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Key Factors Influencing Functionality of Community-Managed Rural Water Supply System in Nepal

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Abstract

The paper aims at examining key factors influencing the functionality of the community-managed rural water supply system in developing countries like Nepal. The study adopts a descriptive cum analytical research design based on primary data only. The required data were collected through a telephone interview using a semi-structured questionnaire on a sample of 486 respondents from the respective community-managed rural water supply projects. The collected data were analyzed using correlation, chi-square test, Cramer's V, and cross-tabulation to find out the results leading to major findings of the study. The study concludes that the key factors influencing the functionality of the community-managed rural water supply system are the systems' caretakers followed by the operation and maintenance fund, the activeness of the users' committee, and the availability of spare parts in the context of Nepal.

Keywords: Caretaker, functionality, operation & maintenance fund, spare parts, users' committee, water supply system

1. Introduction

Functionality is a well-known term in the water supply sector. The issue related to functionality is crucial in both developed and developing countries. The insights gained from the implementation of water supply systems in the context of developing countries reveal that even the best-implementing agencies cannot successfully implement, operate, and maintain the water systems without the full cooperation and commitment of the community people

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(Lammerink, 1998). The factors contributing to the sustainability of water supply systems are the participation of community people in decision-making on operation and maintenance (O&M), the existence of O&M funds, readiness to contribute cash, and the active user's committee in place (Peter & Nkambule, 2012). Thus, the 'functionality' of water supply systems is influenced by several factors.

The involvement of communities in the selection of appropriate technologies and participation in managing operation and maintenance costs as well as users' committee capabilities have positively influenced sustainability (Adaka & Mugambi, 2018). Similarly, the formation of a water committee and the tariff collection for operation and maintenance funds are crucial for sustainable water supply systems (Tadesse et al., 2013). Likewise, the caretaker payment and availability of spare parts are important determinants to keep water supply systems functional in Nepal (Yadav, 2015). Thus, the simple term 'functionality' is impacted by various financial and non-financial factors.

The decisions by users' committees as well as the operation and maintenance funds have an impact on the system's sustainability (Adhikari, 2019). Moreover, the reason for functioning well is due to good technical design, quality of work, active users' management committee, caretakers, and use of O&M fund (NEWAH, 2014). Kativhu et al. (2017) show that the availability of spare parts at the community level, users' committees, the establishment of operation, and maintenance funds were found to be critical factors for the sustainability of water facilities in rural areas of Zimbabwe. However, the gravity-fed piped water supply schemes in rural Malawi are unsustainable because of insufficient funding, ineffective user committees, lack of training, age of the system, and political interference (Zuzani et al., 2013). There are the above-mentioned research findings in the context of other countries and Nepal, however, no such findings using more recent data exist in the context of Nepal's water supply sector.

Nepal's water sector is highly non-functional and obstructs regular access to safe drinking water for rural communities (Adhikari, 2019). In this connection, 95 percent of the population has access to basic drinking water so far (UNICEF, 2019). Still, there are only 28 percent of the existing water supply schemes are functioning well (NIMP, 2018). However, the functionality of the projects implemented by Nepal Water for Health (NEWAH) with the support of the charity: water, USA from 2010 to 2022 in Nepal is much higher i.e., 81 percent (Yadav, 2022). The enduring question arises of how highly functional water supply systems have something special in the context of Nepal. Thus, the study dealing with key factors influencing the functionality of the community-managed rural water supply system in Nepal is of greater significance.

Having meaningful implementation and robust post-implementation monitoring along with follow-up support mechanisms, the functionality of water supply systems has been influenced by other factors as well. In this connection, a combination of institutional factors in the form of the users' committee, technical factors in the form of caretakers and availability of spare parts, and financial factors in the form of operation and maintenance funds may influence the functionality of water supply systems. So, this study is an attempt to find out whether these

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factors influence the functionality of water supply systems in the context of developing countries like Nepal.

2. Methods

The study comprises a descriptive cum analytical research design based on primary data only. The require primary data were collected through a telephone interview i.e., a hello survey with a semi-structured questionnaire on a sample of 486 respondents from the community-managed water supply projects in Nepal as mentioned in Table 1.

The respondents were caretakers and the users' committee office bearers from Baglung, Chitwan, Dhading, Nuwakot, Sindhuli, and Tanahun districts of Nepal to get information about the functionality of the respective past projects. This is a census of the projects that were implemented by Nepal Water for Health (NEWAH) with financial support from the charity: water, USA from 2010 to 2022. Moreover, the data were collected through hello monitoring of 330 projects in Sindhuli followed by 126 projects in Baglung, 26 projects in Chitwan, two projects in Dhading, one project in Nuwakot, and one project in Tanahun districts of Nepal.

Furthermore, the collected data were analysed using correlation, chi-square test, Cramer's V, crosstabulation, and graphs with the help of SPSS to find out the results. The correlation coefficient was computed to analyse the relationship between the number of functional water points and the operation and maintenance fund.

Table 1: Number of community-managed water supply projects selected for the study.

Year	Baglung	Chitwan	Dhading	Nuwakot	Sindhuli	Tanahun	Total
2010	1	1		1		1	4
2011		1	1		1		3
2012		7	1		12		20
2013		10			35		45
2014	3				27		30
2015	6				10		16
2016	10	2			45		57
2017	4	4			52		60
2018	17	1			23		41
2019	25				51		76
2020	24				29		53
2021	12				8		20
2022	24				37		61
Total	126	26	2	1	330	1	486

Source: Hello survey 2022-23.

Chi-square is a statistical test commonly used to compare observed data with expected data. The chi-square test is always testing the null hypothesis**,** which states that there is no significant difference between the expected and observed results.

Cramer's V is a measure of association between two nominal variables, giving a value between 0 and +1. Cramer's V is a method of computing correlation when there is more than 2x2 rows and columns. It is computed as a post-test to calculate the strengths of the association

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after the chi-square has determined significance. Research ethics has been considered throughout the study.

3. Results and Discussion

In this section, an attempt is made to examine the functional status and its relationship with various factors such as caretakers, active users' committees, operation and maintenance funds, and availability of spare parts by employing various statistical tools.

3.1. Comparison of functional status with the national average

It would be worthwhile to analyze the functionality of the selected projects before analyzing their relationship with various factors. The functional status of the selected projects has been classified into three categories- fully functional, partially functional, and non-functional. In this connection, the functional status of the selected projects by province is given in Table 2.

Table 2: Functionality status of the selected projects by province

Province	Fully Functional	Partially Functional	Non-functional	Total
Bagmati	280 (78.2%)	60 (16.8%)	18 (5.0%)	358 (100.0%)
Gandaki	115 (89.8%)	11 (8.6%)	2 (1.6%)	128 (100.0%)
Total	395 (81.3%)	71 (14.6%)	20 (4.1%)	486 (100.0%)

Source: Hello survey 2022-23.

The results show that 81 percent were fully functional, 15 percent were partially functional, and 4 percent were non-functional projects out of 486 selected projects for this study. The fully functional projects for Bagmati province are lower than that of Gandaki province. However, the partially functional and non-functional projects of Bagmati province are higher than that of Gandaki province.

Moreover, the comparison of the functional status with the national average is mentioned in Figure 1. The national functionality status has been classified into five categories namely fully functional, need a minor repair, need major repair, need rehabilitation, and need reconstruction.

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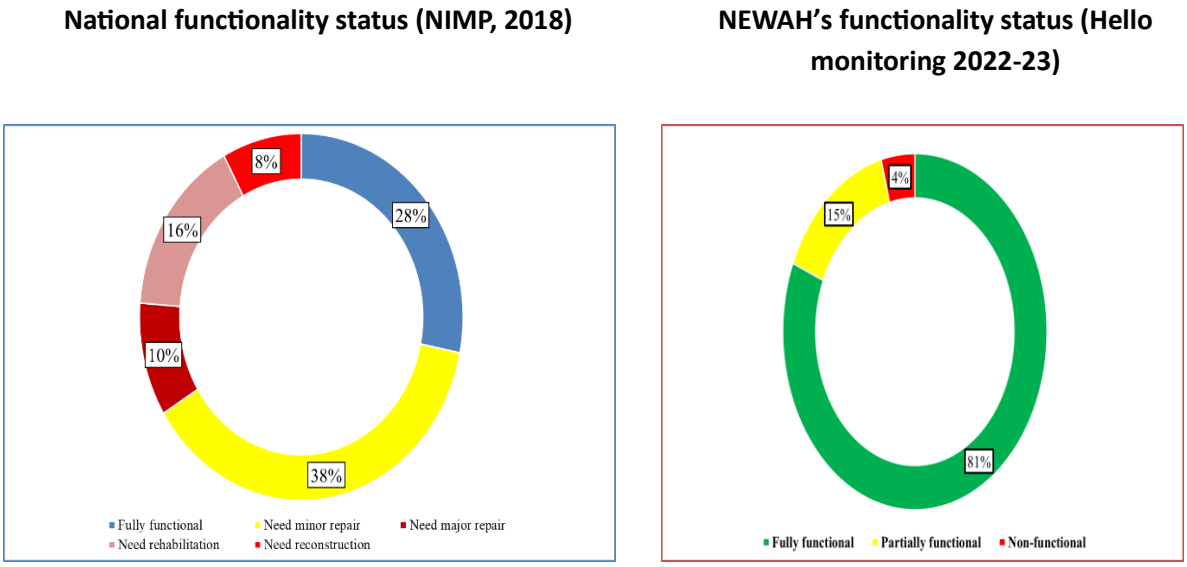

Figure 1: Comparison of the functional status with the national average

In this connection, 95 percent of the population has access to basic drinking water (UNICEF, 2019) so far. Still, there are only 28 percent of the existing water supply schemes are functioning well (NIMP, 2018). However, there is 38 percent needed minor repair followed by 10 percent needed major repair, and 16 percent needed rehabilitation while about 8 percent of the schemes have been identified as needing complete reconstruction in the country (NIMP, 2018). The results show that the functional status of the selected projects (81 percent) is higher than that of the national average of the functional status of water supply systems (28 percent).

3.2. Relationship of the functionality with system caretakers

The system's caretaker is a key person in the water supply system for its smooth operation. The caretaker has been trained during the implementation of the projects and will be assigned for the operation and maintenance of the systems with minimum remuneration by the respective user's committee.

The survey results show that 64 percent of caretakers were paid regularly while 36 percent of caretakers were not paid in the context of rural areas of Nepal. Moreover, the caretakers have been visiting the system 9 times a year to see whether all the water points are functioning well.

In this connection, the relationship of functionality with caretaker payment has been analyzed through cross-tabulation as mentioned in Table 3. 67.7 percent of caretakers get payment monthly while only 3.3 percent of caretakers get paid quarterly. The caretakers get payment six-monthly and annually are 0.6 percent and 3.7 percent respectively. Of the rest of them, 24.7 percent of caretakers are not being paid at all.

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Table 3: Relationship of the functional status with caretaker payment

Functional status	Caretaker payment					Total
	Monthly	Quarterly	Six monthly	Annually	Not being paid	
Fully Functional	299 (75.7%)	12 (3.0%)	3 (0.8%)	16 (4.1%)	65 (16.5%)	395 (100.0%)
Partially Functional	27 (38.0%)	4 (5.6%)	0 (0.0%)	2 (2.8%)	38 (53.5%)	71 (100.0%)
Non-functional	3 (15.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (85.0%)	20 (100.0%)
Total	329 (67.7%)	16 (3.3%)	3 (0.6%)	18 (3.7%)	120 (24.7%)	486 (100.0%)
$\chi^2 = 89.01$,	d.f. = 8,		Cramer's V = 0.30,			P = 0.00

Source: Hello survey 2022-23.

The caretaker payment monthly has higher functionality than that of others. There is 75.7 percent of water supply projects fully functional having monthly payments to the system's caretakers. On the other hand, 85 percent of non-functional projects are not being paid to the caretakers at all. It indicates that there is a relationship between the caretakers' payment and the functionality of the water supply systems in Nepal.

To test whether the difference in the opinions on fully functional, partially functional, and non-functional is significant, the chi-square value and Cramer's V were computed. The computed chi-square value is 89.01 and the Cramer's V is 0.30 which is statistically significant at 1 percent level of significance. The results show that the caretaker payment has a significant influence on the functionality of the water supply systems in the context of rural areas of Nepal. The caretaker payment is one of the crucial factors influencing the functionality of the system which is consistent with the finding of NEWAH (2014) and Yadav (2015).

3.3. Relationship of the functionality with the activeness of users' committee

The users' committee of the water supply system is a key player in the operation and management of the systems and maintains them regularly. In this connection, the relationship of the functionality with the users' committee is presented in Table 4.

The majority of users' committees (65.3 percent) of the fully functional projects meet monthly followed by quarterly (15.7 percent) while 19 percent of users' committees did not meet regularly. In the case of partially functional projects, half of the users' committees meet monthly, and the rest of the users' committees did not meet regularly. In addition, the majority of users' committees (63.4 percent) of non-functional projects meet monthly while 11.3 percent of users' committees meet quarterly. Of the rest of them, 25.4 percent of users' committees did not meet regularly. In aggregate, the majority of users' committees (64.4 percent) meet monthly while 14.4 percent of users' committees meet every quarter. On the other hand, of the rest of them, 21.2 percent of users' committees did not meet regularly. These facts indicate that the users' committees have impacted the functionality of water supply systems in Nepal with a lower impact.

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Table 4: Relationship of the functional status with users' committee meetings

Functional status	Users' committee meetings			Total
	Monthly	Quarterly	Not being held	
Fully Functional	258 (65.3%)	62 (15.7%)	75 (19.0%)	395 (100.0%)
Partially Functional	10 (50.0%)	0 (0.0%)	10 (50.0%)	71 (100.0%)
Non-functional	45 (63.4%)	8 (11.3%)	18 (25.4%)	20 (100.0%)
Total	313 (64.4%)	70 (14.4%)	103 (21.2%)	486 (100.0%)
$\chi^2 = 13.85$, d.f. = 4, Cramer's V = 0.12, P = 0.01				

Source: Hello survey 2022-23.

To test whether the difference in the views on fully functional, partially functional, and non-functional is significant, the chi-square value and Cramer's V were computed. The computed chi-square value is 13.85 and the Cramer's V is 0.12 which is statistically significant at 1 percent level of significance. Thus, the activeness of users' committees is a vital factor influencing the functionality of the water supply system which is consistent with the finding of Lammerink (1998), Peter & Nkambule (2012), Tadesse et al. (2013), NEWAH (2014), Kativhu et al. (2017), and Adhikari (2019).

3.4. Relationship of the functionality with operation and maintenance fund

The tariff collection is crucial for the operation and maintenance (O&M) fund. It is an important factor for payment to caretakers and utilizes to maintain the systems regularly. The relationship of the O&M fund with the functionality of the water supply systems has been analyzed through crosstabulation as mentioned in Table 5.

Table 5: Relationship of functional status with O&M fund

Functional status	O&M fund collection			Total
	Monthly	Quarterly	Not being collected	
Fully Functional	262 (66.3%)	72 (18.2%)	61 (15.4%)	395 (100.0%)
Partially Functional	4 (20.0%)	15 (75.0%)	1 (5.0%)	71 (100.0%)
Non-functional	21 (29.6%)	35 (49.3%)	15 (21.1%)	20 (100.0%)
Total	287 (59.1%)	122 (25.1%)	77 (15.8%)	486 (100.0%)
$\chi^2 = 65.76$, d.f. = 4, Cramer's V = 0.26, P = 0.00				

Source: Hello survey 2022-23.

The 59.1 percent of users' committee collected O&M funds monthly followed by 25.1 percent collected quarterly while the rest of them, 15.8 percent were not collected regularly. 66.3 percent of fully functional projects collected O&M funds monthly followed by

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18.2 percent collected quarterly and the rest of them, 15.4 percent were not being collected. Similarly, most of the partially functional projects (75 percent) were collected tariff quarterly while the larger number of non-functional projects (49.3 percent) were also collected quarterly.

The chi-square test and Cramer's V were employed to test whether the difference in the opinions on fully functional, partially functional, and non-functional is significant. The calculated chi-square value is 65.76 and the Cramer's V is 0.26 which is statistically significant at 1 percent level of significance. Thus, the results show that the O&M fund has significantly impacted the functionality of the water supply systems in Nepal.

Moreover, the correlation coefficient (r) was computed to assess the relationship between the number of functional water points and the operation and maintenance fund. The computed correlation coefficient is 0.20 and significant at 1 percent level of significance. It indicates that there is a positive relationship between them with a low degree of correlation between them. It shows that the operation and maintenance fund is an important factor influencing the functionality of the water supply system in rural areas of Nepal which is consistent with the finding of Peter & Nkambule (2012), Tadesse et al. (2013), NEWAH (2014), Kativhu et al. (2017), and Adhikari (2019).

3.5. Relationship of the functionality with the availability of spare parts

Spare parts are an important element to maintain and keep all the water schemes functional. The stock of spare parts at the store of the users' committee is considered as availability of spare parts. In this connection, descriptive statistics related to the availability of spare parts are given in Table 6.

Table 6: Descriptive statistics related to the availability of spare parts.

SN	Particulars	Number of observations	Minimum	Maximum	Sum	Mean	Std. Deviation
1	Number of projects	486	1	1	486	1	0
2	Total number of water points	486	1	247	16.039	33.00	24.63
3	Number of faucets	486	0	35	322	0.66	2.37
4	Number of washers	486	0	95	1.183	2.43	8.80
5	Number of regulating valves	486	0	6	99	0.20	0.88

Source: Hello survey 2022-23.

Altogether, there are only 1.183 washers, 322 faucets, and 99 regulating valves available at the store of the users' committee for 16.039 water points. In addition, the mean value of spare parts indicates that 2.43 washers, 0.66 faucets, and 0.20 regulating valves are available for one project which seems not sufficient to keep them functional.

In addition, the survey shows that only 56 users' committees out of 486 have faucets in their stores. Similarly, 52 users' committees out of 486 have washers in their stock while only 29 users' committees have regulating valves in their stock.

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Moreover, the relationship between the availability of spare parts and the functionality of water supply systems is presented in Table 7.

Table 7: Relationship of functionality with spare parts in user committee's stock.

Functional status	Number of faucets	Number of washers	Number of regulating valve	Number of projects
Fully Functional	305	1153	99	395
Partially Functional	17	30	0	71
Non-functional	0	0	0	20
Grand Total	322	1,183	99	486

Source: Hello survey 2022-23.

The fully functional projects have a larger number of spare parts in their stock compared to the partially functional and non-functional projects. It indicates that the availability of spare parts has an impact on the functionality of the water supply systems in the context of rural areas of Nepal which is consistent with the finding of Yadav (2015) and Kativhu et al. (2017).

4. Conclusions

The major conclusion of this study is that the systems' caretakers and management of the operation and maintenance fund appeared to be important factors influencing the functionality of the community-managed rural water supply system on top of robust implementation including innovative post-implementation monitoring and follow-up support mechanisms. Similarly, the existence of the users' committee and the availability of spare parts although important but played a lesser role in determining the functionality of water supply systems. All these factors are interconnected so all of them should be considered while assessing the functionality of community-managed rural water supply systems in the context of developing countries like Nepal.

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