used sub-river basins of Njaba, Mmam, Otamiri and Aboine as the sample areas for the study. Data on the various uses of water by the citizens of the sub-river basins were collected through administration of questionnaires. The water use attributes as exhibited in the basin for irrigation, consumption, electric power production and industrialization were collected. From the research, it was discovered that water used in the basin was below the World Health Organization standard and source of water was concentrated on groundwater while the surface water was left underutilized. The research observed the glaring absence of dams making water utilization for irrigation and energy production impossible. The water use in the basin per capita per day was observed to be $0.102m^3$. This research will go a long way to ameliorate the challenges and problems associated with the dearth of data on water usage within the basin and help water managers and planners on how best to allocate water to residents of the basin.

I. INTRODUCTION

Water has far reaching importance which ranges from health improvement, industrial development, hydro-electric power generation, agricultural development, recreation to navigation and it possesses the potentiality of sustaining the existence of the fauna and fora in the earth. It is obvious that direct consumption of water by plants and animals is top among other importance uses of water. Water has other important functions as it can be used for washing, transportation, recreation, industrial applications, chemical uses, fire extinguishing, electric power generation etc (Ayoola, 2011).

Water makes up more than two-thirds of human body weight and life cannot be sustained for few days without water. The human brain is made up of 95% water, blood is 82% and lungs 90%. A mere two percent drop in body water supply can trigger signs of dehydration and fuzzy short memory (Garg, 2010). Water serves as a lubricant in digestion of food as it helps to lubricate our joints and cartilages and allows them to move more freely. Water plays a significant role in moderation and regulation of body temperature, water helps in transporting blood within the body and circulates antibodies from the immune system. The entire world uses world water day to highlight the importance of water. In 1992, the United Nations declared March, 22nd of everyday world water day (Igali, 2011).

The United Nations conference on sustainable development in Rio de Janeiro in June 2012 (Rio+ 20 Summit) stated that water is the blood stream of green economy. Water, energy and food are interlinked and interdependent, securing them is central to alleviating poverty and to creating a climate of resilient and robust green economy. Population growth, expanding cities and accelerating economic activity increase the demand for energy and food and create unsustainable pressure on our water and land resource (Esan, 2002). It has been established that the provision of water to households in developing countries would contribute to the eradication of poverty. However, providing water in an efficient, sustainable and equitable manner is a difficult task, because of the existence of equilibrium trap in the water sector in developing countries (Singh et al, 1993). Provision of water to people needs a flexible approach based on an in depth analysis of the given situation, the players involved and their potential. Good and accountable governance and a sound all-round management of water are keys for sustainable water services in economic, social and ecological relationships and dimensions which portends towards national water supply sustainability.

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A. Water Uses and Applications

Throughout history, water has been considered a natural resource critical to human survival. From the earliest evaluation of hominid species around the lake shores of northern Kenya to the development of the main civilization on the banks of certain major rivers, human history can generally be considered to be water-cantered. The early important civilization developed and flourished on the banks of major rivers such as the Nile, Euphrates, Tigris and Indus. Human history can, in fact, be written in terms of interactions and interrelations between humans and water.

It is not difficult to realize why civilization and habitat often developed along the banks of several strategically important rivers. Easy availability of water for drinking, farming and transportation was can important requirement for survival. Human survival and welfare generally depended on regular availability of and control of water. Floods and droughts inflicted major pains, often contributing to deaths of human beings and livestock. Because water played a very important role, when Rishi Narada of India, probably the earliest leading authority on politics who lived many centuries before the Christian era, met the great Pandava kings, Yuddhistira, his greeting was water cantered because of its importance; "I hope your realm has reservoirs that are large and full of water, located in different parts of the land, so that agriculture does not depend on the caprice of the Rain God" Proper management and control of water means that the ravages due to drought and subsequent famines could be significantly reduced.

World Health Organization estimates that 80% of all diseases is in one way or the other connected with contaminated water usage. (Murty et al, 2009). Without a good functional system, human water system, human productivity will tend to zero, be it agriculture, industry or trade. Despite, the estimable importance of water, almost half of the population of developing countries have neither the quantity nor the quality of water they need and even fewer people have access to sustainable disposal facilities for sewage. Sustainable development means overcoming conflicts between environmental protection and economic growth and implementing concepts that are socially balanced, economically efficient and environmentally sound (Anis et al, 1977).

B. Requirements of Water for Various Uses

Water is required by a community, by a state or a country, for fulfilling its numerous needs. The determining elements for water demand are the population and desired quality of life. Amid rapid pace of urbanization and other telling factors, Nigeria is facing the mammoth challenges of water management and governance and to have the proportion of people living without access to safe drinking water and basic sanitation reduced: these are huge but surmountable challenge. The issues bedevilling the water sector ranges from poor long term investment, corruption, poor management, weak government and contamination of water supply in urban, rural and small towns infrastructure. The 2005 report of the Millenium Development Goals have indicated that 51.6% of Nigerians live below the poverty line of one dollar per day (Jidda, 2011). In view of the importance of water as one of the essential components necessary for the survival of human life, animal life and plant life, its role in bettering the quality of the lives of individuals and nations cannot be over stated.

- Demand for Municipal and Industrial Water:

Water is needed by the public for various uses such as domestic, industrial and commercial, public, fire fighting, compensation losses, leakages and thefts.

- Domestic water demand included the water required in private buildings for drinking, cooking, bathing, lawn sprinkling, gardening, sanitary uses etc. The amount of domestic water consumption per person shall vary according to the living conditions of the consumers. On an average, the domestic consumption under normal conditions in an Indian city is expected to be around 135 litres per capita. In a developed and affluent country like U.S.A., the figure goes as high as 340 litres/day/capita. The total domestic consumption generally amounts to 55%-60% of the total water consumed for municipal and industrial purposes (Anis et al, 1977).

The total domestic water demand shall be equal to the total design population multiplied by the per capital domestic consumption.

- Industrial and commercial water demand includes the quantity of water required to be supplied to offices, factories different industries, hotels, hostels, hospitals etc. The quantity will vary considerably with the nature of the city and the number and types of industries and commercial establishment in the locality. On an average, a provision of 20-25% of the total public water consumption is generally allowed for these uses.

In small residential communities, the industrial use may be as low as 45 litres per day but in industrial cities, it may be as high as 450 litres per day. Commercial districts include office buildings, ware- houses, stores, hotels etc and their demands are not high, averaging about 45 litres per day per capita.

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- Demand for public uses includes the quantity of water required for public utility purposes such as watering of public parks, gardening, washing and sprinkling on roads, use in public fountains etc. These needs are not regarded as essentials and a nominal amount not exceeding 5% of the total consumption may be added to meet this demand on an arbitrary basis.
- Fire Demand: In densely populated and industrial areas, fire generally breaks out and may lead to serious damages if not controlled effectively. Fire fighting personnel require sufficient quantity of water so as to throw it over the fire at high speeds. A provision should therefore be made in municipal water supply schemes for fighting fire. The quantity of water required for controlling fire should be easily available and accessible and kept always stored in storage reservoirs. The water is accessed through manholes connected to the dedicated water line. However, the total quantity of water required is generally very small and it is of the order of 1litre/day/capita.

C. Domestic Water Use in Nigeria

The demand for water by individual or consumption of water by any community is a function of place or time. In the design of any supply scheme, it is necessary to estimate the present need of the people and the projected expected demand putting into consideration among other things, the demographic data and the socio-economic condition of the locality concerned. The minimum water for survival is in the range of 1.8 to 3.0litres per day while the total water requirement per person in a day is given as 300 to 340litres (Nilson et al, 2007). It has been observed that about 10% of water supply to communities is lost in wastages through broken pipes, leaking tanks and damaged water facilities. A typical domestic water consumption in a Nigerian city is shown in Table 1.1

Table 1.1 Typical Domestic Water Consumption in Nigeria.

S/N	WATER USES	DEMAND/DAY(L/D)
1	Drinking and Cooking	6.0
2	Kitchen Washing and Cleaning	20.0
3	Laundry	20.0
4	Car Washing	4.0
5	Garden and Recreation	50.0
6	Flushing and Disposal	50.0

Source: Ayoola, 2011

Table 1.1 shows that garden and recreation with flushing and disposal takes a lion share of the domestic water used in Nigeria while car washing takes least. This suggests that environmental cleanliness depends on water availability.

D. Water Demand for Irrigation

Nigeria is an agrarian nation. Therefore, genuine development of the economy of Nigeria is impossible without giving the deserved attention to agricultural production and industrial sector. 70% of the Nigerian population reside in rural areas and are pre-occupied in agricultural production. In Nigeria, rural areas contribute about 80% of the national agricultural production. (Adewumi et al 2011). Yet the potentials of these rural dwellers are under utilized due to non-provision of dams, and other irrigation facilities. Crops require certain quantity of water during the period of growth. If the natural rain is sufficient and timely to satisfy this requirement, no irrigation water is required for raising the crops. In the tropics and in the sub-Saharan the natural rainfall is either in sufficient or the water falls at intervals not required by the crops. Therefore water has to be augmented artificially from some outside sources such as irrigation methods. The relationship between the irrigation water and the area of crop that matures fully with the amount of water is known as duty of water while delta refers to the depth of water required excluding rainfall for the full crop period (Murty and Madan, 2009).

The total quantity of water required by a crop for its full-fledged growth, when expressed as cm depth of water standing over the irrigated area is known as delta. This total quantity of water must be supplied to the crop during the period of its growth in a number of watering at suitable intervals, as per the needs of a particular crop. The average values of delta for certain crops are shown in Table 1.6. These values represent the total water requirement of the crops. The actual requirement of irrigation water may be less, depending upon the useful rainfall. Moreover these values represent the values on field i.e. Delta on field" which includes the evaporation and percolation losses.

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Another important term which describes the water requirement of a crop is called Duty. The “duty” of water is the relationship between the volume of water and the area of crop it nurtures. Duty of water for a crop, is the number of hectares of land which the water can irrigate. Therefore, if the water requirement of the crop is more, it will irrigate less hectares of land for a given volume of water.

E. Water Requirement for Hydropower Generation

The high costs of electricity provision to the rural areas through extension schemes can gulp up to USD 50000/Km in comparison to a decentralized renewable energy system like small hydro power (SHP) which is considered to be cheaper (Esan, 2002). Micro hydropower is recognized as a renewable energy resources, which is economic, non-polluting and environmentally sustainable and ideal for rural electrification with proven and well advanced technology.

Small Hydro potential sites abound in most states of Nigeria’s river basin authority areas of coverage. Unexploited sites with SHP potentials, with total capacity of 7342 MW exist in various states (Esan, 2002). However, international collaboration and public private partnership PPP is suggested for such developments. The provision of electricity to rural areas through extension schemes of the grid transmission are heavily burdened by expensive equipment with the overhead costs attached to such schemes. It is cheaper to invest in a decentralized renewable energy system like mini and micro hydro SHP than to pay for connecting local communities to existing national grid which can consume about USD50000/km. Hydropower is a widely available resource and has most economically feasible potential in developing countries. It is environmentally friendly as it does not involve fossil fuel for its generation. Hydro power system has lowest operating, longest plant life about 40 to 50 years and can produce multipurpose benefits (Esan, 2002).

Hydroelectric power plants convert the energy from flowing water (hydro potential) in rivers and streams into electricity.. Exploiting water resources has many advantages and energy generation is just one of them. SHP can therefore maximize the value of water, not only by contributing to more security of power supply but also water management such as flood control, irrigation, water storage and water supply. Exploitation of resources is considered as a key area for developmental change as contained in Brundland Report of 1987 during the World Conference on Sustainable Development. Water is yet to be maximized as a major resource for developmental change. The exploitation of economically feasible potential as alternative to fossil fuel brings a reduction in global carbon dioxide production (Makoju, 2003).

Nigeria has considerable potential sources as exemplified by her abundant and large rivers and streams located in the various river basin authorities. The hydropower potential of Nigeria is high and hydro power accounts for a great percentage of the total installed commercial electrical power capacity.

II. METHODOLOGY

A. Area of Study

The areas of study are within the Anambra Imo River Basin and the rivers of study include Njaba, Mmam, Otamiri and Aboine. The host communities consist of Egbu, Nekede, Ihiagwa, Eziobodo, Mgbirichi and Umuagwo for Otamiri River while Amucha, Nkume, Ekwe, Okwudor, Umuaka, Awo omama & Nkwesi were used for Njaba River. Inyi, Awlaw, Akpugoeze and Ufuma communities are hosting Mmam river while Obolloafor, Ikem, Eha Amufu and Nkalaha communities are hosting Aboine river. These areas are sub-basin areas within the Anambra Imo River Basin.

B. Instrument of Data Collection

The questionnaire was divided into three sections A, B, and C. The section A contained item designed to obtain personal information of respondents. The items have options and blank spaces to enable the respondents tick as appropriate. Section B was designed for residents while Section C was for industries. The Section B was structured to obtain information of whether the respondent uses river as the main source of water supply or the borehole. When the source of water supply was established, it enabled us to gather data on the quantity of the water used. Section C was meant for industries and it was targeted to know the quantity of water used for industrial purposes. With these, the water quota and industrial water quota were obtained respectively.

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C. Survey Research Method

The survey research method was used for the study. This method is suitable for the study because it enabled the researcher to obtain information from people, who are considered to be representative of the entire population. Nworgu, 2006). Iwuama, Ogbebor and Onwuegbu (2010) stated that survey research method uses questionnaire or interviews to collect data from a sample that has been selected to represent a population and the area to which the finding of the data analysis can be generalized. Observation method was also used to establish some critical parameters necessary in the allocation of water resources. At the major points of the rivers, in the various host communities research assistants were stationed to collect the estimate of volume of water used by the residents on daily basis spanning for domestic uses over a period of four years. The volume of water drawn by tanker drivers for the purposes of industrial and domestic uses were also obtained by the research assistants. Documentations on relevant information and data wee obtained from existing literature and statutory bodies. Information was also gathered on industries in the area to obtain the industrial Gross Domestic Product of the study areas.

III. PRESENTATION AND ANALYSIS OF RESULTS

A. Presentation of Results

The results obtained in the course of this research were presented in this section and they included water use parameters in the study areas, the degree of use of surface and groundwater, optimal allocation of water for various uses, existing water allocation, and sensitivity analysis.

B. Collected Data From The Study Areas

The data collected for the various parameters of the study areas are shown in Tables 3 .1 to 3.4.

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Table 3.1 Water Use Parameters in Njaba River Basin Sub-Areas

S/N	Parameters/Uses	Amucha	Nkume	Ekwe	Okwudor	Umuaka	Awo Omama	Nkwesi
1	Population	2,471	8875	6137	8619	10,879	13,538	1,435
2	Established Water Quota at 120 lpcd (m^3/yr)	108229.80	388725.00	268800.60	377,512.20	476500.20	592264.40	62853.00
3	Water Usage (m^3/yr)	141.20	292.50	184.42	247.31	298.75	302.47	110.62
4	Area x10^4(ha)	19.40	30.80	29.60	35.70	50.70	70.30	15.62
5	Ecological Water Reqt per duty for crop (maize)	45cm	45cm	45cm	45cm	45cm	45cm	45cm
6	Water Duty x10^4 (m^3/yr)	8.73	13.86	13.32	16.07	22.82	31.64	7.03
7	Industrial GDP x ₦10,000.00	15.00	20.00	15.00	25.00	35.00	50.00	10.00
8	Industrial Water Use (m^3/day)	1.50	1.80	1.75	2.10	2.60	3.00	1.5
9	Industrial Water Quota (m^3/yr)	547.50	657.00	638.75	766.50	949.00	1095.00	547.50
10	Power Generated Installed Capacity (mw)	8.00	8.50	7.50	9.00	9.50	10.00	7.50
11	Efficiency/Head factors	58860	58860	58860	58860	58860	58860	58860
12	Power Generation Water Quota (m^3/yr)	135.92	144.41	127.42	152.91	161.40	169.89	127.42
13	Total Water Requirements (m^3/yr)	196354.42	528418.91	402,951.19	539,378.92	706109.35	910,231.76	133938.54
15	Grand Total	225807.58	607681.75	463393.87	620,285.76	812025.75	1046766.52	154,029.32
16	Per capita reqd. (m^3/yr)	91.30	68.47	75.51	71.97	74.64	77.32	107.34
	Policy use population	2471	8875	6137	8619	10,879	13538	1435

Source: Field Survey Result

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Table 3.2 Water Use Parameters in Mmam River Sub-Areas

S/N	Parameters/Uses	Inyi	Awlaw	Akpugoeze	Ufuma
1	Population	71,136	28,955	48,394	62,778
2	Established Water Quota at 120 lpcd (m^3/yr)	3115756.80	1268236.00	2119671.22	2749676.40
3	Water Usage (m^3/yr)	110.23	88.55	98.67	108.27
4	Area x10^4(ha)	50.90	61.3	90.7	68.6
5	Ecological Water Reqt per duty for crop (maize)	25cm	25cm	25cm	25cm
6	Water Duty x10^4 (m^3/yr)	12.8	15.33	22.68	17.15
7	Industrial GDP x ₦10,000.00	50	16	46	78
8	Industrial Water Use (m^3/day)	2.5	1.5	1.5	2.5
9	Industrial Water Quota (m^3/yr)	912.50	547.5	547.5	912.50
10	Power Generated Installed Capacity (mw)	15.00	8.00	10.00	15.00
11	Efficiency/Head factors	58860	58860	58860	58860
12	Power Generation Water Quota (m^3/yr)	254.84	135.92	169.89	254.84
13	Total Water Requirements (m^3/yr)	3245034.37	1422307.97	2347,188.61	2,922,452.01
15	Grand Total	3731789.53	1635654.17	2,699260.90	3,360,819.81
16	Per capita (m^3/yr)	52.46	56.50	55.78	53.53
	Policy use population	71,136	28955	48,394	62,778

Source: Field Survey Result

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Table 3.3 Water Use Parameters in Otamiri River Basin Sub-Areas

S/N	Parameters/Uses	Egbu	Nekede	Ihiagwa	Eziobodo	Obinze	Mgbirichi	Umuagwo
1	Population	15696	31,261	10,135	5755	18,469	7252	9,120
2	Established Water Quota at 120 lpcsd (m^3/yr)	687,484.80	1,369231.80	443913.00	252,069.00	808942.20	317637.60	399456.00
3	Water Usage (m^3/yr)	70.55	90.60	88.45	68.70	69.88	78.40	81.30
4	Area x10^4(ha)	20.07	28.40	25.67	20.02	20.15	19.81	21.50
5	Ecological Water Reqt per duty for crop (maize)	25.00cm	25.00cm	25.00cm	25.00cm	25.00cm	25.00cm	25.00cm
6	Water Duty x10^4 (m^3/yr)	5.02	7.10	6.42	5.01	5.04	4.95	5.38
7	Industrial GDP x ₦10,000.00	45.00	40.00	35.00	25.00	30.00	25.00	20.00
8	Industrial Water Use (m^3/day)	3.00	3.50	3.80	2.00	2.00	1.50	1.50
9	Industrial Water Quota (m^3/yr)	1095.0	1277.50	1387.00	730.00	730.00	547.50	547.50
10	Power Generated Installed Capacity (mw)	9.50	8.50	9.50	7.00	9.00	8.00	8.00
11	Efficiency/Head factors	58860.00	58860	58860	58860	58860	58860	58860
12	Water Quota (m^3/yr)	161.40	144.41	161.40	118.93	152.91	135.92	135.92
13	Total Water Requirements (m^3/yr)	739011.75	1,377,844.31	509749.85	303,086.63	870394.99	367899.42	454,020.72
14	Grand Total	849,863.51	1,584520.96	586212.33	348549.62	989339.24	423084.33	522,123.83
15	Per capita (m^3/yr)	54.15	50.69	57.84	60.56	53.50	58.34	57.25
	Policy use population	15,696	31,261	10,135	5755	18,469	7252	9120

Source: Field Survey Result

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Table 3.4 Water Use Parameters in Aboine River Basin Sub-Areas

S/N	Parameters/Uses	Obollo Afor	Ikem	Eha Amufu	Nkalaha
1	Population	52,422	24568	92787	19734
2	Established Water Quota at 120 lpcd (m^3/yr)	2296083.60	1076078.40	4064070.60	864349.20
3	Water Usage (m^3/yr)	108.20	96.70	112.50	92.40
4	Area x10^4(ha)	27.40	24.50	30.35	21.40
5	Ecological Water Reqt per duty for crop (rice)	120cm	120cm	120cm	120cm
6	Water Duty x10^4 (m^3/yr)	32.88	29.48	36.48	25.68
7	Industrial GDP x ₦10,000.00	75.00	20.00	30.00	15
8	Industrial Water Use (m^3/day)	2.5	1.5	1.75	1.5
9	Industrial Water Quota (m^3/yr)	912.50	547.50	638.75	547.50
10	Power Generated Installed Capacity(mw)	20	10	25	10
11	Efficiency/Head factors	58860	58860	58860	58860
12	Power Generation Water Quota (m^3/yr)	339.79	169.89	424.74	169.89
13	Total Water Requirements (m^3/yr)	2626244.09	1370892.49	4430046.59	1121958.99
14	Grand Total	3020180.70	1576,525.87	5094553.58	1290252.04s
15	Per capita (m^3/yr)	57.61	64.18	54.84	62.38
16	Policy use population	52,422	24568	92787	19734

Source: Field Survey Result

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The field survey conducted through the use of questionnaires administered on the sample population of the sub-river basins in the various subareas yielded result gave a clear indication of the degree of usage of groundwater and surface water. The usage of groundwater and surface water in the subareas is shown in Table 3.5.

Table 3.5 Groundwater and Surface Water Usage In the River Basin.

S/N	SUB-RIVER BASIN	SUB-AREAS	SAMPLE POPULATION	POPULATION USING GROUNDWATER (%) (RESPONDENTS)	POPULATION USING SURFACE WATER (%) (RESPONDENTS)
1	Njaba	Amucha	124	48 (60)	52 (64)
		Okwudor	431	39 (168)	61 (263
		Umuaka	544	53 (288)	47 (256)
		Awo omama	677	46 (311)	54 (366)
		Nkwesi	72	49 (35)	51 (37)
2	Mmam	Inyi	3557	35 (1245)	65 (2312)
		Awlaw	1448	36 (521)	64 (927)
		Akpugoeze	2420	40 (968)	60 (1452)
		Ufuma	3139	48 (1507)	52 (1632)
3	Otamiri	Egbu	785	75 (589)	25 (196)
		Nekede	1563	74 (1157)	26 (406)
		Ihiagwa	507	78 (395)	22 (112)
		Eziobodo	288	81 (233)	19 (55)
		Obinze	923	85 (785)	25 (138)
		Mgbirichi	363	73 (265)	27 (98)
		Umuagwo	456	70 (319)	30 (137)
4	Aboine	Obollo Afor	2621	58 (1520)	42 (1101)
		Ikem	1228	46 (565)	54 (663)
		Eha Amufu	4639	56 (2598)	44 (2041)
		Nkalaha	987	47 (464)	53 (523)

The quantity of water used by the citizens for the purposes of consumption/domestic, industry, ecology, industry and energy in the various sub basins were articulated and the results obtained were shown in Table 3.6

Table 3.6 Quantity of Water Used in Sub River Basins for Various Purposes

Sub River Basin	Consumption/Domestic Use (m3)	Ecological Use (m3)	Industrial Use (m_3)	Energy Use (m3)
Mmam	8,253,340	679,600	920	-
Otamiri	3,834,821	389,200	6,315	-
Aboine	7,300,581	1,047,200	646	-
Njaba	1,617,359	862,900	3,906	-

C. ANALYSIS OF DATA

From the data collected revealed that the people of Njaba river basin has more propensity towards the use groundwater than the people of Mmam basin. From the data collected, it was discovered that industries are more inclined to the usage of groundwater for their production service because they feel it is a more reliable source of water. It was gathered that the more water was used for domestic/consumption than for any other purpose while the least water was used for industrial and energy purposes. This shows the poor level of industrialization in these areas and the total absence of water use for electricity production. Due to the absence of dams, there were no reasonable and scientific means of irrigating the farmland and improving the quality of ecology. The water usage was analysed further by using bar charts to illustrate the degree of water usage for various purposes. The degree of water usage for the purposes expressed in percentages are shown in Tables 3.7 and the figures are shown in figures 3.1 to 3.4.

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Table 3.10 Quantity of Water used for Various Purposes in Sub River Basins Expressed in Percentage

Sub River Basin	Consumption/Consumption Use (%)	Ecological Use (%)	Industrial Use (%)	Energy Use (%)
Mmam	74.70	25.24	0.07	0.00
Otamiri	75.89	24.00	0.11	0.00
Aboine	80.19	18.60	1.21	0.00
Njaba	61.06	38-70	0.24	0.00

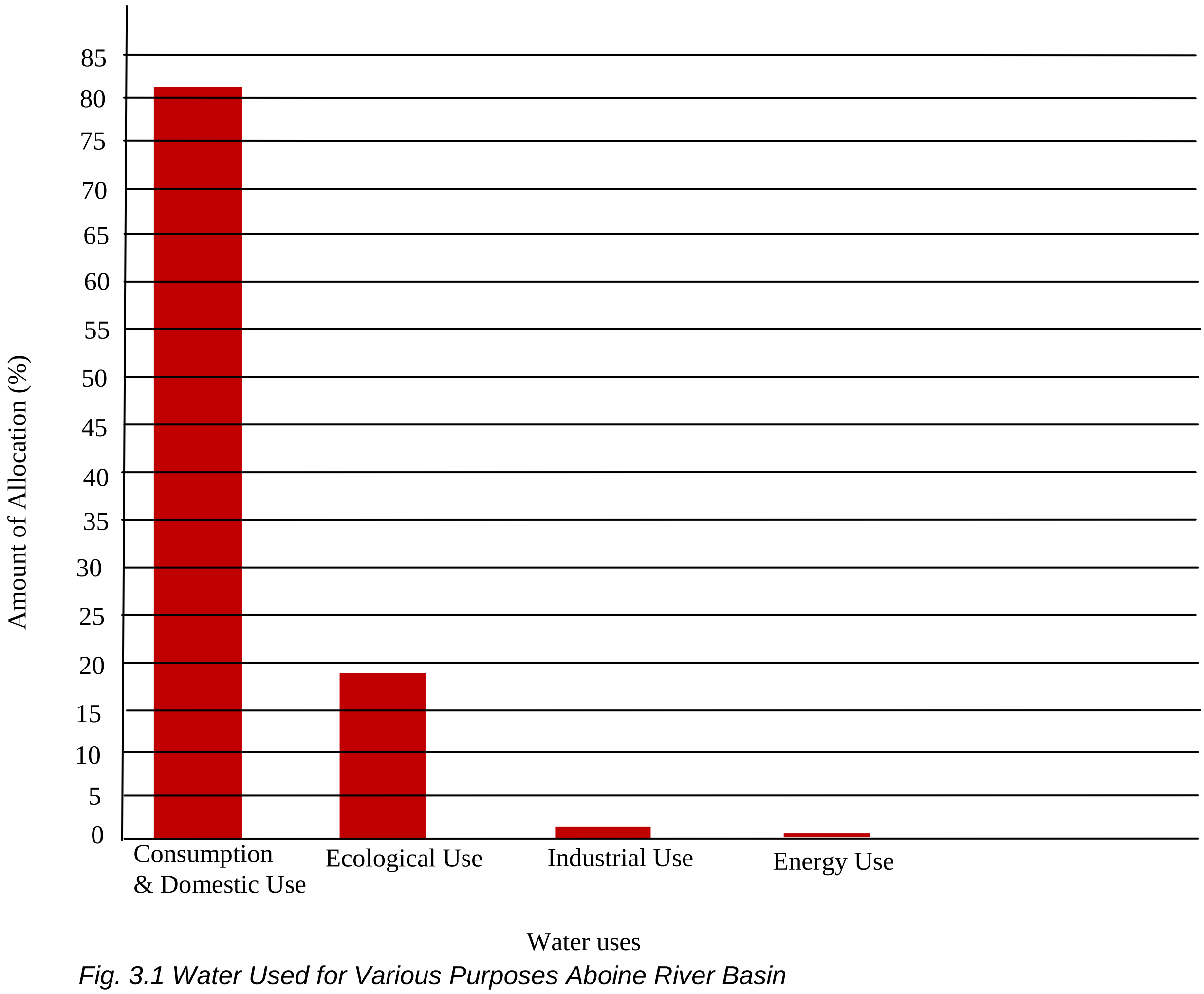

Fig. 3.1 Water Used for Various Purposes Aboine River Basin

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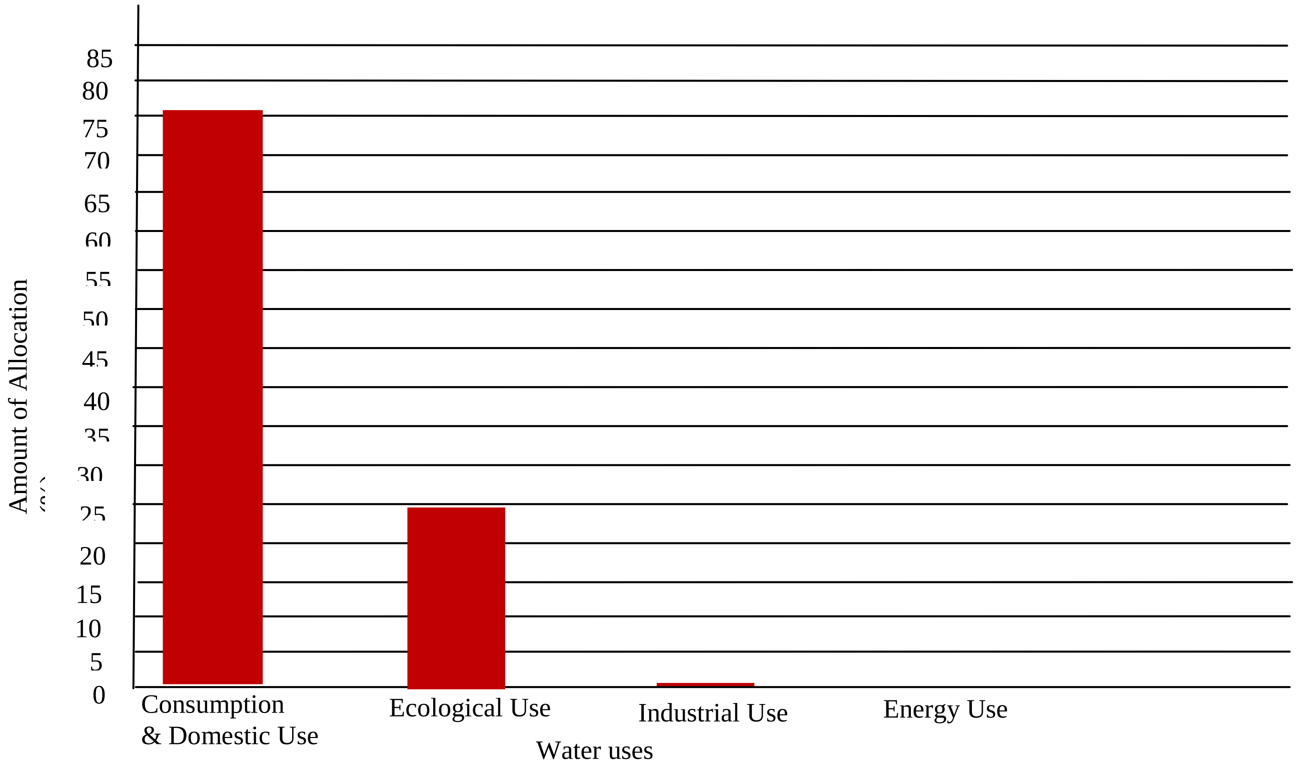

Fig, 3.2 Water Used for various Purposes in Otamiri River Basin

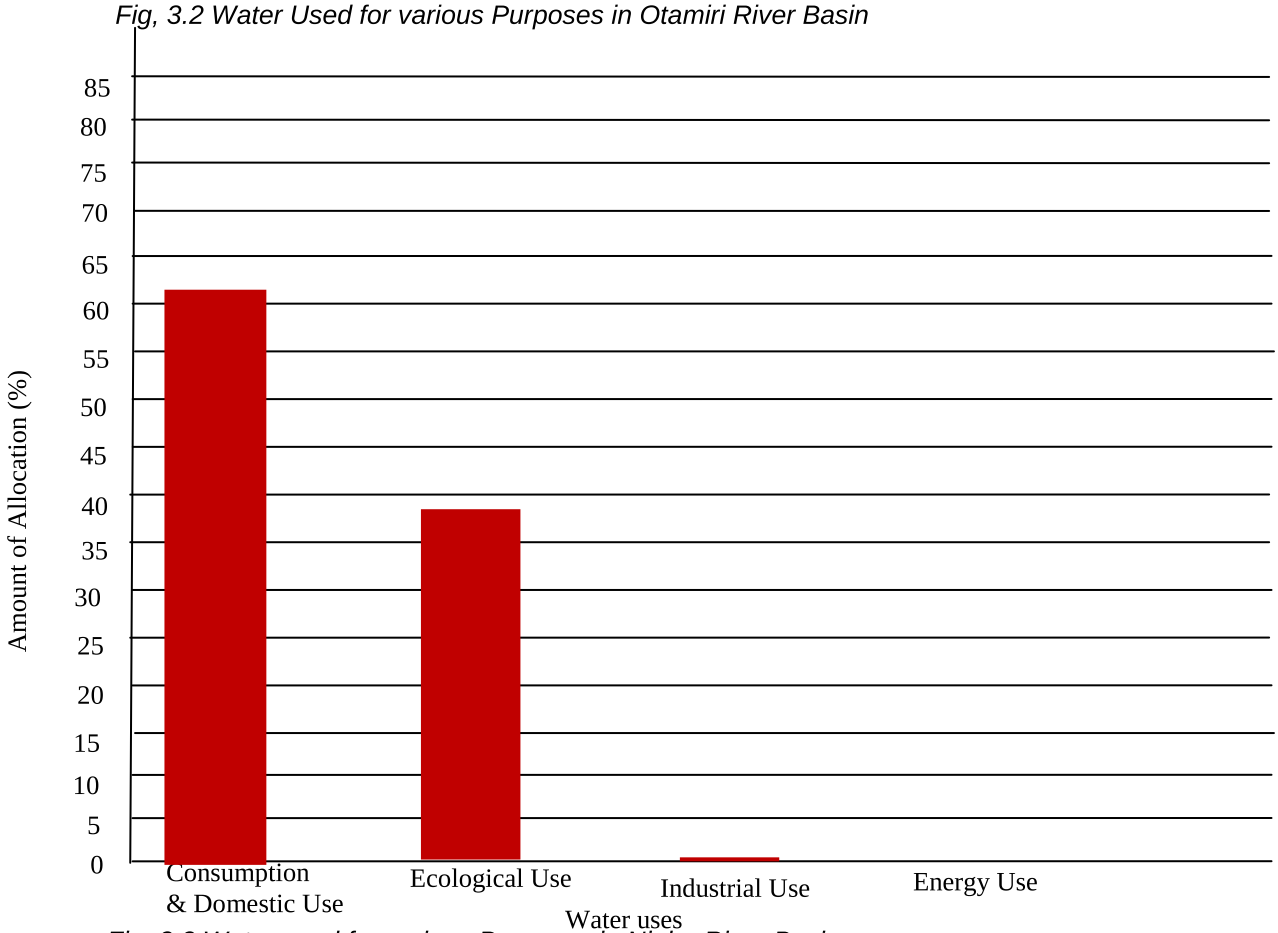

Fig. 3.3 Water used for various Purposes in Njaba River Basin

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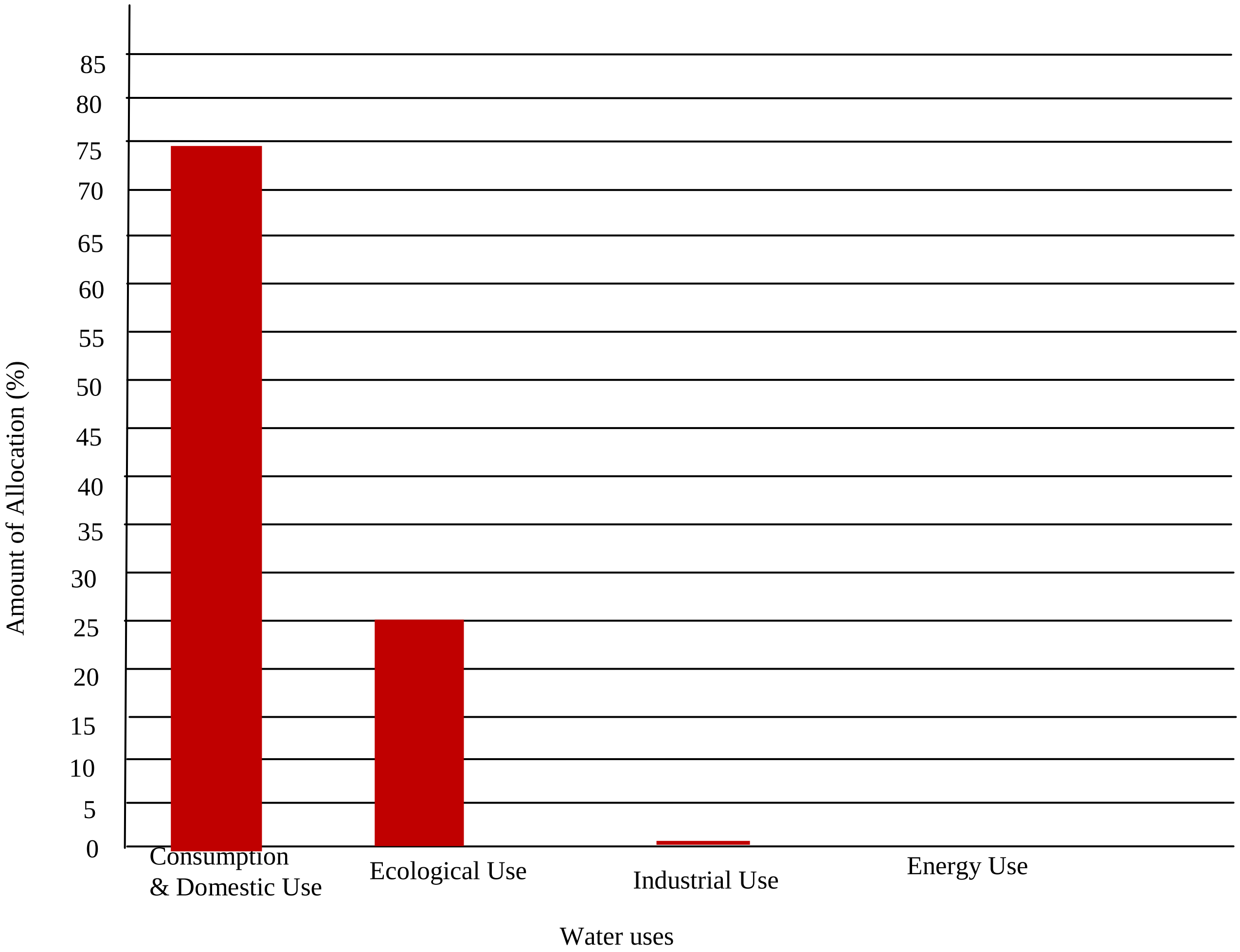

Fig.3.4 Water used for various Purposes in Mmam River Basin

From the tables and charts, it can be discovered that much water was for consumption and domestic purposes to the magnitudes of 61% of total water in Njaba, 74% in Mmam, 75% in Otamiri and 80% in Aboine sub- river basins. The research work revealed that water used for ecology was based on local means of irrigating farms due the absence of conventional and more sophisticate means of irrigation. The water consumed was comparatively analyzed with the World Health Organisation Standard of quantity of water required of an individual in a day and shown in Table 3.14

Table 3.14 Comparative Analysis of Water Use in the Basin with W.H.O. Standard

Sub River Basin	Population	Water Used (M^3)	Water Used Per Capita per day	W.H.O. Standards per capita per day	Remarks
Njaba	51,954	1,617,359	0.086 m^3	0.12m^3	unsatisfactory
Mmam	211,263	8,253340	0.107 m^3	0.12m^3	unsatisfactory
Otamiri	97688	3,834,821	0.108 m^3	0.12m^3	unsatisfactory
Aboine	189,511	7,300,581	0.106 m^3	0.12m^3	unsatisfactory

Table 3.14 reveals that the quantity of water consumed in the basin was short of the quantity recommended World Health Organization. The inadequate water use must have been responsible for the poor sanitary conditions prevailing in most parts of the Anambra River Basin.

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IV. CONCLUSION/RECOMMENDAIONS

Conclusively, it has been observed that water use pattern in Anambra-Imo river basin was characterized with poor standard, inadequacy and lopsidedness in areas of usage which made water not to be applied for energy generation. There is over-exploitation of groundwater in areas where the water table is shallow. It can therefore be recommended that

1. Water usage should be applied in all the prioritized areas of water usage ranging from consumption, ecology, irrigation, industry and energy production.
2. Surface water should be developed by enforcing its full utilization as most of the rivers are underutilized and most areas within the basin are already on the path of over-exploiting their groundwater.
3. Dams should be established in the basin to enable water to be effectively utilized for irrigation and hydro power generations.

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