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The Application of Integrated Water Resource Management Principles in Urban Kenya: The Case of Kapsabet Town

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Abstract

Water is life, as societies need sufficient amount of it to drive their economic and social development. The environment needs water too for its ecological functions. Water issues like shortages and supply deficits are every day challenges that call for an integrated approach to its management taking into account stakeholder participation, institutional integration and catchment protection. The study examined the application of Integrated Water Resource Management (IWRM) principles in Kapsabet town. Kapsabet town has experienced water shortage due to increasing urban migration, setting up of industries and businesses like hotels that require water in their day-to day running of the activities. A sample of 384 respondents obtained from both simple random sampling and purposive sampling were drawn from 12 administrative locations were randomly selected from Emgwen and Chesumei sub-counties for interviews and counterchecked by key informant interviews. The target population was household-holds, business people and officers from county government of Nandi, National Environment Management Authority and Water Resources Authority. The results obtained from data collection were analysed using frequencies and percentages. The research instruments were tested using Test-retest reliability and content validity. The study established that there was water shortage in the study area as pointed out by 68% of the respondents at the backdrop of a high demand for water as 45% of the respondents indicated they would use 70 litres of water per day per person. The sources of water in the study area were; river, borehole, rain- water and piped- water out of which the first three sources were easily available and accessible. In addition, the components of IWRM practised in Kapsabet Town involved stakeholder participation whereby public meetings on water management were done twice per year according to zones. The National Environmental Management Authority and Water Resources Authority institutions are involved in water conservation initiatives. A major factor that supports IWRM practice is the issue of water resource information management system facilitated by Kapsabet/Nandi water supply Company. The IWRM

challenge cited was inadequate funding to support water management activities. The study concludes that full implementation of IWRM in Kapsabet Town is yet to be achieved a result of inadequate funding to improve water infrastructure to increase in water supply to Kapsabet residents and hence the need to increase funding towards water resources management.

Keywords: Water Shortage, Integrated Water Resource Management, Catchment Protection

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Introduction

Water is a natural resource and is an essential component that sustains life forms from plants to animals. However, water is a scarce resource as only 1.2% of the 2.5% of the fresh water on earth is available for human use (Khilchevskyi & Karamushka, 2021).

Due to constant movement of water in different states around the biosphere, its rational planning and management a very complex and difficult task under the best of circumstances (Chowdhury *et al,* 2019). Thus, there is need for an integrated approach to water resource management designed to replace the traditional, fragmented sectorial approach that has led to poor services and unsustainable resource use.

Integrated Water Resource Management (IWRM) is the process, which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Vieira, 2020)

The integrated water resource concept means more coordinated development and management of land and water, surface water and ground water, upstream and downstream users' interests. (Wellens et. al. 2019).

Some of the key water resource management functions are; water allocation, monitoring, financial management, flood and drought management, information management, basin planning and stakeholder management leading to an integrated water resource management (Khan, 2019).

IWRM is a comprehensive, participatory planning and implementation tool for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of ecosystems for future generations (Smith et.al. 2018).

IWRM is based on the three principles: social equity, economic efficiency and environmental and ecological sustainability. (GWP-TAC, 2000). Social equity means ensuring equal access of water for all users including marginalized and poorer user groups to get adequate quantity and quality of water necessary to sustain human well –being (GWP,2010). The right of all users to the

benefits gained from use of water also needs to be considered when making water allocation. Economic efficiency means bringing the greatest benefit to the greatest number of users possible with the available financial and water resources. (GWP, 2010).This requires that the most economically efficient option be selected.

Ecological sustainability requires that aquatic ecosystems are acknowledged as users and that adequate allocation is made to sustain their natural functioning. (GWP, 2010). Achieving this criterion also requires that land uses and developments that negatively affect these systems are avoided or limited (Howarth, 2018).

An IWRM approach focuses on three basics and aims at avoiding a fragmented approach of water resources management by considering the following aspects: Enabling Environment: This way, rights and assets of all stakeholders - individuals as well as public and private sector organizations and companies- and public assets such as intrinsic environmental values are adhered to; Secondly, roles of Institutions are critical to the formulation and implementation of IWRM policies and programmes. Failure to match responsibilities, authority and capacities for action are all major sources of difficulty when implementing IWRM. Thirdly, management Instruments are the tools and methods that enable and help decision-makers to make rational and informed choices between alternative actions. (Dalcin, 2020 & Fernandes Marques).

The expected benefits of implementing an IWRM approach include better planning and management of water quality and supply, more cost-efficient management, and improvements in distribution of water between ecosystem needs and consumptive uses (Ramos et al., 2019).

In Africa, the Global Water Partnership and Partnership for Africa's Water Development Programme (PAWDP) have fostered the development of (IWRM) programmes and policies in several African countries (GWP, 2010).

IWRM has been implemented in several African states and include; "Middle Olifants" river basin, located in Northeast of Pretoria South Africa that focused on increasing the benefit of all water-related activities in a sustainable manner and the approach used modules that were developed for IWRM involving: water resource modules, water allocation modules and water intervention module (Candido, 2022).

In Namibia, the CuveWaters project aimed to develop and implement an IWRM concept in Central Northern Namibia as it is the driest country in Southern Africa, and particularly affected by water shortages and climate change. CuveWaters project helped to achieve long-term improvement in the livelihoods of the people through an IWRM approach adapted to the region (Wanke et al., 2018)

Water management in Kenya is undergoing sector reforms occasioned by the Water Act, 2016 and guided by IWRM. Water management is done at the catchment level, with the formation of Catchment Area Advisory Committees (CAACs) which are composed of all stakeholders in water sector at the catchment level. The water sector reforms are progressive and are bringing about fundamental changes in the way in which water is used and shared among the different users. Its main objective is to ensure a better balance between efficiency, sustainability and equity in all water allocations (GOK; Water Act, 2016).

In Kapsabet town, there is inadequate coordination of water resource management at the institutional level has led to duplication of roles by the

government agencies specifically National Environment Management Authority (NEMA) and Water resources Authority (WRA) leading to wastage of financial resources that could have been channeled to other areas such as pollution abatement of rivers. The water infrastructure in Kapsabet needs an overhaul to factor in the growing water demand both at household and industrial level as the existing water supply and sanitation systems were constructed in 1948 (JICA,2009). The piped water distribution in Kapsabet Municipality is 39% mostly concentrated in urban areas promoting inequality in water distribution (Nandi County Integrated Development plan 2018-2022.) Hence, there is need to enhance the integrated water resource management principles to solve the aforementioned problems.

Thus, the inauguration of the Kapsabet water project by the Japan International cooperation Agency (JICA), Kenya Office deemed a milestone in improvement of water supply to the growing population of the town. It involved improvement of existing water intake facilities, construction of a new water treatment plant, installation of distribution pipelines as well as installation of pumps and meters among other facilities and equipment (JICA, 2009).

There are water shortages experienced in the world and the situation is further aggravated by the increase in the population, industrialization, urbanization, irrigation of the arid and semi-arid lands, catchment degradation leading to an increase in water demand. An approach to solving water issues is IWRM that focuses on stakeholder participation, institutional integration and catchment protection. Kapsabet town and its environs are experiencing water shortages caused by population increase, agricultural activities and industrialization over the years.

The purpose of this study was to examine application of integrated water resource management principles in Kapsabet town for attainment of sustainable development.

Methodology

Study area

Location

Kapsabet town is the headquarters of Nandi County and is located 40 kilometres Southwest of Eldoret. The town lies in the coordinates 0^0 12' North, 35^0 6' East.

Climate of Kapsabet town

Generally, the town receives an average rainfall of about 1,200 mm to 2,000 mm per annum. The long rains start in early March and continue up to end of July while short rains start in mid-September and end in November. However, there is no single month without some rainfall. The dry spell is usually experienced from end of December to late February (Nandi County Integrated Development Plan 2018-2022).

Socio-economic activities

They include bee keeping, cattle and fish- rearing, poultry- keeping, cultivation of tea, maize, beans and vegetables. (Nandi County Integrated Development Plan 2018-2022).

Population data

In 2019, the total population of Kapsabet was 41,997 and this translates to an increase in water demand in town to satisfy the population's water needs. This in turn will put a strain in the available sources of water like rain and river water. Table 1 below shows population projection in Kapsabet town.

Table 1: Population for Kapsabet

Urban Centre	2009 Census			2019 Census		
Kapsabet	M	F	Total	M	F	Total
	11,426	11,378	22,804	21,002	20,995	41,997

Source: Kenya National Bureau of Statistics, (2019)

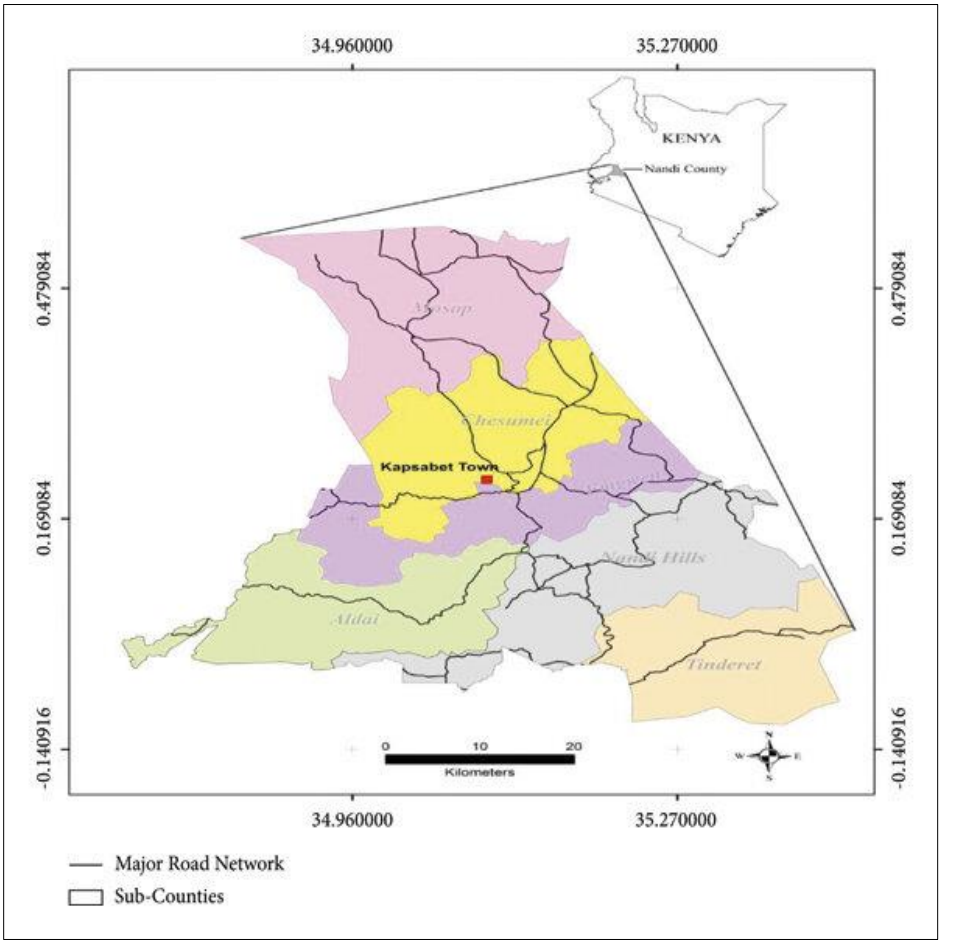

Figure 1: Map showing Kapsabet Town

Methods of data collection

Data was collected through questionnaires, observations, photography, focus group discussion and administering interviews schedules. The data on sources of water, frequency of stakeholder participation in water planning and management, plans for water resource management, gender mainstreaming in water conservation, priority water allocation, water legislations present in Kapsabet formed key variables.

Research design

The research approach used was descriptive survey as it involves identifying and determining the frequency of a particular response among the survey group to establish the status of the variables studied. The research approach was both qualitative-and quantitative.

Study population and sampling

The study population in Kapsabet town and its' environs is 41,997 (Kenya National

Bureau of Statistics, 2019).The sampling frame were households, business premises and relevant government officials living and working in Kapsabet town and its' surrounding villages; from this, a sample size was calculated using Fischer's *et al.,* (1983) for the population more than 10, 000 at 95% confidence level.

The formula for Fischer's *et al.,* (1983) is:

$$n = \frac{z^2pq}{d^2}$$

Where;
n is the sample size
z is the standard normal probability of a given confidence level
p is the proportion of the population affected with the problem under study
q is 1-p
d is the level of significance

Therefore, the sample size was:

$n=\frac{1.96^2x0.5x0.5}{(0.5)^2}$

$n=\frac{384}{2.28}$

n=384

Quantitave data like sources of water in the study area was analyzed using percentages. Data was eventually presented in form of pie charts, bar graphs and tables.

Results and discussion

Questionnaires response rate

The study distributed 384 questionnaires and all of them were completely and correctly filled and returned which represents a response rate of 100% as indicated in table 2 below.

Table 2: The response rates

S/N	Village name	Sample size	Questionnaire administered	Response rate
1	Namgoi	32	32	100%
2	Kabutie	32	32	100%
3	Surungai	32	32	100%
4	Kamobo	32	32	100%
5	Tilalwo	32	32	100%
6	Kapsabet CBD	32	32	100%
7	Kapng'etuny	32	32	100%
8	Singorwa	32	32	100%
9	East view	32	32	100%
10	Chebarbar	32	32	100%
11	Showground	32	32	100%
12	Chebut	32	32	100%

Demographic information of the respondents

Demographic characteristics namely gender, age and type of occupation, were obtained from the field and they were as represented by the figures presented in figure 2, 3 and 4 below.

Sampled population by gender

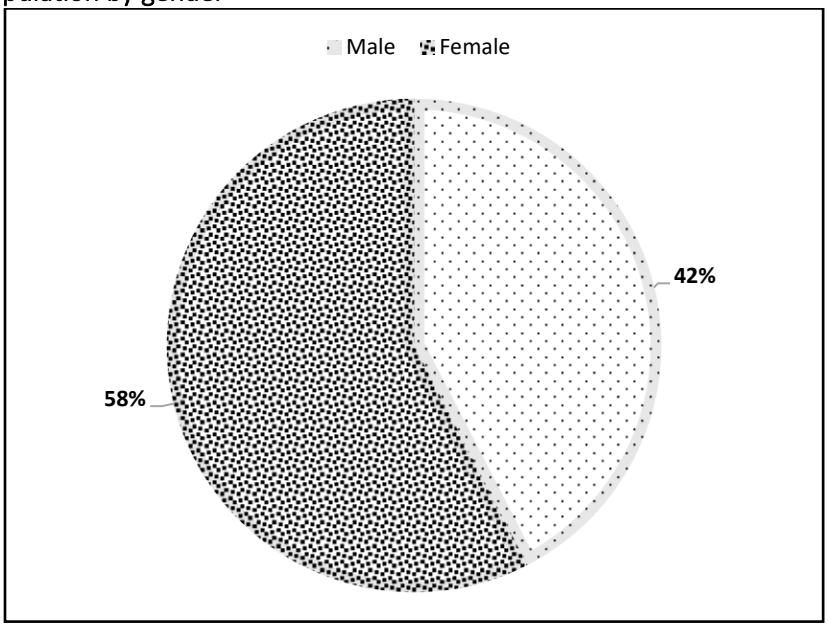

Figure 2: Gender characteristics of the study area

From figure 2 above, 42% of the respondents were male while 58% were female. The females were mostly found in their households and thus provided most information at household level for the research.

Sampled population by age

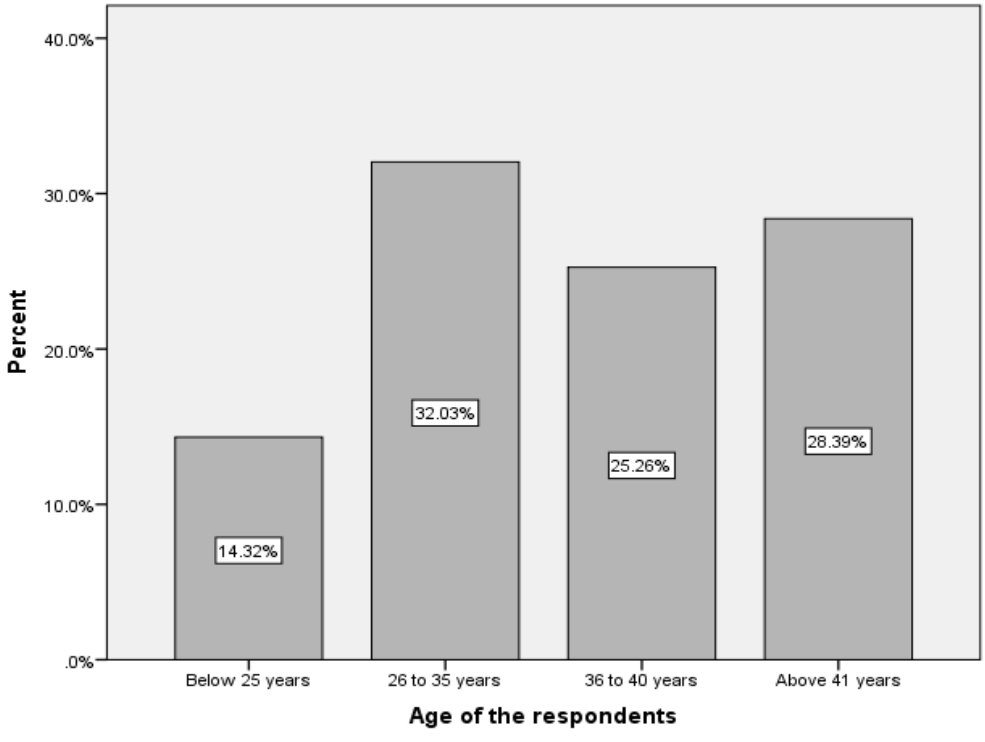

Figure 3: Age of the respondent

According to figure 3 above, 14% of the respondents were below 25 years, 32% were between 26 to 35 years, 25% were between 36 to 40 years and lastly, 28% were above 41 years. The age cohort that was mostly interviewed was between 26 to 35 years and they contributed most information regarding the application of Integrated Water Resource Management in 12 locations under study. This is because they were mostly found in the offices and business premises especially in Kapsabet CBD during working hours.

Sampled population by type of occupation

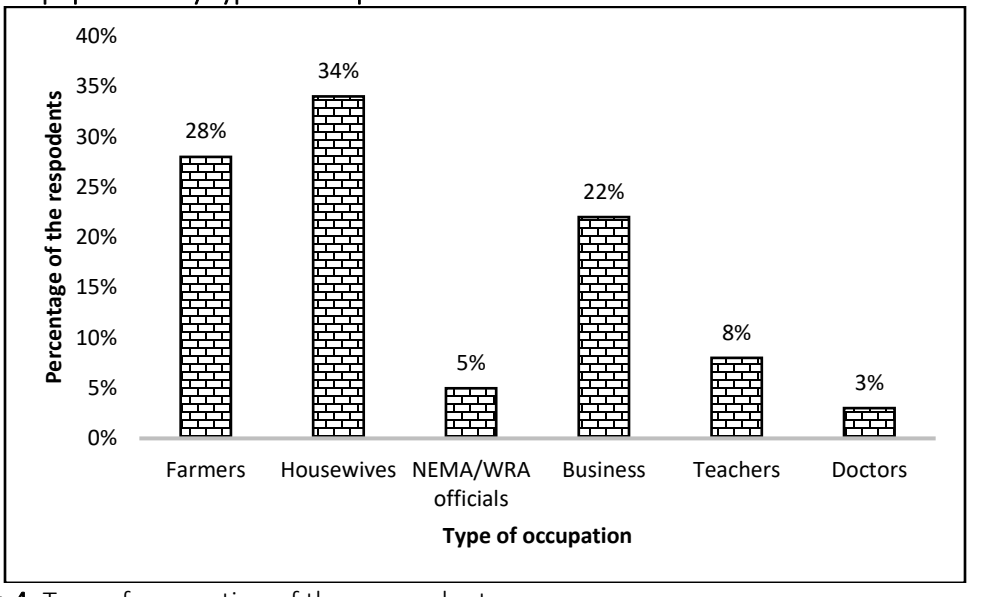

Figure 4: Type of occupation of the respondents

According to the figure 4 above, 28% of the respondents were farmers,34% of the respondents were housewives,5% were NEMA/WRA officials, 22% had businesses, 8% were teachers and lastly,3% were doctors. Notably, most doctors and the businesspersons were found within Kapsabet central business district while most farmers and housewives were found in the villages.

Factors that support IWRM in Kenya

The sources of water in Kapsabet according to figure 5 below are rainwater at 36%, piped water at 26% supplied by Kapsabet/Nandi water and Sanitation Company, boreholes at 15% sank in homesteads, business premises, river water at 9% obtained from river Amai, and Kabutie. The rainwater was seasonal and, the respondents depended on piped water, borehole and river water during dry spell.

A total of 26% of the respondents received water from Kabutie water supply through a pumping system with a plant capacity of 3,800 m^3 against the demand for water in Kapsabet town and its environs amounting to 4,500m^3 per day; the water is pumped out 16 hours a day while during the remaining 8 hours, the water is released to sustain ecological flows. The action was in tandem with the IWRM principle of ecological sustainability that requires that an aquatic ecosystem should be acknowledged as users and that adequate allocation be made to sustain their natural functioning. The water is used for domestic purposes; industrial purposes like cooling of tea processing machines in

Chebut tea factory located in Kapsabet town.

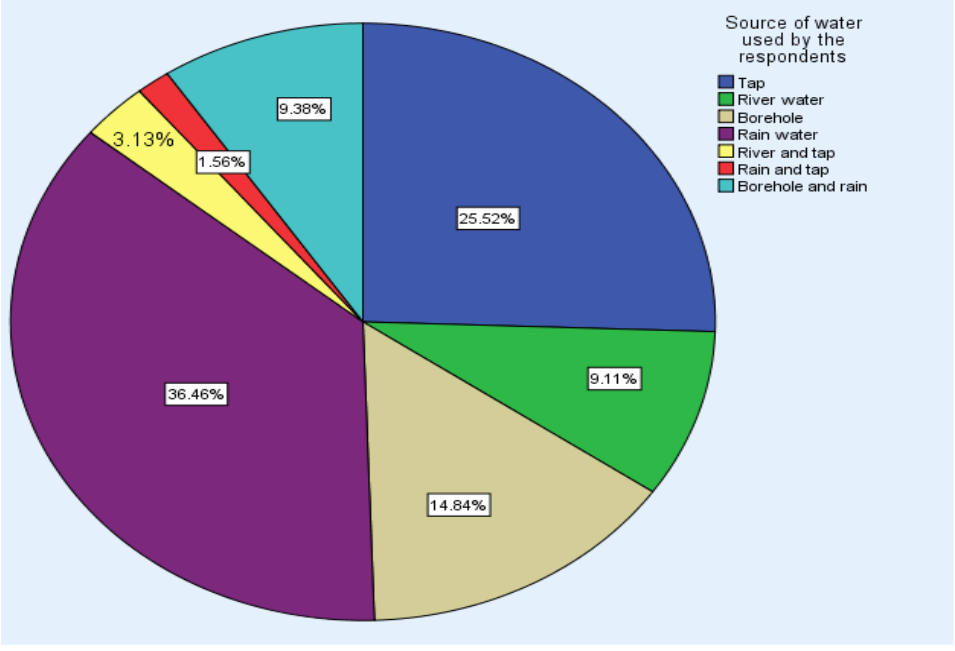

Figure 5: Sources of water in Kapsabet town and its environs

In terms of distribution network, it was noted that only 2.2 Km of water pipeline was laid down by Kapsabet/Nandi Water and Sanitation Company covering parts of the study area. This also explains the disparity in piped water supply as a source of water. This was inconsistent with the principle of social equity that states that there should be equal access of water for all users including marginalized and poorer user groups. Thus, there is need to channel adequate finances to expand on water supply systems (GWP 2010).

Water allocation

Water is allocated for different uses in town due to the sensitivity of the establishment; for example, households and hospitals were given priority in water allocation as existing laws in Kenya like water act of 2016 back it. This is supported by the Water Act of 2016 where priority of water allocations is given to hospitals and households to ensure preservation of health and hygiene in those sensitive establishments (GOK; Water Act, 2016)

On Water resource information management system at Kapsabet/Nandi water and Sanitation Company, there exist development of water resources information management systems at Kapsabet/Nandi water and Sanitation Company, namely a Geographic Information System that maps out company's assets including meters and water pipelines. The final water resources information management system will be a tool for decision-making and it will be an important management instrument for practicing IWRM.

Mapping of water infrastructure will help in maximum usage of this infrastructure to the benefits of the water users .Cases of water shortages will be reduced in areas covered by the water

pipelines (Nandi County Integrated Development Plan 2018-2022).

Economic tools for water demand management

Economic tools used by Kapsabet/Nandi Water and Sanitation company that ensured efficiency in water use were:

- Imposing water levies for instance Ksh.2 per litre to consumers to avoid water wastage at household level.
- Metering of water pipes to monitor water use and charge appropriately
- Imposing water tariffs to consumers by Kapsabet/Nandi water and Sanitation Company that have been approved by WASREB to ensure fair and affordable water pricing to the water users. The water tariffs and levies should be affordable to the poor members of the public. This will ensure equitable access to safe water for drinking and other uses to all members of the public (GOK; Water Act, 2016).

Stakeholder participation

On stakeholder participation, the study established that 46% of the respondents attended public meetings once a year while 32 % of the respondents never attended any public meetings organized by Kapsabet/Nandi water and Sanitation Company on water management. The reasons cited by these respondents on why they did not attend the public meetings included their full-time commitments in their farms and work places as indicated in figure 6 below.

Kapsabet/Nandi water and Sanitation Company is tasked to organize these meetings within the geographical area that they served.

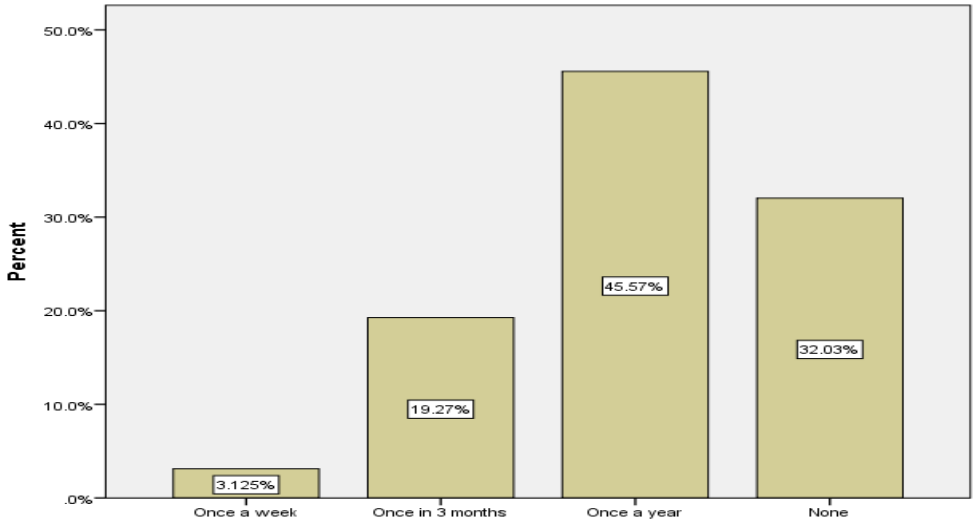

Figure 6: Frequency of the respondents in attending stakeholder meetings regarding water use and conservation

Stakeholder participation in public projects and services is enshrined in the Constitution of Kenya 2010. Hence, stakeholder participation in water resources management by Kapsabet/Nandi Water and Sanitation Company was observed.

Challenges in the implementation of IWRM principles in Kapsabet

The study established that 68 % of the respondents experienced water shortage during all year round. This was due to rationing of piped water during peak hours (0500 hrs-0700 hrs. and 1700hrs-2000hrs) and little rain during dry spell while 32% of the respondents mentioned the water from the other three water sources- (piped water supply, river and borehole)- were adequate to satisfy their water needs. The finfings are presented in figure 7 below.

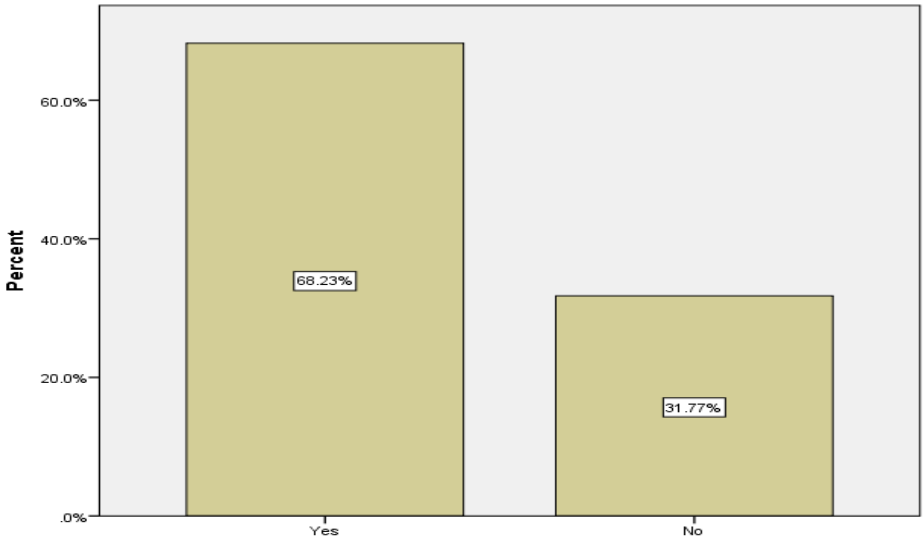

Figure 7: Experiences of the respondents regarding water shortage

Inadequate financial allocation presents a major challenge to water supply as only Ksh. Ksh.150, 300,000 as example were allocated for the financial year 2018/2019 for extension of water projects (Nandi County Annual Development Plan 2020-2021).

The Kapsabet/Nandi water and sanitation company experiences high cost of operations in terms of high electricity and the management transferred this burden to their consumers translating to high water charges where some consumers could not manage to pay leading to financial losses to the company.

In addition, the company experiences water theft and pipes vandalism/illegal connection by unscrupulous dealers contributing to unaccounted for water and this contributed to financial losses the water service provider is experiencing.

There was duplication of roles of the players like NEMA and WRA that contribute to wastage of public money doing similar roles in water management. For instance, both NEMA and WRA's mandate was to protect the catchment through tree- planting activities. The resources channeled to tree planting by both state agencies could have been used in drilling boreholes to the residents in study area

According to the public sector in Kenya, there is increase of cost through unnecessary wastage of resources like finances because of duplication of roles of the Ministries, Departments and agencies in Kenya that warrant reforms (Ongera & Musili).

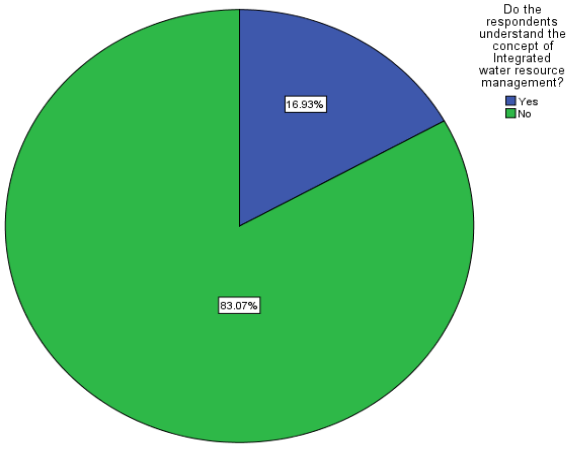

Figure 8: Level of public awareness on IWRM

According to figure 8 above, there was inadequate public awareness on the concept of IWRM, as only 17% knew about the concept of IWRM. Figure 9 shows public awareness rating on IWRM. It is worth noting that the Key Informants from NEMA and WRA showed inadequate understanding of the concept of integrated water resource management as they simply said they have heard about the concept in the seminars and trainings they had attended elsewhere and have not been embedded in the institution.

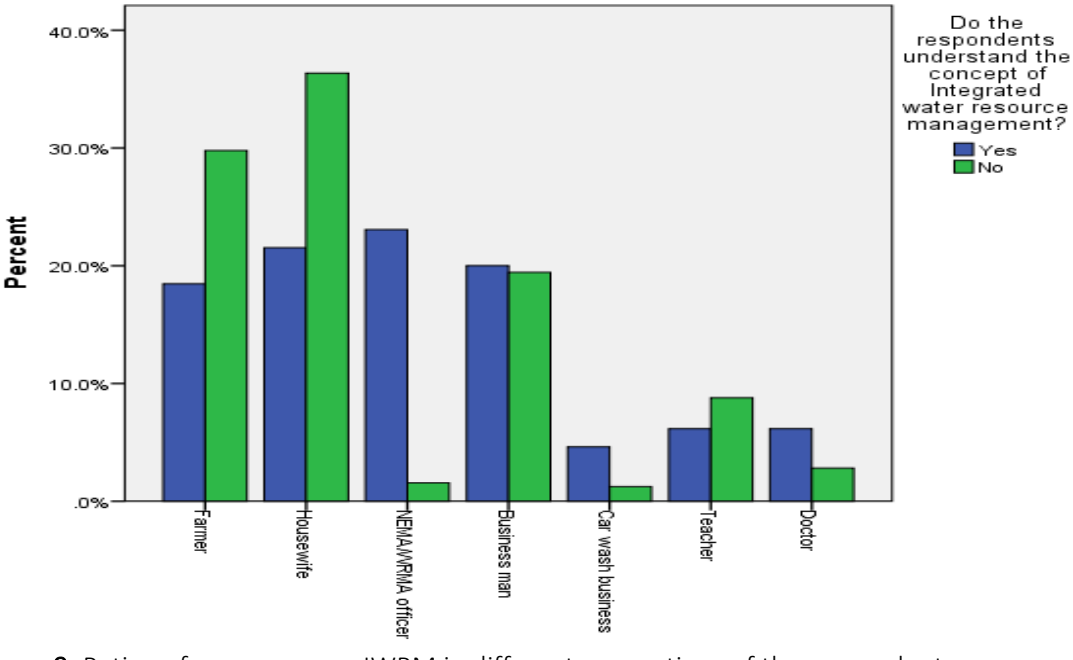

Figure 9: Rating of awareness on IWRM in different occupations of the respondents

According to Seckler (2006), activities that promote sustainability of IWRM initiatives must be designed and implemented with the active participation of those families and communities who are struggling to ensure their livelihood in changing and unfavourable environments.

Conclusion

In conclusion, in as much as IWRM principles are being practiced in the study area, implementation still remain a challenge if barriers are not identified and addressed. IWRM principles that are practiced in the study area are stakeholder (users, planners and policy makers) participation, water allocation, and information management systems. Challenges experienced were inadequate financial allocation for example Ksh 150,300,000 in financial year 2018-2019 towards water projects extensions, inadequate public awareness on IWRM as only 17% of the respondents were aware of the concept, pollution of catchment area, vandalism, theft, illegal water connections, duplication of roles of different players (NEMA/WRA) facing IWRM'S full implementation.

Recommendations

Arising from the study, the following recommendations are made;

i. There should be increased allocation of finances to expand water projects in Kapsabet, as Ksh. 150,300,000 deemed inadequate.
ii. The water undertaker should increase of water supply through tapping of Keben River water through gravity to decreases the water shortages of 68% experienced in the study area.

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