

An Approach to Drainage System Sustainability in Wolaita Soddo Town: A Case Study from Southern Ethiopia

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Abstract

Urban drainage systems have existed as a vital city infrastructure to collect and convey storm water and wastewater away from urban areas. Despite development over the years, it remains a significant challenge to design sustainable and effective functioning of drainage system. This study assessed the approach to drainage system sustainability in Woliata Soddo town. To this end, households of the town and public sector officials were interviewed to obtain necessary information for the study. Inadequate coverage, poor quality and inappropriate provision of drainage infrastructure were problems identified in the study. Weak technical and institutional capacities associated with lack of finance, lack of integration among concerned bodies, lack of community participation and poor operation and maintenance are factors constraining proper drainage infrastructure provision and worsening the situation in the study area.

Keywords: Drainage; Provision; Household; Infrastructure

Introduction

With urbanization, impermeability increases because of the increase in impervious surfaces. This in turn changes the drainage pattern, increases overland flow resulting in flooding and related environmental problems. The impact of this is severe on spatial structures like road. This is because, flooding and its related environmental problems like sheet and gully erosion, surface inundation tends to affect road services and its life span. Given the significance not only in socio-economic development, but also a path way for the location of other infrastructure, issues that affect its performance and longevity are critical areas of research [1].

The pattern of urbanization and modernization in Ethiopia has meant increase densification along with urban infrastructure development. This has led to deforestation, use of corrugated roofs and paved surfaces. The combined effect of this results in higher rain drop intensity and consequently accelerated and concentrated runoff [1]. In Ethiopian context, where watersheds of many urban centers receive significant amount of annual rainfall and where rainfall intensity is generally high, control of runoff at source, flood protection, and safe disposal of excess water/runoff through proper drainage facilities becomes essential.

Soddo town is like other town of Ethiopia has a lot of problems regarding drainage infrastructure including inadequacy and poor quality drainage infrastructure. Stemming from its location at the foot of Demota Mountain with absence of proper drainage line along roads in the town, seasonal floods and other environmental problems are most frequently occurring especially on downstream parts of the town. This has resulted in negative impacts on sustainable urban drainage system provision and management.

Study objectives

The study has the following objectives:

- Assessing the existing condition of drainage infrastructure in the town;
- Identify the main problems in the provision of drainage infrastructure;
- Identifying challenges associated with operation and maintenance of drainage system in the study area.

Description of the study area

Wolaita Soddo, one of the oldest towns in the South Nation Nationalities and Peoples Region (SNNPR), was established as a municipality in 1952. Astronomically, the town has a latitude and longitude of 6°54'N 37°45'E with an elevation between 1600 and 2100 meters above sea level. The mean annual temperature and rainfall of Wolaita Soddo ranges from 15.1 to 200 c and 1201 – 1600 mm respectively. The population distribution of the town, about 24,592 in 1984, 36,287 in 1994, 76,050 in 2007 and 109,200 in 2013, CSA, (2007) [2] and Wolaita Soddo town administrators report of 2013. The average population growth rate of the town is about 6.75% (Figure 1).

Literature Review

Sustainable Urban Drainage System (SUDS) as defined by Warrington Borough Council (2007) as cited in Grimm [3] is 'a sequence of management practices and control structures designed to drain surface water in more sustainable fashion than in some conventional techniques.' In lay terms, this means that SUDS slow down the rate of flow through various controls as close to the source as possible, thereby promoting natural infiltration, the collection of solids through sedimentation, the uptake of nutrients and the reduction of contaminants through vegetation uptake and bacterial action.

Urban drainage systems are designed to remove the rain fall which accumulates on relatively impermeable surfaces in towns and cities. In doing so, they further increase the speed of runoff and reduce the natural attention of the land surface. The runoff from an urban area may have a significant effect on the hydro-graph of a natural water course which

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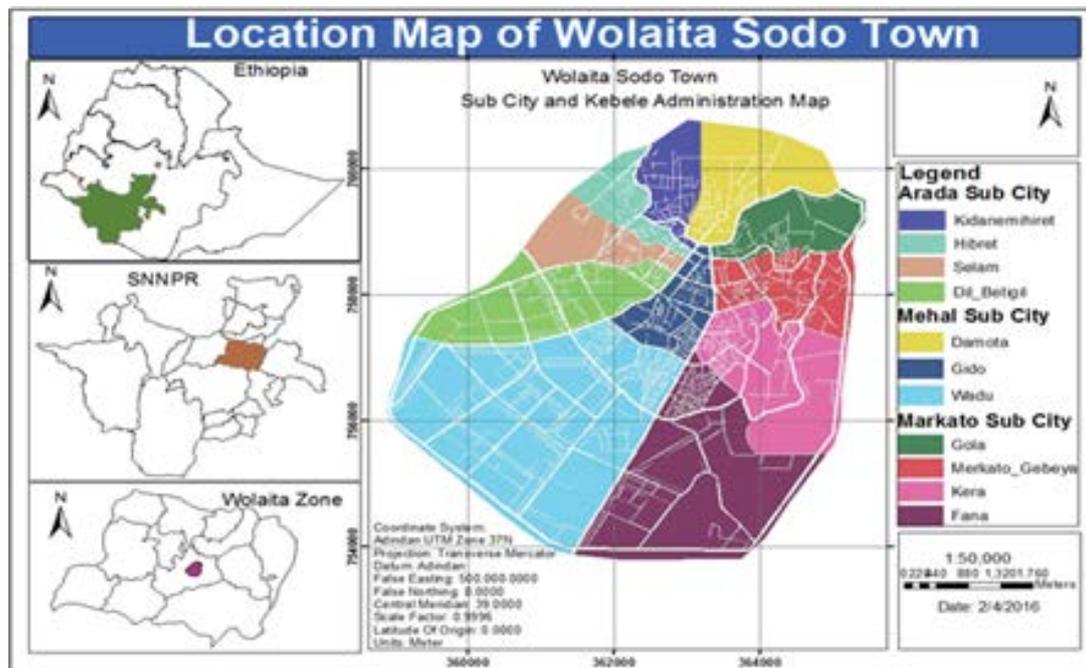


Figure 1: Location map of the study area. Sodd Town Municipality, 2015 [7].

is receiving the runoff, since the later may not have responded to the rainfall. More attention is now being paid to increasing the attenuation of urban drainage system by the use of tanks and reducing the flows by promoting infiltration [4]. Generally, increased flow rates and changes in stream bed morphology threaten the ecosystem of the receiving waters; this effect is amplified if the storm water runoff is itself polluted. It is also noted that the large percentage of impervious surfaces in urban landscape contributes to another form of pollution.

From technical perspective, the design and construction of urban drainage systems is relatively straightforward, but subsequent operation and maintenance remain major challenges to urban authorities who are often ineffective in dealing with the scale of the problem [5]. Uncollected solid waste often finds its way into surface drains and sewers; these drains, blocked with rubbish, then have less capacity than clean ones, and are more likely to flood during large storms.

According to Ethiopian Ministry of Urban Development, Construction and Housing Strategy [6] after a road drainage study has been conducted along with road design, the quality of the road drainage that is built will determine the service-life of the infrastructure. Even though this task has been carried out by many Micro and Small Enterprises (MSE) in recent years and the enterprises have gotten encouraging results. Trainings and technical supports have to provide to these enterprises so as to enable them to conduct the construction of these road drainages and flood elimination systems with good quality. This will improve the quality of the constructions and it will also gradually lengthen their service life.

Methods

Descriptive survey strategy was employed in the study. The mixed research approach is used since it is useful to capture the best of both qualitative and quantitative approaches. 164 statistically determined households of the town were drawn systematically in addition to 7

purposively selected key informants from public sector organizations and included in the study sample. Structured questionnaire were then distributed to these households while the public officials were interviewed to obtain all the necessary data. Both qualitative and quantitative data collected from overall 171 respondents were analyzed accordingly and presented by using tables, percentages, figures, plates and narrative descriptions.

Results

Soddo Municipality, in their 2015 [7] report indicated that the existing drainage network length of the town covers 68.6 km² which is not as much as the total built up area and the road network coverage in study area. Road infrastructure without appropriate drainage system become deteriorated by runoff and storm water. The majority of drainage systems of the town are open channels. There are three types of drainage in the town as indicated below in the table: masonry drainage covers (70%), concrete (29.74%) and pipe drain (0.09%) (Table 1 and Figure 2).

Concerning drainage infrastructure provision the main problems associated are like poor coordination and integration among stakeholders. Moreover, community participation is among the lowest in the study area. For example, 76.22% of respondents proved that there is no community participation in one way or another for drainage infrastructure provision. Therefore, government is the only body responsible for the provision of this service. Operation and maintenance of urban drainage infrastructure is a very challenging issue in the study area. Challenges that are encountered by community during the operation of drainage system were dumping solid waste, discharging of liquid waste and not cleaning the drainage system. Majority of respondents (84.8%) replied that all above mentioned challenges exist in the study area. Maintenance of drainage infrastructure is also a very challenging problem. Poor drainage infrastructure maintenance is

Types of Drainage	Length (m)	Percentage (coverage)
Masonry Drainage	48134.91 m	70%
Concrete Drainage	20403.83 m	29.74%
Pipe Drainage	65.09 m	0.09%
Total	68603.83 m	100%

Table 1: Drainage types in the study area. Soddo Town Municipality, 2015 [7].

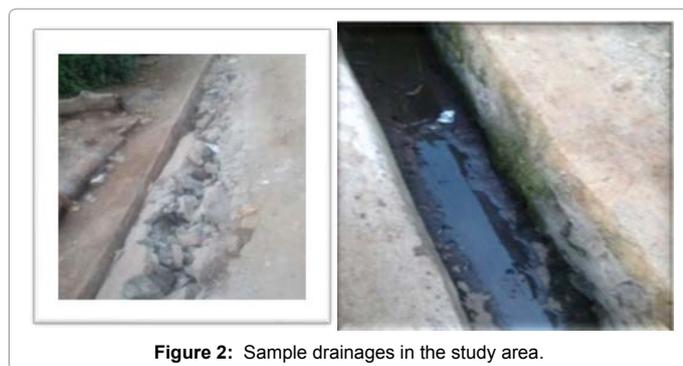


Figure 2: Sample drainages in the study area.

further worsened by lack of adequate waste collection and inappropriate disposal. This in turn causes residents of the town to poor sanitation and blockage of drains (Figure 3).

Discussion

The study findings revealed that, the quality of drainage in the study area is poor and hence, the construction of drainage infrastructure has to be undertaken by skilled man power. With respect to quality, the role of municipality to improve the quality of drainage infrastructure is not convincing. In order to minimize the cost of the construction of the drainage system the construction is undertaken by micro and small scale enterprises and daily workers who do not have enough skill. As stated by Dagnachew [1] with urbanization, impermeability increases because of the increase in impervious surfaces. Inadequacy of Sustainable urban drainage system leads to ill economy and poor environmental conditions. Due to the inadequacy of the drainage system, the low lying parts of the town, especially is hit frequently by splash flood. And this is mainly resulted because of the blockage of drainage system by the solid waste, poor maintenance practice of drainage system and lack strong integration among stakeholders in the provision of drainage infrastructure to ensure sustainability of drainage system. Parkinson [5] in his study founded that, in poorly drained areas, urban runoff mixes with sewage from overflowing latrines and sewers, causing pollution and a wide range of problems associated with the increased risk of waterborne disease. Poor quality drainage, inadequate coverage, low level community participation and weak integration of stakeholders are some of the major problems drainage infrastructure and sustainability in the study area. Theo [8] in his study said that, the absence of coordinating structure to unite and focus the energies of different actors is also a contributory factor. The consequences have thus been inter-organizational conflict, inefficient utilization of scarce resources and the costly undoing of one agency of another agency's accomplishments.

On the other hand, the provision of drainage system in the study area is characterized by absence city wide drainage network plan, shortage of capital and skilled manpower, lack of commitment on the side of contractors and micro and small scale enterprises. According to Armitage [9] in order to plan, implement, monitor and evaluate any activity, human resource has indispensable role in any sector. Ultimately,



Figure 3: Poorly maintained drainages in the study area.

the real obstacles to sustainability are the lack of adequate numbers of skilled personnel who are able to plan and implement urban drainage in a timely and holistic manner – coupled with the lack of funding needed to pay for the work.

Community participation and coordination of private investors in the provision of drainage infrastructure is almost lacking in the study area although the government is not capable of providing and developing the service in sustainable manner. Olukanni et al. [10] founded that, community participation in terms of sanitation provides members of the community the opportunity to contribute in the policy and decision making process. In its contribution, the place of planning, implementation, monitoring and maintenance of drainage channels should be given its rightful place as regards to sustainability. Participation in its approach is seen as a means of ensuring augmented social accountability with the involvement of the citizens in decision making as well as creating a close relationship between the “governed” and the “governing”. Concerning operation and maintenance of drainage system, operational problems caused by poor solid waste management are exacerbated by a lack of effective arrangements for drain cleaning. This tends to be related to a lack of resources and manpower, and inappropriate equipment. But, what makes the situation worse is the department responsible for solid waste management separate from that responsible for drain cleaning and coordination between different urban sectors is generally very poor.

Public participation plays a key role by taking proper care of infrastructure and maintaining them with a feeling of ownership for a prolonged service life of infrastructure, in addition to its contribution in the form of finance and labor. Good maintenance requires a steady and reliable flow of funds. But in the study area, the capital budget allocated for the development as well as operation and maintenance of drainage infrastructure is inadequate.

Conclusion

The existing drainage system has extensive defects and requires immediate rehabilitation or reconstruction, and also maintaining major drainage works. Because, the construction of drainages were not undertaken by skilled personnel but by not dedicates contractors and micro and small scale enterprises. Therefore, there is inadequate and low coverage of drainage system coupled with poor physical condition and ineffectiveness of drainage system development in the town. Lack of skilled man power, poor integration of stakeholders, low level community participation, constraints of budget and absence of drainage network plan in the town were the main problems encountered in the provision of drainage in this study. Operation and maintenance works of drainage infrastructure is challenged by illegal dumping of solid waste, discharging of liquid waste in to drainage which leads health and environmental problems.

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