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ASSESSMENT OF FACTORS AFFECTING MAINTENANCE OF RURAL WATER SUPPLY SCHEMES IN KILOLO DISTRICT, TANZANIA: A CASE OF KIPADUKA WATER SCHEME

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ABSTRACT

In rural Tanzania, although considerable efforts have been made to improve and expand access to domestic water supply, many Tanzanian rural communities still suffer from inadequate and lack of safe drinking water. This research work intended to assess the factors affecting maintenance of rural water supply schemes. A mixed method research approach was adopted whereby both quantitative and qualitative methods were employed in the field data collection and analysis so as to enhance reliability and validity of the results. Secondary data was obtained through a detailed literature review. Descriptive statistic was used to analyze the data. The study findings indicated that maintenance of the Kipaduka water supply scheme is affected by factors related to financial, technical, cost recovery, community support, and spare parts. The paper concluded that local government should budget for technical support, spare parts and conduct refresher training courses to community management members for Kipaduka water supply scheme.

Keywords: *Rural, water ,supply, maintenance, Tanzania*

INTRODUCTION

According to WHO (2010); more than 884 million people do not have improved drinking water supply; almost all of them are from developing regions and 84% of them live in rural areas. An estimated 39% of the population in sub-Saharan Africa did not have access to improved water by 2010, despite the fact that the MDGs (Millennium Development Goals) target of halving the proportion of the population without access to improved water had been achieved by 2010.
Baumann, (2005) reported that 35% of all rural water supplies in sub-Saharan Africa are not functioning. WASH (2002) found that some of the key issues, which lead to non-functional

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schemes, are poor maintenance, poor institutional and organizational arrangements including management bad technology choices, lack of training and efficient capacity building techniques and the unavailability of spare parts. WHO (2000) insisted that poor maintenance has been attributed to ineffective management models. Some of the common operations and maintenance management models, which have been implemented in most of the developing countries, are: centralized institutional or government-managed, and community-based.

COMMUNITY MANAGEMENT OF RURAL WATER SUPPLY SYSTEMS

As stated by Beyene (2012) the community management of rural water supply systems on operation and maintenance is not successful, if financing resources are not available and frequent supports are not provided. Budgeting sufficient funding for rural water supply systems is an important issue for proper maintenance.

Similarly, Harvey & Reed, (2007); Hutchings et al., (2015) reported that many community based service providers are not able to manage their water systems sustainably without external support of some sort. Rural communities in low-income countries are usually not endowed with the financial resources to contribute meaningfully to the upkeep of water supply systems. .If the communities are left alone the water systems often begin to fail once large scale investments for major repair or rehabilitation works are required.

The government of Tanzania started the Rural Water Supply Project in 1971 aiming to provide safe and clean water to the entire nation. The government declared that by 1991 both rural and urban population should have access to safe water within easy reach. To achieve this declaration, a number of efforts have been implemented by Tanzanian government to establish reliable rural water supply systems. The Government prepared the first National Water Policy in 1991 to address the sector challenges; however, emphasis was put on the central Government as the sole implementer and provider leading to unsustainable management and development of water resources (URT, 2006). In response to unsustainable water services, in 2002 the Government introduced a National Water Policy that was based on four key elements: the process of 'decentralization by devolution', cost-recovery, and the issue of ownership. The policy stipulates that communities are responsible for full cost recovery, which means the recovery of the complete cost of the installation of the system, as well as covering costs for operation and maintenance. According to National Water Policy, (2002) due to poor operation and maintenance, over 30% of the rural water supply schemes are not functioning properly. Many of the dysfunctional water systems are operated and managed by community-based organizations such as Community Water and Sanitation (WASH) Committees, Water User Associations (WUA) or Women groups which emphasize community responsibility and authority over operations and maintenance of their water facilities.

Despite all the initiatives by the Tanzanian Government to increase access, many rural water projects completed have either stopped operating or are not operating optimally, access to safe

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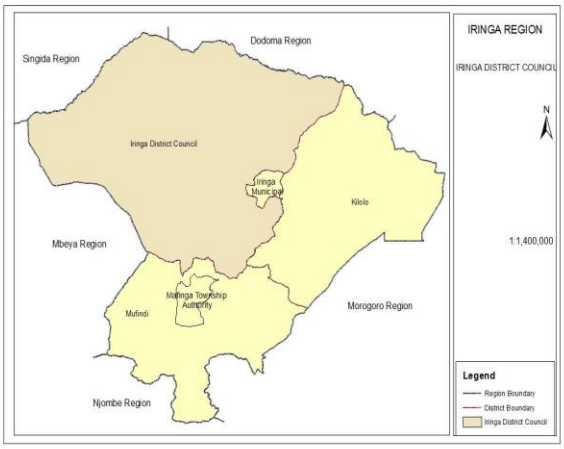
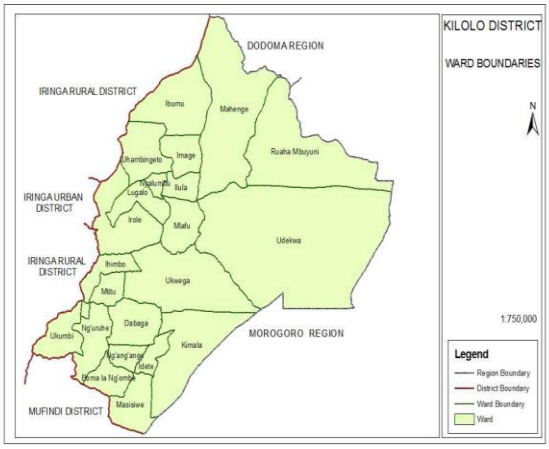
drinking water still remains low. The Kipaduka water supply project is a case example of rural water projects that provides services to the rural communities. Some of the challenges facing Kipaduka water supply scheme include: frequent failure of network components which lead to unreliable water supply services to the served villages. It is against this background that the current study attempts to assess the factors that affect maintenance of the rural water supply scheme with specific reference to Kipaduka water supply scheme as a case study.

Description of study area

The Kipaduka rural water supply is located in Kilolo District in Iringa administrative region in the Northeast of the Southern Highlands of Tanzania. Kilolo district is one of the three districts of Iringa; others being Iringa and Mufindi. Map 1.1 and 1.2 show the three districts of Iringa region and ward boundaries of Kilolo district respectively. Kilolo district has a total area of 7,881 square Kilometers and a population of 204,372 people as per 2012 Tanzania National census. Kilolo district shares borders with Mpwapwa district (Dodoma Region) to the North, Kilosa district to the Northeast and Kilombero district to the East (both of Morogoro region), Mufindi District to the south and Iringa District to the west (both of Iringa region). Kilolo district is administratively divided into twelve wards; namely; Bamalang'ombe, Dabaga, Idete, Ilula, Image, Irole, Mahenge, Mtitu, Udekwa, Uhambingeto, Ukumbi, and Ukwega.





Map 1.1: Location of Iringa region Map 1.2: Map of Kilolo District Council 2012

Source: National Bureau of Statistics (2012)

Kipaduka water supply scheme

The Kipaduka water supply scheme is located, in the Uhambingeto ward. The scheme serves four villages namely; Kipaduka, Ikuka, Iwungi and Vitono all located in Uhambingeto ward. The objective of this scheme is to provide potable drinking water in all the villages. The scheme consists of major elements of water supply scheme namely; headwork (water intake with fence), break pressure tank (BP), air valves with chambers, concrete storage tanks, transmission main,

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distribution, number of water points (WP). The elements and their respective quantities are presented in table 1. The water source for this scheme is Msale spring of Selebu Mountain, in Iyai village located in Image ward. According to Kilolo District Water Engineer, Kipaduka water supply was designed in May 2010 and the construction took place from June 2011 to June 2012. The scheme was designed to serve a population of 12,532 for 10 years. The Msale water source has a minimum discharge of 864m^3 per day and maximum daily demand is 599m^3/day. The scheme is operated, maintained and managed by Water User Association (WUA) known as KIVI. KIVI include members from all four villages.

Table 1: Kipaduka water supply scheme elements

S/NO	Element	Unit	Quantity
01	Water Intake	No	1
02	Pressure Break Tank (PBT)	No	1
03	Gravity main	m	25,528.9
04	Distribution network	m	23871
05	Water storage tanks	m^3	3@100
06	Air valves	No	31
07	Water Points	No	36
08	Gravity Flow meter	No	6
09	Distribution Flow Meter	No	3
10	Washouts	No	36
11	Pipe markers	No	135

(Source: Kipaduka water supply authority, 2015)

RESEARCH METHODOLOGY

Sampling Procedure and Sample

The study adopted a purposive sampling technique in selecting study area, and the respondents. Kipaduka water supply scheme was selected as the case study area due to its representativeness for the maintenance challenges faced by water projects managed by communities in rural Tanzania. The four villages in Uhambingeto ward were selected because they are the beneficiaries of the Kipaduka water supply project.

The respondents were selected because of their important roles in water supply service provision. Selected respondents were: Regional Water Advisor's office staff, four(4) District Water Engineers (DWE) who are responsible for the provision of improved water supplies in the area

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and also responsible for supervising maintenance activities; five(5) technicians and (6) scheme artisans were selected because they are responsible for daily maintenance and operation of the scheme, seven (7) water user association (WUA) members and eighteen (18) water user groups (WUG) respondents were selected because of their overall responsibility in managing the operation and maintenance of Kipaduka water supply project. A total of 41 respondents were selected.

Data collection techniques

Both quantitative and qualitative methods of primary data collection were employed in data collection. The quantitative method used was the questionnaire survey. Qualitative methods used included direct observation which helped to assess the site physically.

Quantitative data collection

A closed format approach questionnaire was adopted combined with some open format questions. The open–ended questions were included for the purpose of getting the detailed answers from the respondents. The questionnaires were administered to Regional Water Advisor's office staff, District Water Engineer's office staff and Water User Association (WUA) and Water User Group (WUG) members of Kipaduka village. The rationale for administering questionnaires to these key informants was to obtain expert relevant information on factors affecting maintenance given their knowledge, and experience.

Direct Observation

Field observations were made to collect qualitative data and to verify the information provided by the respondents. Observation was undertaken with Kipaduka water supply project manager, District Water Engineer, chairman of Water User Groups (WUG) during preliminary survey in the study area to observe and gather technical information.

Secondary Data

Information on secondary material was obtained through intensive reviews of literature and various publications related to maintenance of rural water supply schemes in Tanzania and other developing countries. The information sources included: records and documented reports, text books, journals, published and unpublished research reports. Secondary information was useful to develop research concept and put the study under acceptable body of knowledge on maintenance challenges of water supply projects. Documents reviewed to obtain a better understanding on Tanzanian rural water supply provision included: National Rural Water Sustainability Strategy, Ministry of Water, Dar es salaam-Tanzania, 2015-2020, and Tanzanian National Water Policy of 2002.

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Data Analysis

Descriptive statistic was used to analyze the data. The analysis of data collected from questionnaire survey was entered into the computer using Microsoft Access Data Base. Data entry was manually cross-checked to ensure accuracy. The collected data were edited, coded and processed by using Statistical Packages for Social Science (SPSS) version 20. Editing and coding of the questionnaires was done and data were entered based on the developed codes. After completing data entry, cleaning and verification of the entered data was done so as to remove committed errors such as illogical answers. The qualitative data was analyzed on the basis of personal judgments, comments from experts, and results from informal interviews were also used as a basis for the analysis and interpretation of the information.

RESULTS AND DISCUSSION

The factors affecting maintenance practices in Kipaduka rural water supply scheme are discussed under the sub-headings below:

Community management support (Maintenance support)

The study assesses the management support of Kipaduka water supply scheme based on Capacity building support and technical support .For this study it was learnt that there was no training which had been conducted to maintenance crafts since 2012 when the scheme started operation. It was also revealed that there was no budget allocation for enabling the community management in capacity building. Questionnaire survey data revealed that the maintenance manpower in Kipaduka water supply project was not sufficient as reported by 33 interviewees equal to 82.5% of the respondents and rest of 7interviewees equal to 17.5% acknowledge that, maintenance is insufficient. It was also learnt that there is no support given to the water committee from any organization and the scheme is being administrated by the water committee. The water committee members reported that the community covers both the operation and maintenance cost and there is no training provided to the water committee members. As Harvey and Reed (2007) correctly observe, community management is sustainable only where a strong local government institution is in place to support community and training should be lengthened while capacity building is fostered in various areas (URT, 2006). According to Harvey and Reed, (2004) capacity building is an ongoing, dynamic process since staff may be transferred and knowledge forgotten. It should include periodic assessment of the impact of past capacity building initiatives, so that plans can be made for current and future needs.

Existing Maintenance Management of Kipaduka Rural water scheme

The study depicted that water users are responsible for all maintenance activities including physical repair. When asked about the type of maintenance strategy that is applied by the scheme 100% of all the respondents stated that maintenance is limited to corrective maintenance

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only and maintenance activities are not scheduled. Respondents were also required to give information on how maintenance is being carried out. All respondents (100%) answered that own work force is used. Similarly, as to whether there were shifts of maintenance activities; all the respondents indicated that there were no working shifts. Respondents explained that whenever there is break down of any water system components village members (water users) volunteer to repair. However, volunteers have to get approval from the rest of the village members. As noted by Harvey and Reed, (2007)); the system which relies on voluntary commitment may not be very sustainable because the volunteers may lack skills of doing the repair job. Given the fact that the volunteers are not necessarily guaranteed any allowance or honoraria, they are bound to engage in other activities for the sake of earning a living. In addition, the voluntary service may be hampered by lack of spare parts and other working appropriate tools. Harvey and Reed, (2007)) reports that even where community volunteers are active, some repairs are beyond their ability. As suggested by Batchelor et al., (2009) on-going technical support is required for difficult technical repairs and refresher training, and ongoing institutional support is required to encourage the community members. For those reasons it can be argued that approach of volunteering may be successful where there is support from other institutions such as NGOs or local government.

Availability of spare parts

As reported by respondents spare parts are rarely accessible within Kilolo district. It was mentioned by the respondents that about 30% of spare parts are obtained within Iringa town center the capital of Kilolo district. Iringa town was mentioned to be the nearest place to get the spare parts. About 70 % of the spare parts were reported to be bought from major cities such as Dodoma and Dar es Salaam. The respondents further claimed that even after obtaining spare parts successfully the challenge of the huge distances affect spare parts procurement. For example Dodoma is more than 266 kilometers away from Iringa and it takes 5 hours 12 minutes to reach Dodoma from Iringa while distance from Kilolo to Iringa town is 47 kilometers Distance between Dar es Salaam and Iringa is 407 kilometers. Due to these distances additional money would be required for food and lodging for one or two nights. Respondents also claimed that transportation cost and time required for buying spare parts cause difficulty to do immediate maintenance when a failure occurs. An elaborate literature reveals that spare parts should be bought and held at district level (URT, 2006). Harvey and Reed (2006) report that a sustainable spare parts supply should be available, accessible, and affordable and appropriate. Appropriate tools and spare parts are required to facilitate maintenance and repair. From the findings of this study it is clear that unavailability of spare parts highly affect the adequate provision of potable water in Kipaduka water supply scheme as it restrains the timely maintenance. For example in

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the late 1990s the community maintenance model was deemed to fail in Mauritania, mainly due to problems with access to spare parts and lack of qualified mechanics. (Harvey & Reed, 2004)

Environmental issues

The environmental issues in this study included an assessment of water source discharge fluctuations, and the causes of variations. When asked if there are any changes of discharge of Msale spring which is the water source for Kipaduka water supply scheme; majority of the respondents at (95%) responded affirmatively while 5% gave a negative response. The respondents claimed that the Msale spring discharge changed drastically from 2010 up to 2016. It can be argued that the variation of discharge of the Msale spring was influenced by climate since the rate of water flow from the spring varies also with the seasons. The highest percentage of respondents at (63.2%) indicated that human activities contribute to the changes of discharge of the water source. Respondents explained that farming practices near the water source and over-extraction of water from the source are increasing daily. An additional issue that was raised by respondents was the high turbid water caused by sediments due to soil erosion which is caused by tillage and farming practices around Msale spring.

Over-extraction of groundwater reduces the water pressure in an aquifer (is a saturated geologic formation that will yield a usable quantity of water to a spring), decreasing the volume of flow.

Msale Spring discharge was reported to be insufficient during the dry season which normally leads to drought .Drought was also reported as a cause of spring output insufficiency by 13.2% of the respondents; 2.6% of the respondents indicated that environmental destruction contributes to discharge of water source variations, and 63.1% mentioned that lack of source maintenance as a cause of insufficient water from the spring, while 21.1% of the respondents could not respond to this question. Based on literature (IPCC, 2014), less precipitation during the dry months can lead to drought. Changes in precipitation will ultimately affect ground water availability. Climate change is likely to influence drought conditions. Climate trends in Tanzania have shown greatest annual decrease rainfall has occurred in the southern-most parts of Tanzania (McSweeney et al, 2010). The National Climate Change Strategy of 2012 outlines findings from the Tanzania Meteorological Agency that southern highlands will continue to be affected by declining rainfall, frequent droughts. This situation automatically affects spring output since rainfall is one of the factors that control flow to the spring.

Financial issues

Financial issues assessed in this study were maintenance budget allocation, and source of maintenance budget. 90% of the respondents indicated that there is no any allocation of maintenance budget. The remaining 10% could not respond to question on the allocation of budget. 92.5% of the respondents confirmed that the main source of maintenance budget was the

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user fees, and 7.5% of the respondents could not give any answer. The financial responsibility for the maintenance of Kipaduka water supply scheme lies within the user community. These findings support NAWAPO (2002) recommendations that for sustainable arrangement for making communities fully responsible for operation and maintenance of their water supply schemes, community will be required to pay full operation and maintenance costs and cost of higher service levels as well as to manage their schemes. Binder,(2008) states that "increasing the budget allocation for rural water supply systems is very important, but that is not the only thing to meet the challenges of achieving the Millennium Development Goals (MDGs)."

Cost recovery collection

This study revealed that users of Kipaduka water supply scheme have agreed to raise maintenance funds as a means of cost recovery from each village receiving water supply service from the scheme. Tables 2, 3 and 4 present the summary of planned revenue collection for the villages served by Kipaduka water supply scheme from 2013 to 2015 respectively. It can be seen from the table targeted amount in TZS (Tanzanian shillings) for each village; as well as the collected and uncollected amounts.

Table 2 Revenue from January – December, 2013

S/NO	Village	Consumers	Target amount(TZS)	Collected (TZS)	Uncollected (TZS)
1	Kipaduka	811	4,055,000	2,550,000	1,505,000
2	Ikuka	1,100	5,500,000	3,005,000	2,495,000
3	Vitono	601	3,005,000	2,005,000	1,000,000
4	Iwungi	701	3,505,000	2,850,000	655,000
	TOTAL	3213	16,065,000	10,410,000	5,655,000

Table 3: Revenue from January – December, 2014

S/NO	Village	Consumers	Target amount(TZS^2)	Collected (TZS)	Uncollected (TZS)

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1	Kipaduka	811	4,055,000	3,000,000	1,055,000
2	Ikuka	1,100	5,500,000	4,300,000	1,200,000
3	Vitono	601	3,005,000	2,900,000	105,000
4	Iwungi	701	3,505,000	2,400,5000	1,104,500
	TOTAL	3213	16,065,000	13,205,000	2,860,000

Table 4: Revenue from January – December, 2015

S/NO	**Village**	**No. of Consumers**	**Target amount(TZS)**	**Collected (TZS)**	**Uncollected (TZS)**
1	Kipaduka	811	4,055,000	3,950,000	105,000
2	Ikuka	1,100	5,500,000	4,005,000	1,495,000
3	Vitono	601	3,005,000	2,900,000	105,000
4	Iwungi	701	3,505,000	3,005,000	500,000
	TOTAL	**3213**	**16,065,000**	**13,860,000**	**2,205,000**

[1] Tanzanian Shilling(1 US Dollar equals 2247.30TZS in 31st January 2018)

As the table shows the amount which was set differ from village to village. However, it wasn't clear whether the amount was set on the basis of village population because as seen in the table the larger the population the higher the amount. The trend shows that water users (villages) were willing to contribute although there was no village that could achieve the targeted amount per year. The main reasons that may contribute to the failure of the villages to raise the planned amount possibly the amount set was unaffordable, high burden or impossible to Kipaduka poor water users. Thus observation by Mebrahtu, (2012) may also apply for the case of Kipaduka that in times of increasing financial severity and practicality, the trend is to place this burden of recurrent cost on the community. Another possibility of not achieving the planned target can be similar to that noted by Harvey and Reed, (2007) that convincing people to pay for water is often not easy in communities, especially where there is a history of receiving services for free this belief when combined with existing levels of poverty, reduces their ability and willingness to pay for services. After many years (during the policy of socialism in Tanzania until 1990's) of relying on government for the provision of rural water, the new CBM programme was received with mixed feelings by the communities.

On the other hand inadequate cost-recovery will result to inability to operate and maintain existing supplies properly with consequent increased of leakage, water supply interruption and likely deterioration in both the quality and quantity of the water supplied. This will lead to increased public health risks, a likely increase in morbidity and mortality rates and an increased burden on the health care system. According to Davis & Brikke (1995) maintenance costs can only be recovered from users if they are both able and willing to pay for a water supply. Even if users can afford to pay operation and maintenance costs they may still be unwilling to pay

Technical factors

The technical factors assessed in this study focused on: scheme operation, water availability, design and construction. Responding to the question on water availability majority of the

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respondents at 82% responded that water availability was poor and only 18% were of the opinion that water availability was reliable. Seventy percent (70%) of the respondents interviewed said that the scheme is not operated as per design and the remainder thirty percent (30%) of the respondents affirmed that the scheme is operated as per design. 77% of the respondents confirmed that construction quality of water scheme was fair and good. The remainder twenty three (23%) of the respondents did not answer the questions. Based on literature (Mebrahtu, 2012), poor construction quality or the use of low-grade materials may lead to the failure of the water system before the end of its design life. Similarly, design mistake of schemes, and overestimates of the water sources may cause a system to fail from the outset. Therefore, requirements for technical aspects include: a technically good design, which is adhered to in construction and operation, and first-rate workmanship and materials. This will ensure enough water of an acceptable quality.

Other technical problems which were physically observed included: intake silting, breakdown of gate valves, air valves and non-functioning water points and human activities in catchment area of water source, like animal keeping, firewood collection.

CONCLUSION

Key factors from the findings came under four main areas: cost recovery, financial practices, technical, community support, capacity, and availability of spare parts.

This study argues that all of the factors outlined above must be viewed together as the sum parts of one solution to rural water supply scheme maintenance. The need to improve one factor against another will vary depending on context yet, for the challenges to be overcome, there is no one factor that should be addressed alone – all need to be considered collectively to ensure services last over time.

The local government support to the community management reported is poor due to lack of budget for training the existing committee members and training the new members. The availability of spare parts was found not to be sufficient, some of spare parts are obtained in Dar es Salaam more than 500 Kilometers from the village. Unavailability of spare parts at district level contributes to more spending just for bringing the equipment from far. The environmental conservation for water source not undertaken, caused the water discharge reduced, due to human activities.

Recommendations

The Maintenance Management System should developed as a tool for minimizing if not completely avoiding sudden breakdown water facilities, unplanned maintenance works, untimely failure and undue replacement so that the service availability and reliability is optimized. Further study should be conducted that will identify the correct mitigation measures for water source protection procedures. Cost recovery mechanisms can also be used to charge higher income

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consumers, determined by area, for example, according to the number of taps in a dwelling or by metering water use, so as to cross-subsidize lower income households.

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