Assessment of sustainability of rural water supply services in Tanzania: the case study of Dodoma region
Lightness Eliamringi and Shija Kazumba

ABSTRACT
Rural water supply services in Tanzania are still inadequate. Despite the substantial resources invested to provide safe water, there is a significant number of water points that are non-functional. Knowledge of the degree of sustainability and the contributing factors for rural water supply projects is limited. This study employs the fuzzy set concept to assess the degree of sustainability of water points in seven Local Government Authorities (LGAs) of Dodoma region in Tanzania. Dodoma region lies in the semi-arid area of Tanzania where boreholes are the major sources of water supply. Due to limited information, four dimensions of sustainability of water projects were used in this study. These include water quantity from the water sources, water quality, institution setting with regard to community participation in meetings, and financing of the projects for operation and maintenance. The multidimensional sustainability indices of water points were determined. The results indicate that only two LGAs, of Bahi and Kondoa, have sustainable water points with sustainability indices of 0.86 and 0.83, respectively. Kongwa has the lowest sustainability index of 0.17 due to poor water quality and inadequate quantity of water from the boreholes.

Key words | Dodoma, fuzzy set, rural water supply, sustainability index, Tanzania, water points

INTRODUCTION
One of the key issues leading to the establishment of ‘Ujamaa’ villages in Tanzania (a type of African socialism) in 1967 was the quest to give clean water to all citizens. It was argued that gathering people in villages would ease and facilitate the provision of community services such as water, schools, security, hospitals, etc. As it turned out, most people expected the Government to provide such services free of charge, but to do so became too expensive for the Government of Tanzania to sustain.

In 1971, with the aim of providing access to adequate and safe water supply within a walking distance of 400 meters from each household, the Government of Tanzania launched a 20-year Rural Water Supply Programme, but according to the report by WaterAid (WaterAid Tanzania 2009), the resulting water projects were unsustainable. Pumps for deep boreholes which should have been maintained by the government became inoperable. The same results were obtained by the Netherlands Development Organization (SNV) Tanzania (SNV 2010) through Water Point Mapping (WPM) carried out from 2007 to 2008 for 20 districts. It was observed that out of 6,109 water points mapped, only 3,489 were functional, and the remaining 2,620 (43%) were non-functional due to various reasons.

In 2006, the National Rural Water Supply and Sanitation Programme (NRWSSP) was adopted for the period 2006–2025. It is a long term plan for the rural water supply and sanitation development to meet the Millennium Development Goal (MDG) targets and beyond. Based upon the NRWSSP, the water sector came up with the Water Sector Development Programme, which is supported by several Development Partners, including the World Bank. According to the Water Sector Status Report (Ministry of Water 2012), Rural Water Supply and Sanitation component planned to increase access to clean and safe water supply...
from 53% in 2003 to 66.4% in 2010 so as to attain the 74% anticipated MDG service coverage by 2015. The actual results of implementation showed that coverage had increased from 57.1% in 2007 to 68% in 2015 as reported in the Water Sector Status Report (Ministry of Water 2015).

Despite the substantial resources invested in Tanzania to provide safe water and improve sanitation since the 1990s, the WPM report by the GeoData Consultancy Company (2015) indicated that 28,215 out of 74,250 rural water points in Tanzania are non-functional. This is about 38% of the constructed water points in the country. The report also showed that most of the water points became non-functional even before the end of the design period.

Sustainability and functionality of water points sometimes have not been clearly differentiated. Most studies conducted on sustainability of water points focus on functionality of the water points. A water point is functional if it is actually in use by the local community at a particular point in time (WaterAid Tanzania 2009). On the other hand, a water point is sustainable if the water sources are not over-exploited but naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply, the benefits of the supply continue to be realized by all users indefinitely, and the service delivery process demonstrates a cost-effective use of resources that can be replicated (WaterAid Tanzania 2009). The two concepts are, however, closely related, but good sustainability should enhance functionality.

The concept of sustainable development has been in the rhetoric for nearly a quarter of a century without much empirical content. It was virtually an ‘empty box’ empirically except in sector-specific analysis such as fisheries and forestry. Water resource professionals even considered that its (sustainability) ‘usefulness, irrespective of its conceptual attraction and widespread acceptance, can only be marginal, unless it can be used operationally and effectively in the real world’ (Biswa 2006). In this context two aspects of measurement of sustainability are of particular interest to policy makers, sector specialists and development professionals. First, such an attempt provides the framework for ‘the development process, which could be planned and implemented in such a way that it could become inherently sustainable’ (Tortajada 2005). The second equally important aspect of such an empirical exercise is to identify the parameters that should be monitored and evaluated continuously so that timely intervention reverses the transition of systems from sustainability to non-sustainability. We are more concerned about this ‘transition process’ of systems towards non-sustainability so that timely public and institutional intervention could reverse the process.

Studies assessing the extent of the sustainability and influencing factors for rural water supply services are limited. World Bank (2000) and Asian Development Bank (2006) indicate the broad ‘admissible dimensions’ in the complex nature of sustainability of potable water supply. The dimensions of the factors following the specification of the concept in the literature include attributes from: (i) Source; (ii) Technology; (iii) Quality; (iv) Institution; (v) Finance; and (vi) Human behaviour. These broad dimensions are elaborated below.

(i) Source: Source refers to a source of natural water – surface or sub-surface – from which water is extracted, treated and distributed to the needy community. A perennial water source is a prerequisite for sustainability of a system.

(ii) Technology: Technology refers to the devices used to extract water from source, process and deliver it to the users. Right selection of technology is important in the sustainability of the system. It may be noted that its impact on sustainability can be measured only through its interaction with other factors such as water source, quality etc.

(iii) Quality: The broad parameter that affects the potable supply of water is its quality. The relevance of quality to sustainability depends on two aspects: First, water extracted from the source should be amenable to treatment to attain potable standards before delivery to consumers; Second, even if the quality of water is good at delivery point, the users should also perceive that the quality is good. If both dimensions are not met, then the system is non-sustainable.

(iv) Institutions: According to North (1990), ‘Institutions are rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction.’ He further elaborates that institutions can reduce uncertainty by making available a well-knit structure to everyday life. In the present context, institutions signify formulation of rules and
regulations for the transparent and efficient functioning of the systems that ensures sustainability. This would mean identification of rules and regulations for the efficient operation, maintenance and management of water supply systems.

(v) **Finance**: Sustainability in terms of finance implies that the system generates adequate cash flow to meet the expenses for current operation and maintenance (OM) and for future expansion or renewal. If such adequate cash flow cannot be generated, the system cannot sustain itself.

(vi) **Human behaviour**: The last prerequisite for sustainability is appropriate human behaviour. This constitutes, among others, personal, domestic and environmental hygiene and awareness. A summary of dimensions and attributes of sustainability is indicated in **Table 1**.

Water sources for water projects in Tanzania are mainly shallow wells, boreholes, springs, lakes, and rivers. Due to decline in water sources from rivers, shallow wells, and springs in many parts of the country, people are reverting to the use of boreholes as alternative source of water for water supply projects. This is especially practiced in the semi-arid region, which covers about 16% of the area of Tanzania.

Understanding of the index of sustainability of water points and contributing factors enables policy makers to make right decisions and design interventions to ensure the sustainability of water services. The purpose of this study is to determine the relationship between sustainability index of water points and influencing factors, which include: water quantity, water quality, institutional setting, and financing of water schemes in Dodoma region. The issues of technology and human behaviour are not considered in the assessment in this study due to lack of information.

### METHODOLOGY

#### Study area

Dodoma region lies between 4° to 8° latitudes and 35° to 37° longitudes, as shown in Figure 1. It is in the central part of Tanzania with an area of 41,310 km². Dodoma region is characterized by semi-arid weather with a large number of about 1,534 water points (Figure 1) in the rural area whose water sources are from boreholes. However, in this study 1,371 water points have been used for analysis because some water points had insufficient information.

#### Data

Data from WPM System (www/wpms.maji.go.tz), which is managed by the Ministry of Water and Irrigation, Tanzania, were used to determine sustainability indices for each Local Government Authority (LGA) in Dodoma region. The data were downloaded on 25 February, 2015. Information contributing to the sustainability of water points was selected. This includes: water quantity, quality, institutional (meeting) and

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Dimensions and attributes of sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimension</strong></td>
<td><strong>Attribute/indicator</strong></td>
</tr>
<tr>
<td>Water source adequacy</td>
<td>Adequacy of quantity of water supply throughout the year</td>
</tr>
<tr>
<td>Technology</td>
<td>Physical condition of the scheme to which the water point belongs State of operations and maintenance</td>
</tr>
<tr>
<td>Quality</td>
<td>Perceived quality of water</td>
</tr>
<tr>
<td>Institution</td>
<td>Record keeping Social audit of the records At least one General Meeting in a year Distributional equity - adequacy of quantity of water distributed to households</td>
</tr>
<tr>
<td>Finance</td>
<td>Cost recovery, i.e. Revenue – OM costs</td>
</tr>
<tr>
<td>Human behaviour</td>
<td>Water (source) pollution due to human behaviour</td>
</tr>
</tbody>
</table>
financing of projects. Only water points whose sources are from boreholes were considered.

**Distribution of water points in Dodoma LGAs**

The total number of water points used in analysis is 1,371 out of 1,534 water points. The distribution of these water points is provided in Table 2. About 69.1% of 1,371 water points that were used in this study have good quality, while 47% of these have adequate water quantity. Financing of the projects in Dodoma region is from 81% of water points. The reported meetings for institutional strengthening with regard to water issues were conducted to 99% of water points studied.

**Sustainability model by fuzzy sets**

Fuzzy sets are sets whose elements have degrees of membership. Fuzzy sets were introduced by Zadeh (1965), who noted that there are classes of objects that do not have precisely defined criteria of membership but rather, can be characterized by a continuum of grades of membership. In classical set theory, the membership of elements in a set is assessed in binary terms according to a bivalent condition – an element either belongs or does not belong to the set. In contrast, fuzzy set theory permits the gradual assessment of the membership of elements in a set. This is described with the aid of a membership function valued in the real unit interval [0, 1]. Fuzzy sets generalize classical sets, since the indicator functions of classical sets are special cases of the membership functions of fuzzy sets, if the latter only take values 0 or 1.

If $S$ is a fuzzy set and $x$ is a relevant object, the statement ‘$x$ is a member of $S$’ is not necessarily either true or false, as required by classical dual logic, but it may be true only to some degree, the degree to which $x$ is actually a member of $S$. Fuzzy sets have imprecise boundaries that facilitate gradual transition from membership to non-membership and vice versa. In itself, the fuzzy set theory is not multidimensional.
But there are two major reasons that make it an appropriate tool for analyzing multidimensional sustainability: (a) it enables the analysis of each dimension/attribute in turn; and (b) it enables dealing with all the attributes together.

The fuzzy set theory attempts to capture simultaneously the vagueness of sustainability boundaries and the multidimensional character of sustainability. The approach is useful because it allows capturing the multidimensional nature of sustainability, avoiding the use of arbitrary thresholds imposed from the outside. The fuzzy set theory replaces the traditional approach to the demarcation of sustainability through a binary function that assigns projects to two non-overlapping sets (sustainable and non-sustainable) by a generalized Membership Function ($\mu$), whose values vary between 0 and 1. Larger values of the function indicate higher degrees of membership to the set of sustainable projects.

### Assignment of variables

Assigning values of the membership function to each water point for each attribute depends on the type of variable/attribute being analyzed (in our case, whether the variable is dichotomous or ordinal).

**Dichotomous variable:** For a dichotomous variable, the degree of membership of the $i$th water point (for $i = 1, \ldots, n$) with respect to the $j$th attribute (for $j = 1, \ldots, m$), to the fuzzy subset $S$ is defined as:

\[ x_{ij} = \{0; 1\} \]

- $x_{ij} = 0$; if water point $i$ is absolutely non-sustainable with respect to the $j$th attribute,
- $x_{ij} = 1$; if water point $i$ completely belongs to the set of sustainable water points with respect to the $j$th attribute, and
- $0 < x_{ij} < 1$; if water point $i$ reveals a partial membership to the set of sustainable water points with respect to the $j$th attribute.

This approach takes care of the vague aspect of sustainability. The main issue in the multidimensional analysis of sustainability using fuzzy sets is how to determine the values of the individual membership function, $\mu_S(x_i)$, and then how to aggregate these values into a composite sustainability index.

### A theory of multidimensional sustainability analysis using fuzzy sets

Let $X$ be a set of $n$ water points and $S$, a fuzzy subset of $X$ – the set of sustainable water points. In the fuzzy sets approach, the value of the degree of membership $x_{ij}$ of the set of sustainable water point $i$ with respect to attribute $j$;

\[ x_{ij} = \mu_S(x_i), \]

is defined as:

- $x_{ij} = 0$; if water points $i$ is absolutely non-sustainable with respect to the $j$th attribute,
- $x_{ij} = 1$; if water point $i$ completely belongs to the set of sustainable water points with respect to the $j$th attribute, and
- $0 < x_{ij} < 1$; if water point $i$ reveals a partial membership to the set of sustainable water points with respect to the $j$th attribute.

<table>
<thead>
<tr>
<th>LGA</th>
<th>Quantity of water</th>
<th>Quality</th>
<th>Meeting</th>
<th>Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adequate</td>
<td>Partially adequate</td>
<td>Not adequate</td>
<td>Good</td>
</tr>
<tr>
<td>Bahi</td>
<td>175</td>
<td>170</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Chamwino</td>
<td>154</td>
<td>0</td>
<td>151</td>
<td>3</td>
</tr>
<tr>
<td>Chemba</td>
<td>192</td>
<td>179</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Dodoma urban</td>
<td>345</td>
<td>29</td>
<td>68</td>
<td>248</td>
</tr>
<tr>
<td>Kondoa</td>
<td>123</td>
<td>112</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Kongwa</td>
<td>289</td>
<td>83</td>
<td>63</td>
<td>143</td>
</tr>
<tr>
<td>Mpwapwa</td>
<td>93</td>
<td>77</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,371</td>
<td>650</td>
<td>324</td>
<td>397</td>
</tr>
</tbody>
</table>
The adequate, partially adequate, and adequate quantity of water from the source has ordinal type of attribute; having adequate water sources is sustainable in the dimension represented by the attribute threshold under which the individual water point is seen as partially sustainable in cases where \( x_{ij} \) is the threshold above which the water point is seen as sustainable, and \( x_{ij} \) is the threshold above which the water point is seen as unsustainable in the said attribute. The water point \( i \) is partially sustainable in cases where \( x_{ij} \) lies between the two thresholds. For instance, the adequacy of quantity of water from the source has ordinal type of attribute; having adequate, partially adequate, and adequate quantity of water. The \( m \) categories (adequate, partially adequate, and not adequate) are ranked from the category with a high sustainability to the one with a lower sustainability of 5,2,1. With regard to Equation (1), a score \( x_{ij} = 3 \) is assigned to water points with adequate water sources. The score of \( x_{ij} = 2 \) is assigned to water points whose water sources are partially adequate, and a score of \( x_{ij} = 1 \) to water points whose water sources have inadequate quantity of water. From Equation (1), the value of the membership function \( \mu_S(a_i) \) is 0.5 for all water points having partially adequate water sources.

**Determination of sustainability indices**

Sustainability indices of water points in this study are determined using the ‘fuzzy sets’ method by Zadeh (1965). Having computed the value of its membership function for each water point \( i \), the multidimensional sustainability index of the set of rural water points can be computed by aggregating the values of the membership functions across the \( m \) attributes.

The sustainability index of water points in a given LGA with respect to attribute \( j \) (in this study \( j \) = quantity of water, quality, institution with regard to meeting, and financing of water project) is determined by (Zadeh 1965):

\[
\mu_S(a_i) = \begin{cases} 
1, & \text{if } x_{ij} = x_{\text{max},j} \\
\frac{x_{ij} - x_{\text{min},j}}{x_{\text{max},j} - x_{\text{min},j}}, & \text{if } x_{\text{min},j} < x < x_{\text{max},j} \\
0, & \text{if } x_{ij} \leq x_{\text{min},j} 
\end{cases}
\]  

(1)

where \( x_{\text{max},j} \) and \( x_{\text{min},j} \) represent the two thresholds (or extreme values). The value \( x_{\text{max},j} \) represents the extreme threshold under which the individual water point is seen as sustainable in the dimension represented by the attribute \( j \), and \( x_{\text{min},j} \) is the threshold above which the water point is unsustainable in the said attribute. The water point \( i \) is partially sustainable in cases where \( x_{ij} \) lies between the two thresholds. For instance, the adequacy of quantity of water from the source has ordinal type of attribute; having adequate, partially adequate, and adequate quantity of water. The \( m \) categories (adequate, partially adequate, and not adequate) are ranked from the category with a high sustainability to the one with a lower sustainability of 5,2,1. With regard to Equation (1), a score \( x_{ij} = 3 \) is assigned to water points with adequate water sources. The score of \( x_{ij} = 2 \) is assigned to water points whose water sources are partially adequate, and a score of \( x_{ij} = 1 \) to water points whose water sources have inadequate quantity of water. From Equation (1), the value of the membership function \( \mu_S(a_i) \) is 0.5 for all water points having partially adequate water sources.

The composite multidimensional sustainability index, \( \mu_S \), is a monotonic increasing function of the degree of sustainability of each water point. The increase in sustainability of a subset of the water points, other things remaining unchanged, results in an increase in the value of the composite sustainability index \( \mu_S \). The absolute contribution of the \( j^{th} \) attribute to the multidimensional sustainability index by Zadeh (1965) is:

\[
C_j = \frac{\mu_S(X_j)}{\sum_{j=1}^{m} w_j}
\]  

(5)

For the estimation of the global overall sustainability index in the region, \( S \), Equation (4) is applied by treating all water points in the region as a single LGA.

**Sustainability classification**

In this study, for classification purposes we consider water points in a given LGA when the calculated index of
sustainability is below 0.50 to be non-sustainable. The water points are considered to be in transition when the index of sustainability ranges between 0.50 to 0.70; and sustainable when the calculated index of sustainability has a value above 0.70.

DATA ANALYSIS AND RESULTS

Assignment of variables

In order to determine the Index of Sustainability for each LGA, the variables for sustainability were assigned a value of degree of sustainability. The quantity of water at the source was considered to be an ordinal variable with attributes of either adequate, partially adequate, or not adequate, as indicated in Table 1 and Table 2. Values of the membership function \( \mu_S(a_i) \) were defined as presented in Equation (1). A score of \( x_{ij} = 1 \) was assigned to water points whose sources of water had adequate quantity of water, and a score of \( x_{ij} = 0.5 \) was assigned to partially adequate water sources; while \( x_{ij} = 0 \) was assigned to water points having inadequate water sources. In this case, the number of water points in each category was defined. For instance, in the case of Kongwa LGA where the total number of water points \( n = 289 \), the frequency of occurrence of water points with adequate source of water is \( n_i = 83 \), while the frequency of occurrence of water points was \( n_i = 63 \) and \( n_i = 143 \) for partially adequate and not adequate sources, respectively.

The dimensions of sustainability with regard to water quality, conducting meetings to strengthen institution for water management, and financing of water supply services were considered to be dichotomous variables. A score of either \( x_{ij} = 1 \) was assigned to water points that satisfied the requirement of the attribute or \( x_{ij} = 0 \) for those that did not comply. The frequency of occurrence of each category of the attributes was defined. For instance, in the case of Kongwa LGA the frequency of occurrence of water points with good water quality is \( n_i = 20 \) and that with poor quality is \( n_i = 269 \). In the same manner, the frequencies of the variables for conducting meetings and financing status were defined.

Determination of sustainability indices

The sustainability indices with respect to a given attribute \( j \), \( \mu_S(X_j) \) of water points in a given LGA were computed using Equation (2); and the multidimensional sustainability index \( \mu_S \) of water points in LGA with respect to all attributes was determined by using Equations (3) and (4). The results are presented in Table 3.

The results in Table 3 indicate that LGAs of Kongwa and Dodoma urban have the lowest multidimensional sustainability indices, \( \mu_S \), of 0.17 and 0.3, respectively. Kongwa LGA has the lowest global sustainability index due to poor water quality from the aquifer and inadequate quantity of water from the water sources. The index of sustainability with respect to water quality \( (\mu_S \text{ Quality}) \) in Kongwa is 0.07 and that of quantity \( (\mu_S \text{ Quantity}) \) of water from water sources is 0.4. The quantity of water from existing boreholes in LGA of Dodoma urban is inadequate. Sustainability index with respect to water quantity is 0.18.

Water points in Bahi and Kondoa LGA reveal high global sustainability indices, \( \mu_S \), of 0.86 and 0.83, respectively. This is because most of the attributes in these LGAs showed good sustainability indices ranging from 0.77 to 0.99.

Chamwino, Chemba, and Mpwapwa LGAs are in the transition to sustainability with global sustainability indices, \( \mu_S \), of 0.56, 0.68 and 0.59, respectively. Strengthening of financing of water projects is required in Mpwapwa and Chemba since it has low indices of 0.49 and 0.60, respectively. Inadequate water quantity in the existing boreholes of Chamwino leads to low sustainability of water supply

<table>
<thead>
<tr>
<th>LGA</th>
<th>( n )</th>
<th>( \mu_S ) Quality</th>
<th>( \mu_S ) Quantity</th>
<th>( \mu_S ) Meeting</th>
<th>( \mu_S ) Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahi</td>
<td>175</td>
<td>0.86</td>
<td>0.99</td>
<td>0.99</td>
<td>0.84</td>
</tr>
<tr>
<td>Chamwino</td>
<td>154</td>
<td>0.56</td>
<td>0.95</td>
<td>0.49</td>
<td>0.98</td>
</tr>
<tr>
<td>Chemba</td>
<td>192</td>
<td>0.68</td>
<td>0.82</td>
<td>0.97</td>
<td>1.00</td>
</tr>
<tr>
<td>Dodoma urban</td>
<td>345</td>
<td>0.30</td>
<td>0.78</td>
<td>0.18</td>
<td>1.00</td>
</tr>
<tr>
<td>Kondoa</td>
<td>123</td>
<td>0.83</td>
<td>0.93</td>
<td>0.95</td>
<td>0.98</td>
</tr>
<tr>
<td>Kongwa</td>
<td>289</td>
<td>0.17</td>
<td>0.07</td>
<td>0.40</td>
<td>1.00</td>
</tr>
<tr>
<td>Mpwapwa</td>
<td>93</td>
<td>0.59</td>
<td>0.70</td>
<td>0.90</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 3 | Sustainability indices of water points in LGAs with respect to given attributes
services. This is revealed in the data of Table 2 and the index of water quantity in Table 3.

The global overall sustainability index, \( S \), for Dodoma region was determined by Equations (3) and (4) by treating all water points in the regions as a single LGA. The Dodoma regional overall sustainability index is 0.68 (Table 4). The contribution of each attribute to the regional overall sustainability index was computed by Equation (5). The results for each attribute contribution to the overall sustainability index, \( S \), are presented in Table 4.

Financing of projects contributes more to the overall sustainability indices of water points in Dodoma LGAs with the exception of Kongwa, Chamwino and Dodoma urban. Meanwhile, their overall sustainability indices make a high contribution with respect to water quantity. This means that improvement in water quantity in LGAs of Kongwa, Chamwino and Dodoma urban will bring a significant contribution to the overall sustainability index in the region. This is revealed also in the data of Table 2, where there is a large number of water points with inadequate water sources for Kongwa, Chamwino and Dodoma. The contribution of meetings to the overall sustainability indices of water points in Dodoma LGAs is approximately zero. This is because all LGAs in Dodoma have a good record of management meetings, as indicated in Tables 2 and 3.

### CONCLUSIONS

The fuzzy set concept has been employed in this study to determine the degree of sustainability of rural water supply services in Dodoma region of Tanzania. The major findings in this study showed that out of seven LGAs in Dodoma region, Bahi and Kondoa indicate high global sustainability indices of 0.86 and 0.83, respectively. The LGAs of Dodoma urban and Kongwa have low global sustainability indices of 0.30 and 0.17. The LGA of Dodoma urban experiences inadequate quantity of water from the existing water sources. Kongwa experiences both inadequate quantity of water from the existing boreholes and poor water quality.

Chamwino, Chemba and Mwapwa are in the transition to sustainability, with indices of 0.56, 0.68 and 0.59, respectively. Strengthening for financing of projects in Chambe and Mwapwa is required to improve water supply services. This is because the sustainability indices with respect to financing in Chemba and Mwapwa are low. Financing performance for water projects in Chamwino is good, but it experiences inadequate quantity of water from the existing boreholes. Water sources from alternative sources are required in addition to the existing ones.

The overall sustainability index of Dodoma region is 0.68. This indicates that water supply services in LGAs of Dodoma are in transition and more efforts are required to make them sustainable. Financing of projects plays a greater role towards contribution to the overall sustainability indices of water points in Dodoma LGAs except in Kongwa, Chamwino and Dodoma urban. These areas require additional sources to the existing ones to make the water supply services adequate.

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