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Assessment of water resources management, utilization and conservation in Mombasa polytechnic

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ABSTRACT

Mombasa polytechnic in recent years has experienced steady increase of population since its inception in 1972.The total population was 4746.This was projected to increase with the introduction of degree courses in future. This increase will put a lot of strain on the utility resources in the college, with water being the most affected because everybody makes use of it in the polytechnic. The current installed storage was 227,400 liter. The daily consumption of water was estimated at 248,110 liter. Official deficit was estimated at 23,200 liter while unofficial deficit due to illegal resident's students was 103,200 liter. This study assessed the water resources management, utilization and conservation in Mombasa polytechnic by specifically finding out untapped potential sources of water, areas of wastage, sustainable conservation, and the purity of the current water supplied. Survey, participant observation and laboratory analysis designs were used to collect primary data. Random and purposive samplings were used on student's respondents and key informants. Analysis employed descriptive statistics. The institution received water from six sources while the untapped potentials identified were also six. Leakage from 26 sampled sites was estimated at 177.76 liter per day. Conservation to include attitude change and prompt response of the students and' management respectively. Faecal streptococcus was analyzed in water supplied, pointing at diffuse point of pollution. In conclusion water available was constrained. The study recommends, rain water harvesting, surface run off collection, sinking borehole, soil and water conservation, overhaul of supply systems, regular analysis of water supplied among other measures.

Key words: Water supply, storage capacity, water consumption, water wastage, water tanks, water conservation, official residents, unofficial resident, water resources, hostels.

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INTRODUCTION

There is a lot of water globally but its distribution and quality is questionable. It needs a lot of resources to make water sufficient to each people. 99.97% of water cannot be utilized globally. There is enough water for all people but some areas experience acute shortage and serious water supply problems. This is because of little rainfall, flooding, run off looses and lack of sanitary water (Fresh water web site,2004). In 1980,World Health Organization (WHO) estimated that 70% of people in low developed countries and 25% of urban dwellers does not have enough safe water.

Human demand for water has been growing due to growth of the human population and needs of water in industry,agriculture and domestic use, however there is limited quality of fresh water on the earth and for many nations including kenya. This resource is scarce in its availability,increasing demand for this resource will soon create problems that can only be corrected by management and conservation (Fresh water web site,2004).

In kenya this resource is scarce and its negative impacts is being felt in all parts of the country with high concerns being noticed in institutions of higher learning like Mombasa polytechnic. Mombasa polytechnic is a tertiary institution situated on Mombasa Island on the northeastern side of the island. It is one of the higher institutions of learning in coast province, which offers technical and professional courses up to higher diploma and certified public accountant part three levels respectively. The institute started in 1948, as Mombasa institute of Muslim education with donation amounting to £450,000 from the Aga Khan, the sultan of Zanzibar and the Bora community of East Africa to train Muslim students in East Africa on adequate technical education (Mombasa polytechnic booklet, 2004).

Government of Kenya sessional paper number 6 of 1988 recommends the facilities in national polytechnic for upgrading and therefore requires them to expand their training programmes to Bachelor of technology degree level in future (Mombasa polytechnic booklet, 2004). The above proposal was likely to see an increase in the population of Mombasa polytechnic which stands at 4746 currently.

The above anticipated population increase in future will put a lot of strain on the existing infrastructures and utility resources in the college. The utility resource that is likely to be constrained most will be water, because the resource was consumed by everybody in the polytechnic compound. Currently water problems were being experienced in Mombasa polytechnic by the students and the polytechnic management alike as far as its supply, quality, management and effects on the storage facilities within the institution. This study is to explore other potential sources of water supply, identify sources of wastage, conservation measures in place and analyses the quality supplied currently, in order to avail information that the college management might use to plan for their future needs of water and development.

MATERIALS AND METHODS

The study design used here was survey method. Using Nassiuma (2000) sampling formula, representative sample size for this study was approximated to 355 respondents, out of which 346 were to be the general student's respondents randomly picked from the eleven departments in the college at an average of 31 respondents each and 9 were to be purposively sampled from the management and government agency as key informants. They were either given questionnaires or interview schedules respectively to answer questions concerning other potential sources of water, water wastage, conservations measures and general quality of water supplied currently.

The distribution activity was carried out between 3rd-10thFebruary, 2005. Unfortunately within that month a student's strike occurred and the college was temporarily closed. The above disturbance interfered with this study as 246 questionnaires got lost and were never returned. Time, financial constraints, exams and submission of the project timeline could not allow for all old questionnaires to be traced or new ones to be issued a fresh. Only 109 questionnaires and interview schedule were recovered, therefore this study became a non- probability type of study as selected sample size of 100 general student's respondents and 9 key informants from the management were surveyed. The study collected both primary and secondary data which were later used in the analysis. Ethical consideration was taken in handling data received from the respondents.

On average, 10 student's respondents were received back from different departments. Since the questionnaires were open ended, the respondent answered freely and their responses were polished, grouped coded and quantified for effective analysis. The generated information was used in the findings and discussion. This data collection tool was effective in collating and collecting the relevant data among the students sampled. The key informants from the college management and ministry of water interviewed were water engineer, pump attendant, maintenance officer, finance manager, house keeper, laboratory technician, registrar of students, college principal and the cateress. Their interview schedules or questionnaires were all returned.

Observation design was employed to help corroborate the findings from the survey method. This was done using either observation sheet or camera of 35mm lens. The sheet was used to note the details of the occurrence of some observation while the camera was used to take permanent features as they happen to help qualify and justify facts from the survey findings as attached in the Appendix 1.

Laboratory analysis was used to test the quality of water supplied and consumed in Mombasa polytechnic during the study period. Two samples of water were collected from the dining hall tap and from the borehole next to medical engineering department in the college, between the months of May and June, 2004. The presence of microbial organism was tested using (FAO/EC methods, 1976) that began with presumptive test followed by confirmation test using spread plates and gram staining tests.

Sample bottles of 250ml screw capped were used. They were sterilized in auto clave at temperatures and pressure of 121^{o}C and 15psi to kill germ. Mac Conkey Agar single and double strenght was made from 12g that dissolved in 300ml of sterilized water and 4g that was also dissolved in 100ml of distilled water. Three water

Table 1. Presumptive test of microbial organisms in water supplied and consumed in Mombasa polytechnic.

Water sample	Single strength 1ml			Double strength 10mls			Double strength 50mls		Reading			MPN
Tubes	1	2	3	4	5	6	7	8	SS	DS	DS	
Borehole water	+	-	+	+	+	0	-	+	2	2	1	10
Tap water	+	+	-	-	-	+	-	+	2	1	1	7

SS-Single strength, DD-Double strength, MPN-Most probable number

Table 2. Confirmation test of microbial organisms in water supplied and consumed in Mombasa polytechnic.

	coliforms			
Water sample	EMB plate	Endo plate	**portable**	**Non portable**
Tap water	+	+	No	4
Borehole water	+	+	No	4

Table 3. Spread plates and grain staining confirmed that *Feacal Streptoccocus* were present.

Water sample	Plates	Gram stain
Tap water	SS	+
Borehole water	DS	+

strengths of mac conkey broth after sterilization were poured into three tubes in two sets of row that had six tubes each.In the first set of tubes of 10ml, 1ml of water samlpe was added. (tap and borehole water respectively). Then a double strength of 150ml broth was added to 10ml of water samples as in the first set and the last set of tubes had 50ml of broth of double strength and 50ml of water sample added. All of them were incubated at 37^{O}C for 48hours. Observation were made and tabulated as shown in Table 3. The positive tubes with gas production and colour change were poured into plates with endo agar to and the observation are shown in table 4 and 5 respectivly.

RESULTS AND FINDINGS

From the two key informants (Staffs of the pump machine and maintance departments), source of water supply to Mombasa polytechnic were from different sources. These supply sources include the Nattional Water Conservation and Pipeline Coorporation (NWCPC) which is a state corporation, the well near the overhead tank and a borehole dug behind the medical engineering department within the polytechnic compound. Whenever there is a breakdown or supply problem with the above mentioned sources, Lorry tanker from community are hired to supply water. Bottled water found in the canteen were purchased from the whole salers in the town to supplement the college supply and are sold to the students at a fee . Water from NWCPC,well and borehole were stored in different tanks as shown in the Figure 1.

Water is supplied to various users from 7.00am - 10.00am in the morning and 3.00pm- 8.00pm in the evening. This supply lasted for 12 hours in the lower hostels while upper hostels like SE,SF(men hostels) and SJ(women hostels) received 9 hours supply but experienced 3 hours shortage daily. This was due to high usage by official resident and non official residents students. The Supply to department of supply lasted for 12 hours while mechanical and electrical departments supply lasted for 24 hours because of their large storage tanks and low consumption according to two key informants from the pump machine and maintance departments and 60% of students respondent.

Major water utility areas were found to be kitchen, hostels, departments and staff quarters. They used water for cooking, drinking,washing ,bathing, cleaning of rooms, flushing of toilets, watering flower beds and washing apparatus in laboratories. The total official consumption of water in hostels SB(C),SD(A),SB(B) (men's hostels in the lower part of the college) ,SE,SF and SJ, Kitchen and the laboratory was quantified as shown in Figure 2.

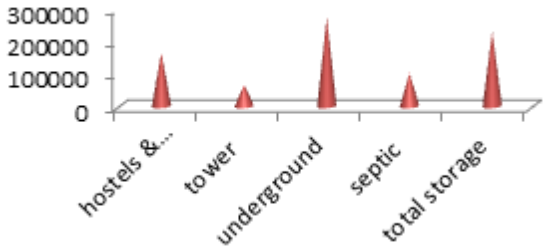

Figure 1. Site and storage capacity of water tanks in Mombasa polytechnic.

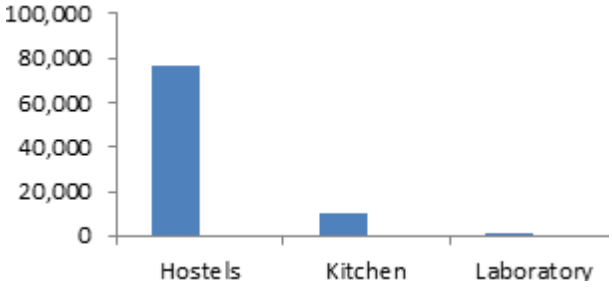

Figure 2. Total official consumption of water in hostels, kitchen and laboratory.

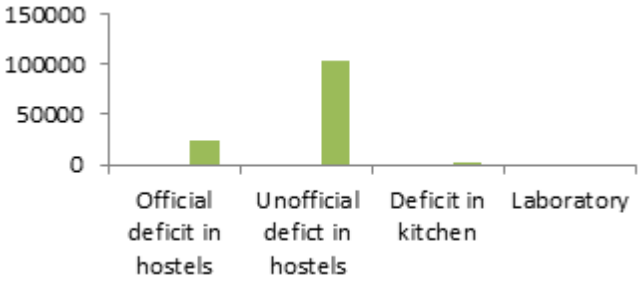

Figure 3. Official and unofficial water deficit in Mombasa polytechnic.

The official deficit in hostels , kitchen, laboratory and the unofficial deficit caused by survivors was quantified as shown in Figure 3

Water wastage and misuse in Mombasa polytechnic caused by student ranges from open and runing taps while brushing their teeth, excessive use of water to rinse cloth while washing, leaving taps unfastened when they find them dry, opening showers and leaving the water running before the start of bathing and frequent bathing by students (morning, afternoon and evening) and the use of parlour for bathing by day scholars. Wastage attributed to college management were cases like overflowing water while watering the flower beds, overflow of the storage tanks in the hostel building blocks and overhead tanks as observed in block M and SC (C), cases of burst pipes due to ageing, broken showers as shown in Appendix 2, lack of water register at the pump house and slow response by the maintance department to reported faulty cases,easy access of the bathroom and toilets by outsiders,negligence by the catering department by leaving water to overflow their cooking utensils, lack of assistant to the pump attendant, negligence by the laboratory technician to fasten the taps in the evening before leaving for home and faulty/leaking facilities . During the study period, a total of 26 leaking taps were observed in different departments as shown in Table 4. Leakage in blocks SC A, B and C taps were quantified at 533.28 liters per day.

Rainy season run off and roof collected water were lost to the ocean as a result of pavements.

This increased their run off rates, as there was no collection point and storage tanks for them.

Table 4. Identified water leakages points as per building blocks in Mombasa polytechnic, 2005.

	Building Blocks										
Faulty facility	**SC (A)**	**SC (B)**	**SC (C)**	**SJ**	**SE**	**A/S**	**BD**	**ENG**	**COMP**	**DISP**	**Total**
Taps	1	4	1	1	1	1	4	1	1	1	16
Showers	-	2	-	1	1	-	-	-	-	-	4
Toilet WC	-	2	2	-	1	-	1	-	-	-	6

Key:**SC-SE**: Hostel blocks for men,SJ:Hostel blocks for women, **BD**:Business department, **ENG**: Engineering department, **COMP**:computer department, **A/S**: Applied science department and **DISP**: Dispensary.

This interfered with the recharge systems of the borehole and well acquifers in the college. Increased soil erosion on bare land within the polytechnic was massive as shown in Appendix 3. They ended up blocking the drainage systems causing flooding in the lower areas of the college .

The conservation measures were found lacking in the college because there was no water rationing policy during acute shortage period, no public awareness and sensitization to the students and the management on the rational utilization of water in the polytechnic and poor flow of information about water supply problem to the students and other college workers were not put in place by the mangement as confirmed by the key informant who was in-charge of the whole college administration and response from 80% of the student respondents.

Water quality in the polytechnic was not pure according to the students respondents. 60% of them claimed that the water contained some whitish particles on top after boiling, while 76% stated that it contained salt paticles that is causing corrosion damage to cooking utensiles, heating appliances and taps while 50% claimed that the water was not fit for human consumption unless it is boiled first. They alleged that they suffer abdominal pain after consuming the unboiled water. 45% of them claimed that water drawn from the fire point tap was different from those drawn from the hostel taps.The Laboratory analysis to test the quality of water from the borehole and tap show that the water is contaminated and non portable as shown in Table1,2 and 3.

DISCUSSION

Potential sources of water supply in Mombasa polytechnic

The majority of the respondents answered specific objective number one by suggesting that the current inadequate water supply and anticipated future population increase in Mombasa polytechnic can be mitigated by exploring the following alternative/ potential sources of water supply which are untapped currently.

The two key informants from the ministry of water and college maintance department, suggested that the installation of two lines of water supply from the Mzima spring by the ministry of water which currently has one line can increase the water supply. This existing line has low pressure and that was why the supply from National Water Conservation and Pipeline Corporation was not enough. When the two supply lines are installed in future, they will increase the pressure and amount of water available for supply to the residents of Mombasa town. That moment , mombasa polytechnic will increase their supplly lines from the corporation hence the more quantity of water available for supply to the college.

The key informants from the maintance department states that an addition of a borehole or a well next to the SE,SF,SJ and the kitchen was another potential source of water supply which can alleviate water shortage in those blocks and increase sources of water suupply to the polytechnic.

The sinking, installation and operation of a borehole was estimated to cost kenya shillings 150- 200,000. This was an amount of money the college administration could afford ; considering the long term benefits of the project.

The number of students affected by inadequate water supply currently was 288 officially as given by the key informant from the house keeping department. Water shortage in these blocks were experienced from 6.00am to 8.00am daily according to 50% of students respondents.SE and SF buildings were officially and unofficially experiencing water shortage. This supply problem to these blocks was compounded by the size of pipes taking water to those blocks. They were regularly affected by air locks. The size of of the pipes should be $1^1/_2$ in diameter to increase the presurre as explained by the key informant from the pumping machine. The water from the borehole or well can then be pumped by machine to raised tanks on the roofs of these buildings to increase the quanity received now and in future.

The present supply were only enough to last for 13 hours at maximum in the lower hostels buldings. This was found to be 11 hours less to make a 24 hours supply.The

Table 5. The estimated water need of population in Mombasa polytechnic based on CP 310 (1965).

Population	Number	Average quantity uesd per person	Total quantity
Boarding students	562	150 litres	84,300 litres
Day scholars	3929	37 litres	145,373 litres
Lecturers	300	37 litres	11,100 litres
Support staff	256	37 litre	9,435 litres

digging of another borehole or well will solve water shortage in blocks SE ,SF SJ and minimizes cases of students moving to lower hostels blocks to bath or wash clothes, thereby decongesting those water outlets now and in future. The total water storage capacity of Mombasa polytechnic was 227,400 litres. There was need to increase the storage capacity to accommodate the present and future population adequately. The current population and their need of water based on CP 310 (1965) and ministry of water design manual of 1974 as shown in Table 5.

Total storage quantity required – present storage capacity = shotfall storage.(250,208-227,400 = 22,808 liter). Official deficit in blocks SE and SF = 23,200 liters. Storage tank deficit = 22,808 litres. The difference between the two figures = - 392 litres. The Unofficial deficit of water = 103,200 litres of water. The differnce from the storage capcity was (227,400 - 103,200=124,200 litres). The official deficit can be overcome with the construction of more underground tanks to hold more water, while the unofficial deficit caused by survivors should be addressed by the college administration through house keeping department according to 60% of students respondent and other key informants.

According to Mburu (2002) rain water harvesting through roof catchment and using guters connected to underground water pipes which can direct it to a central collection tank was established to be a viable project, that can increase water supply sources in the polytechnic now and in future. Most of the asbestos roof in the college have been replaced with galvanised iron sheets, this makes water collected now to be safe for human use. Mburu (2002), further states that the 90% probability annual rainfall of Mombasa Island was found to be 801.2mm. The ministry of water resources development design mannual for water supply in kenya (1979) gave Mombasa a dependable rainfall at 750mm. The analysis could be used to install the appropriate rain water harvesting and storage facilities.

The roof areas of individual buldings marked for rain water harvesting included : Assemly hall-1000 m^2, Applied sciences- 750 m^2, Library- 610 m^2, Computer department- 320m^2, Registry-120m^2, Small business centre-120m^2, Supplies department-120m^2 and Mondas house -180m^2. Since rain water could be erratic in its supply a 300m^3 underground water tank was recommended by Mburu (2002); and the key informants from maintance department . The collected water will be sterilized to kill bacteria. Since the proposed tank will be situated next to the pump house, water can be pumped into the existing supply system and distributed to users. The collection gutters should be installed with dust sieve to prevent dust pollution.

The collection of rain water run-off in the college to a central underground tank next to the boathouse will also increase sources of water supply for future uses. Presently most of this water drains into the Indian ocean. Run-off water are usually collected into water pans, dams or small ponds, but Mombasa polytehnic has sandy type of soil whose structure was not suitable for water storage in the open, a constructed underground water tank was suggested as the most appropriate storage facility for collecting run-off in the college.

Considering a run off co-efficient of 0.8 and the 90% probability annual rainfall, the area considered in the college could yield 3388m^3 (9.28m^3 per day) of water per year. This translates to 282.2m^3 per month. A moderated mean annual rainfall of 1120.2mm was worked out for Mombasa. This moderated mean annual rainfall has a probability of recuurence of 42.18%. Annual yield from the mean annual rainfall is estimated at 4734m^3 (12.97m^3 per day) (Mburu,2002).

The above estimated amount of water, when collected could help alleviate water shortage in mombasa polytechnic . Water collected from the run off could be used to irrigate botanical garden for botany studies, watering flowers and planting grassess near the office blocks during dry periods, cleaning toilets and bathrooms when there was water shortage. The tank inlet for run off should have mud sieve to prevent them from being filled up by mud and silt washed from bare soils and other debris collected from the ground surfaces in the college as enumerated and explained by the key informants and 40% students respondents survyed.

The desalinization of ocean water by distillation process where water is evaporated then the vapour is cooled and leaves behind the solutes. The cooled vapour is soft water which is portable while the other process involve the reverse osmosis whose principle is to force water

under high pressure through a semi- permeable membrance with small pores which allow water to pass and not salts or minreals. It is an expensive source of water but some hotels based at the coast like Jadini in south coast of kenya were already practising the technology according to the three key informants and 45% students respondents interviewed. Since the college borders the ocean, this project was viable and worth exploiting when funds becomes available.

The use of vast net mesh technology to trap ocean vapours was also another technology mentioned to be worth exploring in future to increase water suupply to the college. The mesh should be sited at a high strategic site where vapour generated from the ocean by evaporation can be trapped and directed to a tank and later used to supplement water supply in the polytechnic. This technology has been practised successfully in the chilean coastal desert to supply water for irrigation as explained by two key informants and 30% of students respondents surveyed.

The last options of increasing water supply source in mombasa polytechnic was the recycling of used water from the varoius uses . Waste water were directed to the septic tanks behind nautical bulding from where it was later released to the Indian ocean after passing through tanks while their retained sediments were removed manually by the contracted companies for further disposal. The potential of recycled waste water in the collge was estimated to be 100,800 litres which was the storage capacity of the septic tank. The project was found to be viable but expensive as explained by the key informant from the maintance department .

Water wastage and proposed conservation measures in Mombasa polytechnic

The above specific objective on water misuse and wastage in the college was found to be in two folds: student attitude and management planning strategies and response. Student attitude was found to be negative in terms of water use; like 80% reported by students and 26 observed cases, where the opening of water taps and leaving them to run without using the water or using excessive amount of water without considering other users was commonly observed among the students through participant observation. To avoid this negative attitude among the students population , there was a felt need to carry out extensive public awareness and sensitization campaign using different forms of media by the college management to change the prevailing condition. The campaign should be regularly done as acknowledged by 90% of students respondents and all key informants interviewed.

The management planning strategies and response was found to be ineffective. The maintance department in the college was sluggish in their response to reported cases of burst pipes. The study established from the key informants that the water supply systems in the polytechnic were last renovated in the late seventies implying that it had taken two decades without major rennovation work. Taking note of the corrossion effects of water in Mombasa polytechnic, the period was too long and the pipes were aging and required overhaul to reduce increseasd cases of leaking which was found to be common in most taps and pipes as reported by 60% students respondents surveyed and key informant from the maintance department.

The quantification of water loss through leaking in terms of money was thus: The leaking taps and showers in Table 1 found in sampled sites to be 26. Average quantity of water leaking per day was estimated at 177.76 liter. Total leakage from the sampled sites (26* 177.76) = 4621.76 liter per day. In the open market 20 liter jerican cost 10 kshs. Water bill paid by the college between 9/11/2004-16/2/2005 was 291.293 kshs. The differnce between paid bill and wastage through leaking was (291,293-46,217.60=245,045.40) kshs . This was the actual amount of money paid for water used positively. From the data worked above the polytechnic was paying for water supplied to it but was not used positively by the users due to leakage, pointing at lack of conservation measures currently.

The analysis of water safety in Mombasa polytechnic

Many watering points in the college were located in bathrooms-cum toilets in hostels, toilets in departments and one tap in the dinning hall (serving 562 students). It was unhygienic to have drinking points located in the toilets. It was suspected that contamination of the drinking water was probably taking place here. Most of the students respondents proposed that fabricated tanks should be placed at strategic points in the polytechnic where a student can draw water using their own drinking cups or bottles. The tanks should be placed under some coolers to keep the water cool most of the time. The water should also be enriched with minerals for nutrition provision as suggested by 70% of students respondent.

The proposed sites for locating these water drinking tanks should include main gate, main doors of all departments, Uncles hotel and student centres, the library, all hostels in the college and the dinning halls.Water supplied currently was found to be hard water. There was need to treat it to make it soft as it was found to be forming scum when boiled or consumed a lot of soap when washing. Safe drinking water for human consumption should be soft , sedimented, filtered , aerated and disinfected (Dent,1978). Water supplied in mombasa polytechnic was only disinfected.

Ngeny (1979), states that government of kenya requires water for human consumptions to be tested regularly at intervals of at least 2 hours for bacterial contamination and chemical residues. This was to confirm that water supplied was fit for human consumption. Mombasa polytechnic analysed their water at government chemist and mombasa public health department. The two government agencies took long time to submit their result according to the key informants from maintance department, implying that the college adminstration was not complying with the ministry of water regulation.

The failure to comply with the ministry regulation was best illustrated by the experiment carried out on water samples drawn from bore hole and tap water in the polytechnic, which revealed that most probable number of bacteria from the bore hole water was 10 while the tap water was 7. This findings indicated contamination of water. Confirmation test, proved that water samples had coliforms bacteria. Gram staining of the positive plates with growth confirmed the presence of *Escherichia Coli* bacteria in the water. Spread plates and grain staining showed that *Feacal Streptoccocus* were present (FAO,EC/Microbial Test,1976). The contamination by *F. Streptoccocus* requires that urgent action be taken to establish the source of diffuse pollution which was probably polluting underground water acquifers at the same time reduce contamination due to poor handling and siting of water outlets supply and facilities in the polytechnic.

The water well, pump house and borehole were not properly secured as vital installations/utility sites in the polytechnic. They should be fence off to prevent access by people who were not authorized. With increased cases of terrorisms such facilities can be targeted. The tanks on the roof tops should also be locked . The area surrounding these current water sources should be fenced and locked and a guard stationed there to mann it.

Conclusion

The study has established that water reources was available in Mombasa polytechnic but the quantity and quality were not enough and fit to meet the needs of the current population and the anticipated population increase in future : thus there was an urgent need to start exploring other identified sources, put measures to reduce misuse and wastage observed and improve the quality of water supplied currently which was confirmed to be contaminated.

RECOMENDATION

The study recommends that the management of Mombasa polytechnic should implement the following projects to supplement the current supply

Harvest rain water through roof catchment and collection of surface run off, construct underground tanks to store water collected from the roof and surface run off,add another line when the minisrty of water increase their line from Mzima springs,sunk another borehole water or well between SJ and staff quarters, control soil erosion by planting bare grounds with grass and trees to improve the recharge systems of the acquifers,carry out total overhaul of the water supply system in the college, put posters with writings like “lock up the tap after use”, “Do not leave the water running if you are not using it”, “conserve that water you will need it later” among others as ways of reducing misuse and wastage,construct a state of the art laundry, bathroom cum toilet at a central site for day scholars to decongest the water outlets in residential hostels,college management to address the problem of survivors (illegal residents in hostels) and the mangement should also regularly and promptly analysed the quality of water supplied and consumed in Mombasa polytechnic.

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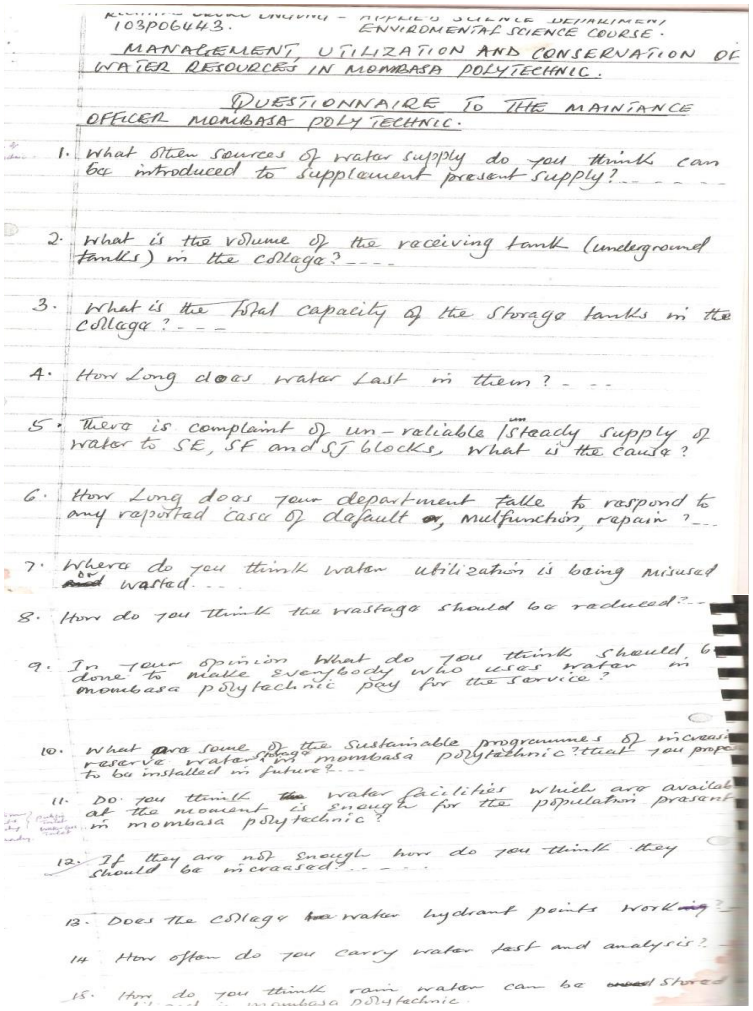
Appendix 1. Questionnaire.



103P06443. ENVIRONMENTAL SCIENCE COURSE.

MANAGEMENT, UTILIZATION AND CONSERVATION OF WATER RESOURCES IN MOMBASA POLYTECHNIC.

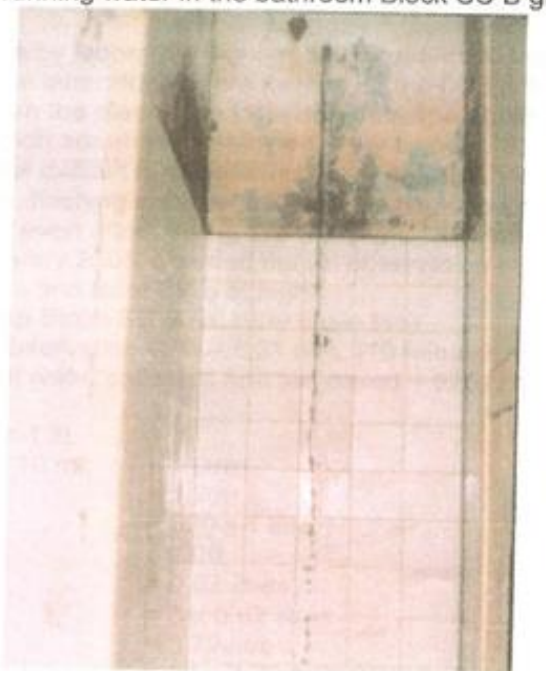
QUESTIONNAIRE TO THE MAINTANCE OFFICER MOMBASA POLYTECHNIC.

1. What often sources of water supply do you think can be introduced to supplement present supply?
2. What is the volume of the receiving tank (underground tanks) in the college?
3. What is the total capacity of the storage tanks in the college?
4. How long does water last in them?
5. There is complaint of un-reliable/steady supply of water to SE, SF and SJ blocks, what is the cause?
6. How long does your department take to respond to any reported case of default or, malfunction, repair?
7. Where do you think water utilization is being misused or wasted.
8. How do you think the wastage should be reduced?
9. In your opinion what do you think should be done to make everybody who uses water in mombasa polytechnic pay for the service?
10. What are some of the sustainable programmes of increasing reserve water supply mombasa polytechnic? that you propose to be installed in future?
11. Do you think the water facilities which are available at the moment is enough for the population present in mombasa polytechnic?
12. If they are not enough how do you think they should be increased.
13. Does the college have water hydrant points working?
14. How often do you carry water test and analysis?
15. How do you think rain water can be used stored in mombasa polytechnic

Appendix 2 : Running water in bathroom of block SCB ground floor.

- While filling standby water storage tanks in the toilets there were occasions (two) in block M and block SC C when the water did overflow after filling up the reserve tanks. The attendant was not in sight to close the tap.
- While pumping water to the storage tanks either at the distribution (towers) or the storage tanks in the roof tops of the buildings, cases of overflow were occasionally observed. This happened when the pump attendant was doing some other plumbing work somewhere while the machine was also pumping water to those storage tanks.
- There is frequent bathing by students. Some bathe in the morning, afternoon and evening daily using.
- Cases of water burst pipes were sighted. This problem is caused by aging pipes which were lastly repaired in late seventies (***pump attendant***)
- Maintenance department takes long to respond to reported cases for example on 9/2/2005 a burst pipe from the water distribution to the fire point was sighted as from 4.00 p.m. – 9.00 a.m. the next day (10/2/2005). Broken showers in block B ground floor took three (3) days before being attended to. A photograph was taken and its shown below here.

Photograph of running water in the bathroom Block SC B ground floor)



Appendix 3: Soil erosion in mombasa polytechnic.

Photograph of the ground floor of Block B

RAINWATER MANAGEMENT

Rainwater should be harvested to supplement the supply system already existing. The run-off from the rain should also be collected and be used instead of letting it to drain into the ocean. The environment should also be improved by planting grasses in all bare lands in the college. This will improve the underground water recharge system and reduce soil erosion, which is now rampant in the upper grounds of the college. The washed soil and debris are filling up the open drainage system in the college, which might lead to flooding in future. They are also leaving the college without topsoil meaning eco-system balance is being interfered with.

The rainwater should be managed to improve the environment and conserve the resource, as it is scarce. (Proposed improvement and conservation plan will be given in the recommendation in detail).

Soil erosion photograph