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**ACCESS TO SANITATION AND SAFE WATER:  
GLOBAL PARTNERSHIPS AND LOCAL ACTIONS**

**Management of Sewerage System:  
Case Study in Tema**

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*Many sanitation systems in most developing countries have deteriorated resulting in a lower level of service and consequent deterioration of environmental conditions. The sewerage system in the Tema Municipality is not different from other developing countries; three pumping stations and the treatment plant have been shut down hence raw sewage flows through a by-pass into the sea without treatment, creating an environmental hazard. This study examined the problems associated with the management of the sewerage system in Tema Municipality through field visits, administering questionnaires and interviews with key stakeholders. The study revealed that Tema Metropolitan Assembly (T.M.A) lacks key personnel; equipment, logistics and funds to manage the system. 33% of the residents using the sewer lines are not billed; the tariffs paid by the industries are low. The revenue does not march Operation and Maintenance cost and current electrical energy cost make up 64% of the Operation and Maintenance cost.*

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## **Introduction**

The Tema Municipal Sewage System was constructed in the early sixties for the collection, transport and treatment of human excreta and grey water within the Tema Municipality. The management of the system was under the control of the Tema Development Corporation until 1995 when it was transferred to the Tema Municipal Assembly (T.M.A.). The transfer was done after a major rehabilitation of the system had been carried out and a new treatment plant constructed to treat the sewage before it is discharged in the sea. T.M.A. has been experiencing difficulty in the operation and maintenance of the Sewerage System in the Tema Municipality. The newly constructed treated plant and the three pumping stations have been shut down and raw sewage is flowing through a by-pass into the sea without treatment. This situation is very alarming and creates environmental pollution and health hazard. This study therefore seeks to assess problems associated with operating and maintaining the sewerage network and the treatment plant, assess the current tariff structure to determine the adequacy of the tariff, the subsidy level and to determine the cost of operation and maintenance of the sewerage system in Tema Municipality.

The study began with a review of relevant documents at T.M.A. Household questionnaires were then administered to assess public perception and the billing system. In addition interviews were conducted with officials at T.M.A. to collect quantitative and qualitative data on financial, institutional and technical aspects of the research.

## **Institutional Capacity and Development**

The strength of every institution is judged by its performance in terms of performance indicators. Performance indicators are related skills, procedures and capabilities that define a particular area of institutional function. A strong institution is one that has positive performance indicators such as quality of service, cost-effectiveness and consumer satisfaction in terms of service delivery. For example management, training capacity, leadership and technical capability are often found to be the areas of institution deficiency. If management skills and knowledge are deficient, this will be seen in the operation and maintenance of the sewage system, billing and collection of revenue.

The key elements of institutional capacity are policies and procedures existing within the institution, the Organizational Structure, Management and Human resource development and ability of the institution to finance its operations. (Edwards et al, 1991)

**Procedures**

Procedures are formal or official order of doing things in institutions or organizations. Systems usually designed by institution include written procedures for design, construction supervision, procurement, operations and maintenance. For the overall management of the institution, procedures will cover management control, management information systems, performance measure and standards.

**Policies**

Policies are plans of action, statement of ideas proposed or adopted by an institution. For an institution responsible for sewerage works, there must be a policy on operations, maintenance, procurement, fixed assets inventory, inventory control, financial planning, billing and collections (Edwards et al, 1991).

**Organizational structure**

In order to operate successfully, every institution or organisation needs to be organised in such a way that every employee has a clearly defined role in terms of his or her own work and of work relationships with other employees. Most organizations start this process by drawing up an organizational chart. This defines management responsibilities by function. It should not be used to show personal status but as a tool that will allow any employee to identify personal, work group and company responsibilities and communication link.

This document should clearly show not only the duties and responsibilities, but also the objectives, by defining the ways in which the jobholder can contribute towards the overall objective of making the organization into a world-class player (Edwards et al, 1991).

**Management development**

Management development involves management strengthening. This requires a management development program. A well – conceived program to strength management will aim at changing managerial behaviour in the work place. Management development should involved programs such as on-the-job training, short courses or workshops in management skills, tailored to meet the needs of the institution.

This includes both formal training programs and the informal training that occurs through on-the-job training, apprenticeships, and job rotation. In addition to a regular process of skill transfer, effective institutions maintain staff through providing sufficient incentives, compensation, employee benefits, and promotion opportunities so there is a minimum of unwanted turnover.

**Study Area****Geographical Location**

Tema is a harbour town close to Accra in the Greater Accra Region. Its construction started in 1951 to provide residential accommodation and urban amenities to the harbour and the work force of industries. Tema is located on Longitude 0° and Latitude 5° 38” North.

It occupies an area of 163.2 km<sup>2</sup>. It has currently twenty three Communities with three more to be developed. It shares boundary with Ningo Prampram on the north, Gulf of Guinea on the south, Kpone and Nungua on the east and west respectively. Tema Municipality has a population 141,479 as at 2000 and a current projected population of 450,085. (Statistical Service, 2000).

**Sewerage System**

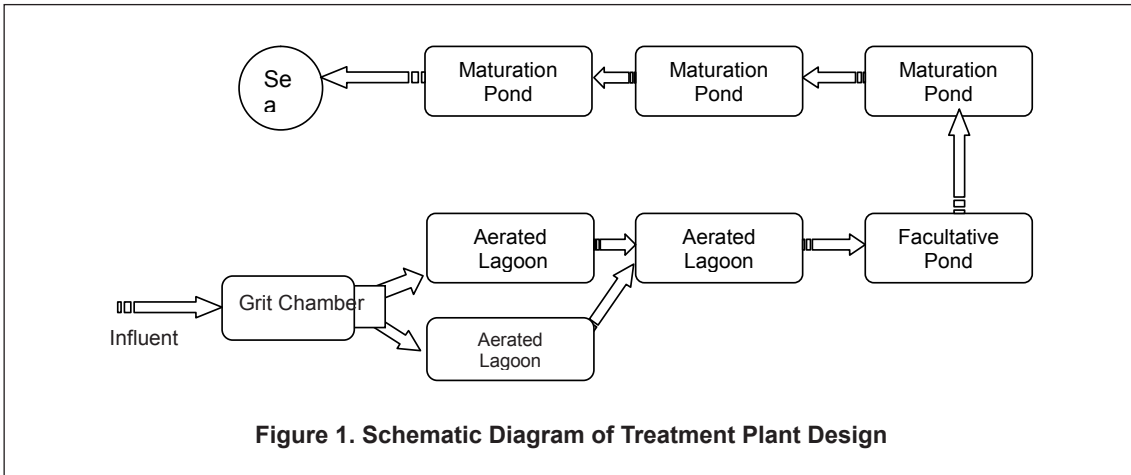
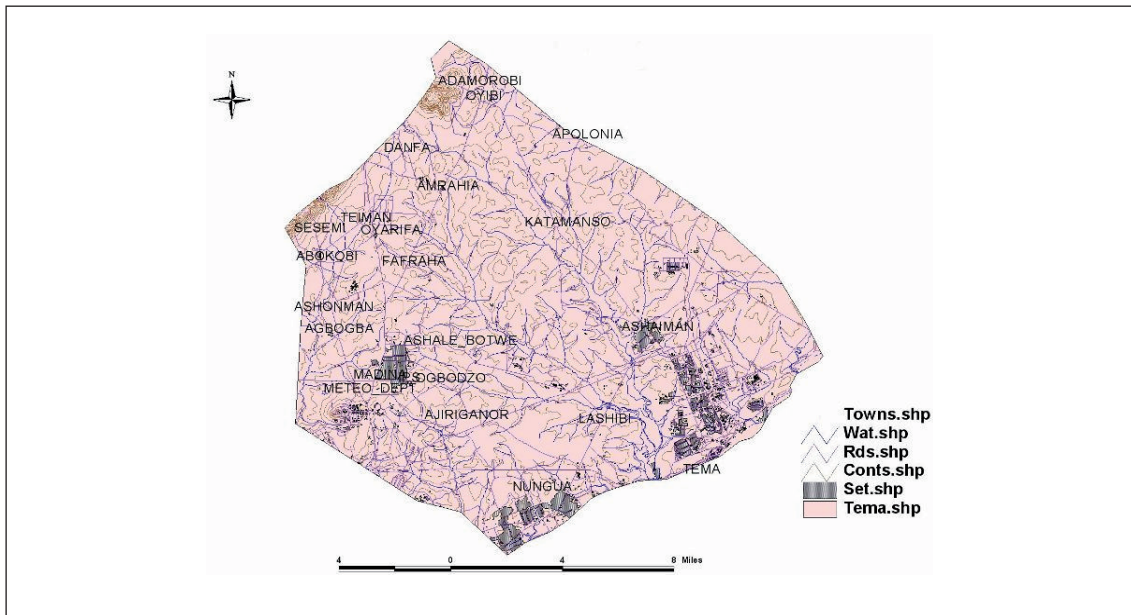
The Tema Sewerage System was constructed in 1963. The existing Sanitary Sewer System covers twelve communities, the harbour and the industrial area. The whole area of the town is divided into three catchments basins by two ridges. The three basins are:

- The southern basin, which covers part of Communities 2, 3 and the harbour;
- The western basin, which covers Communities 5, 6, 7, 8, 9, 10, 11 and 12;
- The eastern one covers Community1, parts of Communities 4 and 7 and the industrial area.

The system has 100mm diameter gravity house sewers, 150mm diameter sub-mains and 300mm diameter mains or trunk sewers forming the sewer network.

The system has three pumping stations (PS); all these pumping stations had three pumps each and each had a pumping capacity of 105, 53 and 94 L/s for PS1, PS2 and PS3 respectively.

In 1994, a major rehabilitation of the three pumping stations was done under Urban II Project. Two new pumps were installed at each pumping station. The pumping capacity for each pump was 225, 60, and 304



**Figure 1. Schematic Diagram of Treatment Plant Design**

L/s for PS1, PS2 and PS3 respectively. A new treatment plant was construction at Community 3 to treat domestic sewage from PS1 and PS2. Sewage from these pumping stations was diverted to the treatment plant via a 450mm and 300mm diameter pumping mains for PS1and PS2.

**Treatment Plant**

The treatment plant is made up of seven ponds; the first two in parallel connected to the last five in series. The first three ponds of the treatment plant have been designed to function as aerated lagoons but currently only one of them operates as an aerated lagoon. The fourth pond is a facultative pond and the last three in one pond serves as a maturation pond.

**Problems Associated with Operation and Maintenance of Sewerage System**

The study identified four group of problems associated with the management of the Tema sewerage system. These are technical, institutional, social, and environmental.

**Technical Problem**

The study showed that the tree roots and rodents disturb the sewer lines. This is probably because the tree roots near the sewer lines causes the lines to break thus rodents end up in the lines. Broken manhole covers and pipes can be attributed to the age of sewers and low maintenance of the system. The study revealed that the sewerage system is over forty years, thus most of the appurtenances are bound to deteriorate for

lack of routine maintenance. The broken manholes and pipes are the probable cause of the siltation of the sewer-lines. Also, the sewer lines were blocked by oil deposits from factories and garages; this is because there are no regulations set by T.M.A. to ensure that factories treat their wastewater before discharging it into the sewer lines.

### **Institutional Problems**

The study revealed the under listed problems:

- T. M. A. lacks the capacity in terms of personnel, equipment, logistics and finances to manage the sewer network and the treatment plant,
- Lack of incentives, motivation and poor salary of workers,
- Poor record keeping,
- Financial mismanagement,
- No separate account for sewer revenue,
- No separate budget for Operation and Maintenance,
- Poor billing system,
- Trained personnel leaving after contract period.

The institutional problems that have engulfed T.M.A. might be attributed to the fact that the sewerage works were transferred to T.M.A. without first building the needed capacity.

### **Social Problems**

The social problems identified during the study were improper sewer user attitude, non-payment of tariff, abuse of system by users, building on sewer-lines, dumping of refuse into sewer manholes, use of improper anal cleansing materials and illegal connections.

The study revealed that these social problems have accounted for the present state of the Tema sewerage system. The cause of all these problems stems from the fact that people have not been given the needed education on the use of the sewer hence the abuse of the system. Users also feel it is the responsibility of T.M.A. to maintain the system out of its own resources.

### **Environmental Problem**

From the field visits and interview with the Assembly, problems related with the environment was that of the offensive odour from the sewage treatment plants and its associated nuisance caused by mosquitoes and other flies. This is because two of the ponds, which had been designed as aerated lagoons, are now being used as anaerobic ponds because they have no aerators.

### **Operation and Maintenance (O&M) Cost**

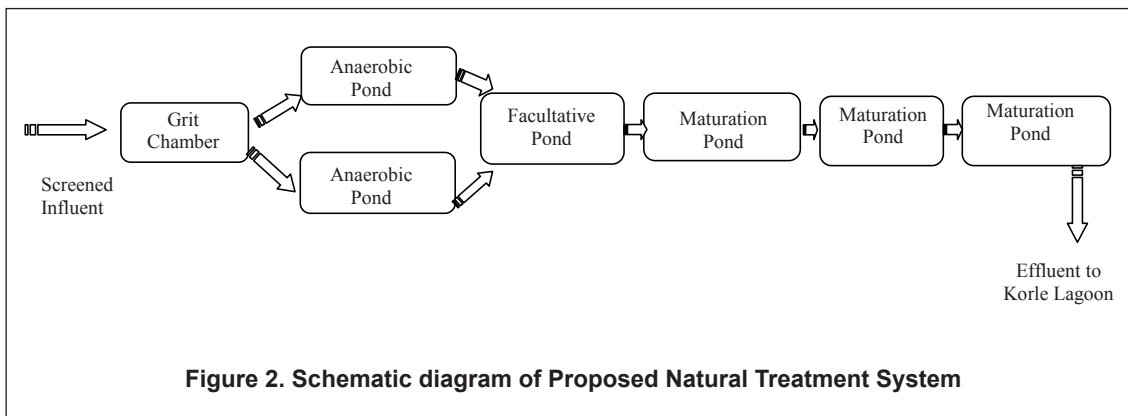
Table 1 above shows that the current operation and maintenance cost is **\$203,629.86** and the electrical cost make up 64% of the O&M. The electrical energy is used for the pumping stations and one aerator unit; it can therefore be inferred that if all three aerator units are put into operation the electrical cost will increase hence the actual O&M will be **\$430,686.85**. The study revealed that T. M. As inability to pay for the electrical energy has led to cutting of power and subsequent shutting down of the pumping stations and the treatment plant. Awuah et al, 1996 carried out studies on the performance of neglected Waste Stabilisation Ponds (WSP) and it was found that WSP in its worse state could perform well in Ghana. The treatment plant can therefore be converted to a natural system consisting of two anaerobic ponds, a facultative and three maturation ponds.

### **Revenue and Cost Comparison**

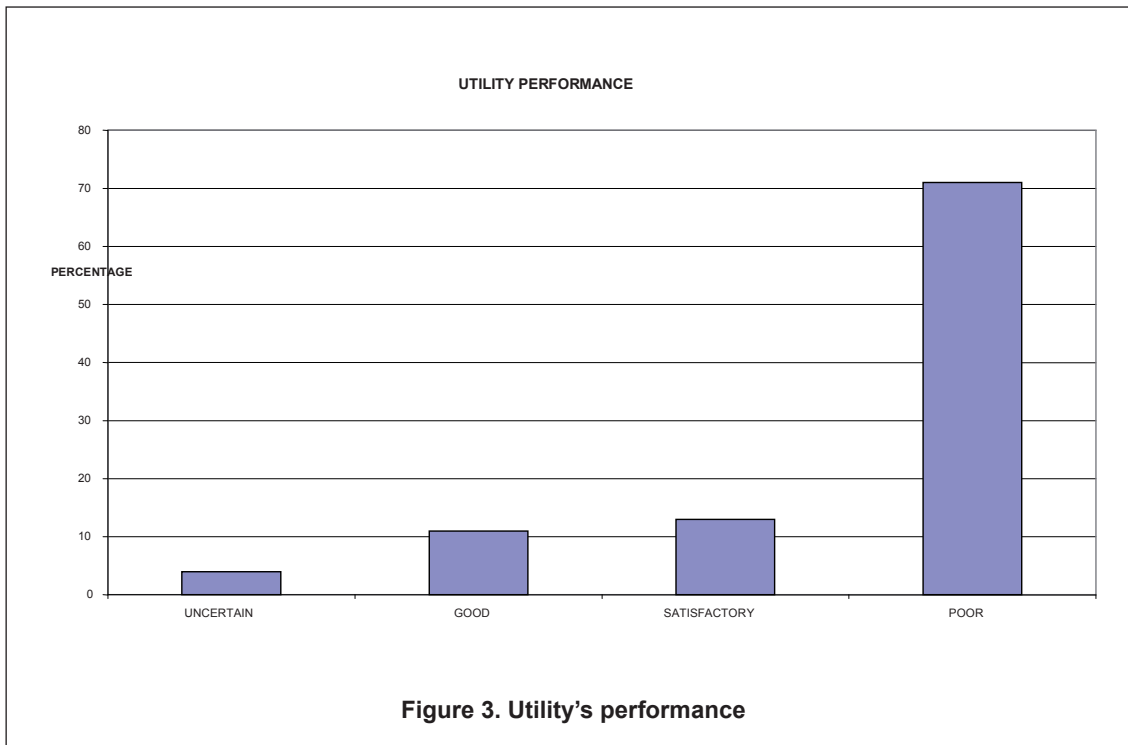
The study revealed that the Assembly charges \$0.029/m<sup>3</sup> for all types of waste without considering the characteristics of the waste. The study further showed that 33% of residents were not billed. The residential commercial and institutional revenue amounted to **\$153,923.07** and the industrial revenue was **\$69,692.31** bringing the total to **\$223,615.38**. It can therefore be inferred that if the 33% of customers were billed the Assembly could raise the O&M cost or close to the cost. Apparently, the revenue of **\$223,615.38** collected by T.M.A does not cater for the true operation and maintenance cost of **\$430,686.85**.

<b>Categor</b>	<b>Existing cost (\$)</b>	<b>True cost (\$)</b>
Salary/Wage	37,831.77	99,318.30
Electrical energy cost	130,527.00	200,000.00*
Maintenance (materials)	5,645.97	19,782.80
Maintenance (vehicles)	9,113.34	18,227.09
Maintenance (equipment)	2,000.00	28,400.96
T plant chemicals	0.00	32,120 .00
Administrative expenses	18,511.78	32,837.70
<b>Total</b>	<b>203,629.86</b>	<b>430,686.85</b>

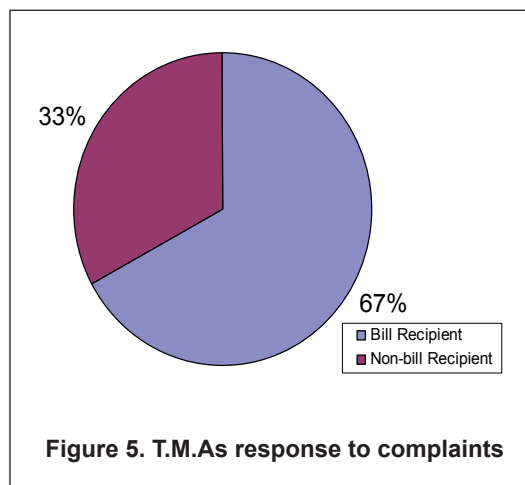
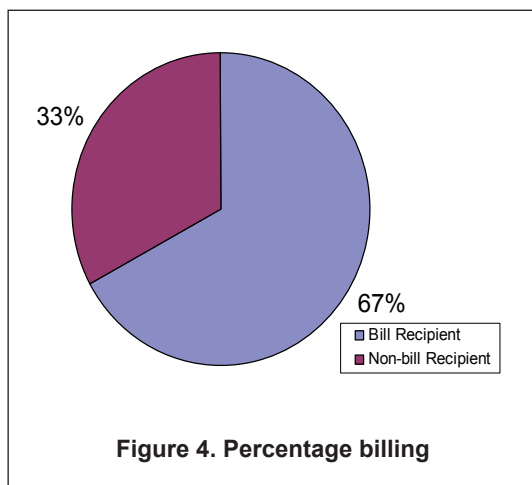
\* Suppose all three aerated lagoons are in operation



**Figure 2. Schematic diagram of Proposed Natural Treatment System**



**Figure 3. Utility's performance**



### Performance of the Tema Municipal Assembly: Public Perception

The study showed that the performance of the Assembly in terms of service delivery, response to complaints and billing were poor. Figures 1, 2 and 3 below are the charts illustrating the performance of the Assembly.

### Conclusion & Way Forward

The following are the conclusions drawn from the study:

- Tema Municipal Assembly lacks the managerial, technical and financial capacity to manage the sewerage system in the Tema municipality hence the system is not being managed efficiently.
- The government should redefine roles of the management and put in place proper procedures and policies to increase the performance of management and in tend increase the efficiency of the treatment plant.
- T.M.A. needs an amount of \$430,686.85 to cover the Operation and Maintenance cost per year.
- The treatment plant should be converted to a natural treatment system consisting of two anaerobic ponds, a facultative and three maturation ponds.
- The Assembly should set tariffs based on the characteristics of the waste water.
- T.M.A. should improve their collection system by billing all customers so as to be able to generate enough revenue to operate the treatment plant efficiently.

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### Keywords

management, sewerage system, service delivery

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