



Evaluating Socio-cultural Roles in Behavioural Adaptation for Sustainability of Rural Water Supply for climate change intervention. A Case Study of Sangara village, Babati District, Manyara Region, Tanzania

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Abstract

Climate change significantly threatens rural water supply infrastructures, compromising water quality and availability while increasing community vulnerability. This study evaluated socio-cultural roles in behavioural adaptation for sustaining rural water supply for climate change intervention. The analysis was conducted using the RANAS model, a behavioural change framework where data collection methods were Household surveys, Interviews and Focus Group Discussions. The findings were: 70.7% of respondents never engage in tree planting while 95.9% cut trees for charcoal production. Most participants (91.2%) consider charcoal the low-cost energy source, and 56.7% prefer cooking with firewood. The 76.3% recognize agriculture's environmental degradation and 73.1% acknowledge environmental protection norms where behaviours remain counterproductive to intervention for environmental sustainability while 82.3% support integrating scientific knowledge with traditional practices in climate adaptation. The community behaviours largely oppose climate change intervention sustainability thus calling the Government and Non-Governmental Organizations for need and applying behavioural change to sustainable access to safe drinking water, sanitation, and hygiene.

Keywords · Behaviour, Rural Water Supply, Socio-cultural, Sustainability

1. Introduction

Climate change refers to significant changes in global climatic elements and other measures of climate considered over several decades (Atwoli et al., 2022; Magnan et al., 2016). It is attributed by human activities and natural factors (Mishra et al., 2021; Song et al., 2018; Stern and Kaufmann, 2014). In the context of water availability, climate change has posed significant challenges to rural water supply infrastructures, exacerbating water scarcity and impacting water quality (Misra, 2014; Sarker and

Ahmed, 2015; Żywiec et al., 2024) which makes rural communities more vulnerable to impacts of climate change as this leads to contaminated water sources, unreliable supply, and forces communities to depend on unsafe alternatives (Denton, 2002; Dumenu and Obeng, 2016).

Despite the efforts made to cope with the climate-related impacts, many countries in Africa are still vulnerable to climate impacts including floods, and droughts due to low adaptive capacity (Atwoli et al., 2022; Daramola et al., 2016; Leal Filho et al., 2022; Nursey-Bray, 2014). Adaptation interventions, such as

building climate-resilient water supply systems, are crucial to ensure sustainable access to safe drinking behavioural science is inevitable to enhance decision making among policymakers and practitioners.

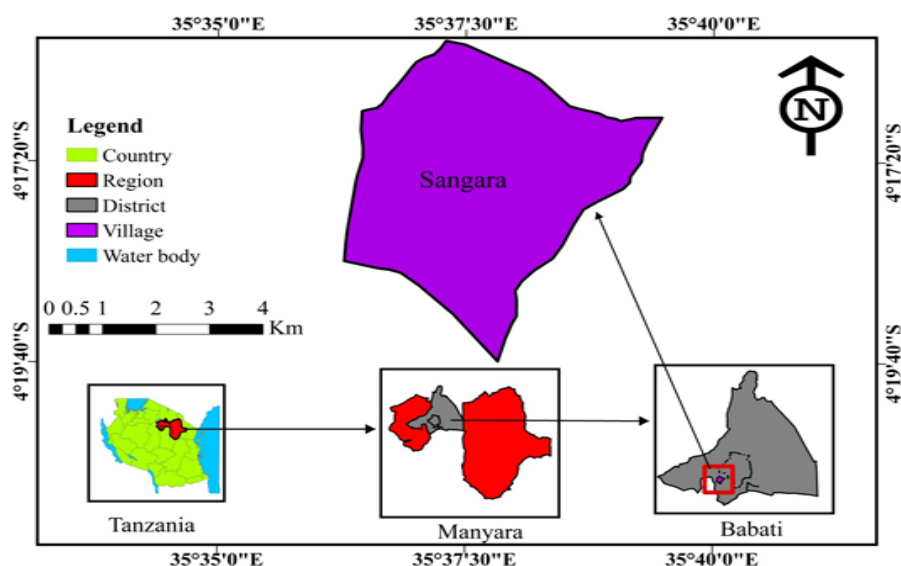


Figure 1: A map of Sangara village

water, sanitation and hygiene (Bassi et al., 2021; Chirisa and Nel, 2022a), yet most of these interventions are not sustainable in many rural communities including Tanzania (Chirisa and Nel, 2022b; Drolet and Sampson, 2017). According to Seibert (2024), community water security is directly connected to the concept of human behaviour, which highlights: - the importance of integrating behavioural and psychological sciences in any sought when considering water and its availability.

In developing countries, including Tanzania, the Government and Non-Governmental Organizations (NGOs) invests large sums every year to implement water supply projects, but they are always not sustainable (Mgoba and Kabote, 2020). Sangara village in Babati District is among villages where the implemented climate change adaptation interventions such as the construction of climate resilient rural water supply scheme, capacity building to the community, use of briquette charcoal and energy saving stoves, by the Water Aid in collaboration with the Government of Tanzania (GoT) are evident, yet their sustainability is still questionable (WaterAid, 2021). Assessing sustainability of the climate change interventions employed in Sangara village through the application of

Therefore, the objective of this study was to evaluate the socio-cultural roles in behavioural adaptation for sustainability of climate change interventions.

2. Materials and Methods

2.1. Description of Study Area

Sangara is a village in Riroda ward, Babati District, Manyara region in Tanzania with 2,950 residents. Sangara village is located at Latitude: 4° 3" South, Longitude: 35° 63" East and an average altitude of 1500 m above sea level (Figure 1) composed of four sub-villages namely Sangara, Enderberg, Gideshan and Dakaumo. The major economic activities in Sangara village are small-scale farming and livestock keeping.

2.2. Research Approach

A mixed-methods research approach that combines both quantitative and qualitative methods was used during this study where the household survey, Key Informant Interviews (KIIs) Focus Group Discussion (FGD), Observation and Probing were used (Fongar et al., 2020; Islam, 2024; Wisener, 2014). In analysing data, the Statistical Package for Social Science (SPSS) software was used (Domínguez et al., 2019; Hilal and Alabri, 2013).

2.3. Data Collection Methods and Materials

2.3.1 Conceptual Framework

The Risks, Attitudes, Norms, Abilities and Self-regulation (RANAS) model approach to systematic behaviour change was used where the behavioural factors of individual person, Attitude and Norms were focused to determine personal behaviour change (Ranas, 2023) as illustrated (Figure 2). In addition, gender roles, environmental factors and family structure were assessed to complement the collectiveness of sustainability framework.

2.3.2 Sample Size

The sample size for household survey was determined using standard criteria as provided by (Cochran, W.G., 1977). The basic two steps included:

the equation: Adjusted sample size = $(S)/1+[(S - 1)/\text{Population}]$ where for $S = 384.16$ and population of 2,950 the sample size expected was 340; and instead the household survey reached the population of 249 (73%). Moreover, the sample size for FGD was 8 for Elders and 30 for primary students respectively while for KIIs were 4 Climate Champion members, 2 Village leaders and 1 primary school Teacher.

2.3.3 Data Collection Methods and Tools

The information on each behavioural factor was collected or measured using Household survey (for quantitative data), Interviews (for in-depth personal insights), Focus Group Discussions (FGD) (for community level perspectives), Observation (for seeing actual behaviours versus reported), Probing and Literature review (Akyıldız and Ahmed, 2021;

Table 1: Population by Gender, Age and Education level of Respondent

Demographic information	Category	N	%
Gender of Respondent	Male	115	46.2
	Female	134	53.8
Age of Respondent	18 - 30 years	66	26.5
	31 - 40 years	73	29.3
	41 - 50 years	48	19.3
	51 - 60 years	34	13.7
	61 and above years	28	11.2
	Total	249	100
Education level of Respondent	Informal education	48	19.3
	Primary education	186	74.7
	O_Level	12	4.8
	Diploma education	3	1.2
	Total	249	100

1. Calculating the sample size for infinite population and 2. Adjusting the sample size to required population. The sample size for infinite population was determined by the following equation: $S = (Z^2 \times P \times (1 - P))/M^2$; where S = Sample size for infinite population, Z = Z-score, which was based on confidence level, P = Population proportion (assumed to be 50% or 0.5) and M = Margin of error. For $Z = 1.96$ (95%), $P = 0.5$ and $M = 0.05$ (5%), the sample size for infinite population was 385, but sample size was adjusted to 2,950 using

Conway, 2024; Moerman, 2010; Robinson, 2023; Domínguez et al., 2019; Salvatory et al., 2022)). The tools employed during data collection were household questionnaire checklist, Key Informant Interview guide and FGD guide (Domínguez et al., 2019). The mWater software was used in collecting data during household survey into which the survey questions were uploaded.

2.4 Data Analysis Methods

The data collected through the structured

who were reached during the survey were 115 (46.2%) and 134 (53.8%) respectively whose total was 249.

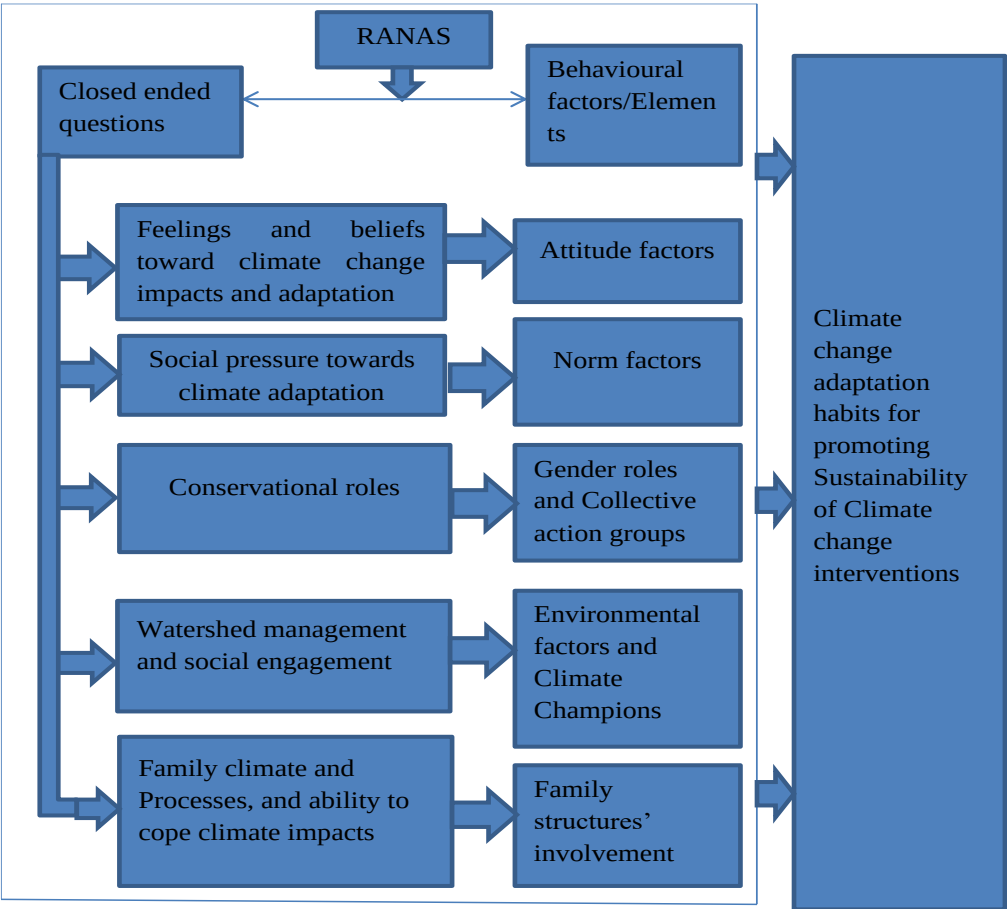


Figure 4: Framework Implementation of RANAS model in the Household survey

questionnaires under quantitative aspect were analysed using the Statistical Package for Social Science (SPSS) software, which provided a detailed descriptive statistics analysis of the parameters. On the other hand, the data collected from the Focus Group Discussion and Interviews under qualitative aspect were analysed using the Content Analysis method to evaluate the insights of respondents.

3 Results and Discussion

3.1 Demographic Information

The household survey was conducted at Sangara village where the respondents were found in all four sub-villages namely Sangara, Gideshan, Enderberg and Dakaumo. Both males and females were asked the structured questions as the results males and females

Based on the age of respondents, majority ranged from 18 – 30, 31 – 40 and 41 – 50 years were 66 (26.5%), 73 (29.3%) and 48 (19.3% respectively. Majority of respondents had primary education academic qualification about 186 (74.7%) and the rest fell under informal education 48 (19.3%), Ordinary Secondary education 12 (4.8%) and Diploma education 3 (1.2%). A clear presentation is made in (Table 1). This study typically involved local people who are familiar with the environment.

3.2 Personal Behaviour

The information on personal behaviour was collected at the household level by assessing a few behavioural attributes that focused on climate change adaptation. The results indicated that people's

behaviour of planting trees every season is very low since 176 (70.7%) respondents do not plant trees thus



Plate 1: Random cutting of natural forest at Sangara Juu sub-village

the habit of conserving environments is obviously low; and instead, cutting trees to make charcoal seemed to be at critical as 239 (95.9%) of respondents agreed. This indicates significant impacts on environmental degradation because nearly all community members cut trees for charcoal making while (70.7%) do not plant trees to replace them as consequences the forest disappear, reducing natural water filtration and fostering soil erosion that adversely contaminates water sources. The results align with the study conducted by (Atwoli et al., 2022; Daramola et al., 2016; Leal Filho et al., 2022; Nursey-Bray, 2014) whose results showed that many countries in Africa are still vulnerable to climate impacts including floods, and droughts due to low adaptive capacity. On the other hand, the community was found to have a belief that foods cooked using firewood are more delicious than other sources of energy as 174 (69.8%) supported such perception as the results, people who use low-energy stoves were only 4 (1.6%) of respondents. This indicates that almost the whole community at Sanagara depends on firewood and charcoal usage for cooking which is not an environmentally friendly approach to the sustainability of Rural Water Supply climate interventions (Figure 3).

3.3 Personal Attitude

The findings on personal attitude were measured using some questions that were meant to address the

awareness and mindset of individuals on some aspects. The attributes highlighted during the survey and their results are presented in Figure 4. The findings indicated that people need potable water than one collected from natural springs because the people’s belief on natural water from springs, 215 (86.3%) of respondents showed a desire on potable water; and instead, only 10 (4%) supported natural water from springs. The 227 (91.2%) view charcoal a low-cost source of energy and 56.7% prefer firewood for cooking. It is obviously that these preferences of people in the community drive continue deforestation despite environmental consequences that are likely to occur. For environmental conservation and management, this is dangerous because the community is at uttermost in threatening a sustainable climate change intervention. On the other hand, the results showed conventional farming practices has impacted and still continue to degrade the environments as 190 (76.3%) of respondents acknowledged to practice conventional farming as presented in (Plate 1). However, the sustainability of the Rural water supply project was brought into question after realizing that the community’s sense of ownership is low since people

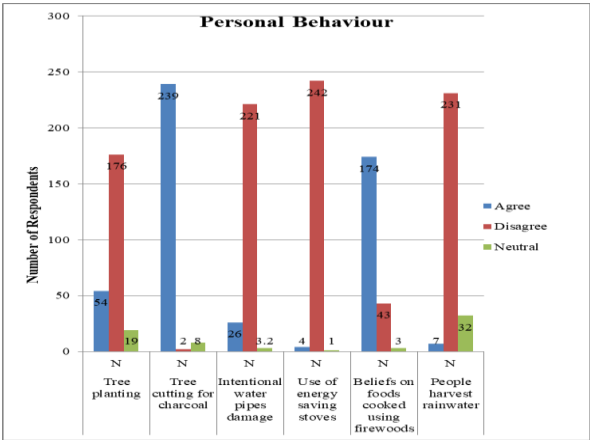


Figure 5: Personal behaviour towards climate change adaptation

appeared to believe that water supply project belongs to the government as 124 (49.8%). This is very dangerous when we think of the sustainability of the Rural Water Supply climate change interventions. Currently, the government through Rural Water Supply

Agency (RUWASA) is in charge of all matters related to the water supply project at Sangara village; that is why people think that the project is government's property.

3.4 Community Norms

The community norms at Sangara village are not a limiting factor in people's response to climate adaptation (Figure 5). The findings from the elements measured revealed that 189 (75.9%) respondents agreed that cultural beliefs never impact peoples' response to climate adaptation. This indicates that efforts made towards climate adaptation are not affected by community norms; and the community never rely on ancestral practices to cope climate change adaptation, as 176 (70.7%) disagreed, although there are norms in place which are useful in promoting climate adaptation as for example, people are not allowed to cut trees without permission where 146 (58.6%) of respondents were aware of this norm. Furthermore, the results indicated that at Sangara village there is a socio-cultural group that in one way; it promotes environmental conservation as 171 (68.6%) respondents confessed about this social group and is environmentally friendly culture.

According to FGD made with elders (Plate 2), they said 'Social and cultural values at Sangara village have a great role in fostering climate change adaptation behaviour because there is common local community

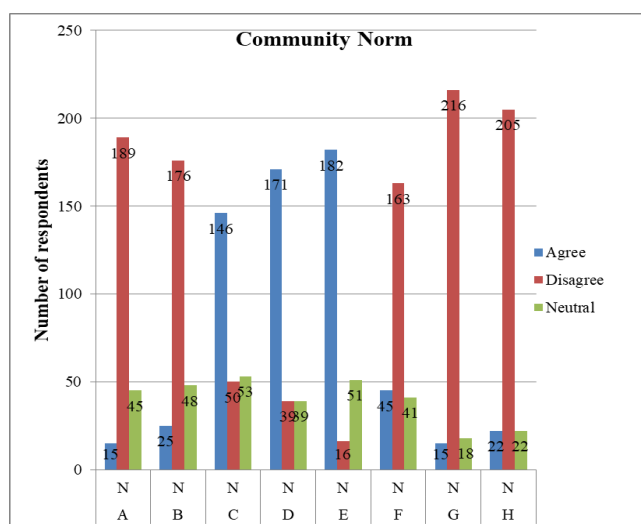


Figure 5: Community norms influencing climate change adaptation

of 'ghorowa people' where both men and women own

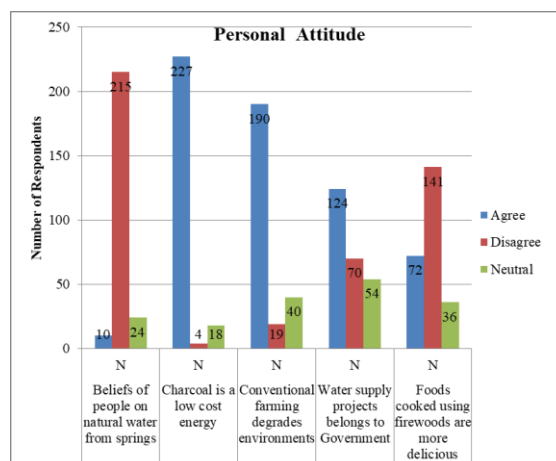


Figure 6: Personal attitude towards climate change adaptation

the preserved local forest into which they are used to discuss their matters. For women, it is commonly called 'ghaye desu' meaning 'forest of women'; and for men, there is cultural norm called 'Manda' and their forest is commonly called 'Qayi Manda' meaning forest of the local culture of Manda people. An interesting story is that in this forest no one can go in the forest without permission of the owners and people do obey'. This is an example of culture conduct that is environmentally friendly. Moreover, Climate Champions said 'The available culture at our village of Sangara is friendly to our environment since we have local natural forest called 'Qayi manda' which is preserved and people are used to call it as 'the way of rain'.

In addition, the results indicated that there is no resistance to integrating scientific knowledge and traditional practices when promoting climate change adaptation where 216 (86.8%) respondents supported the need of integrating both scientific knowledge and traditional practices. However, the response of people to plant trees was observed to be very low as 205 (82.3%) respondents confessed to have no such a norm. For environmental conservation, the positive norms need to be emphasized in the community. However, 'the youths are so reluctant on socio-cultural and norms matters held by elders as consequences habit of destroying environments will continue', a statement from climate champions and Elders. The Elders

mentioned the major barrier to sociocultural inclusion in climate change adaptation behaviour is the emergence and prospering of Christianity beliefs that seem to totally go against the local doctrines.

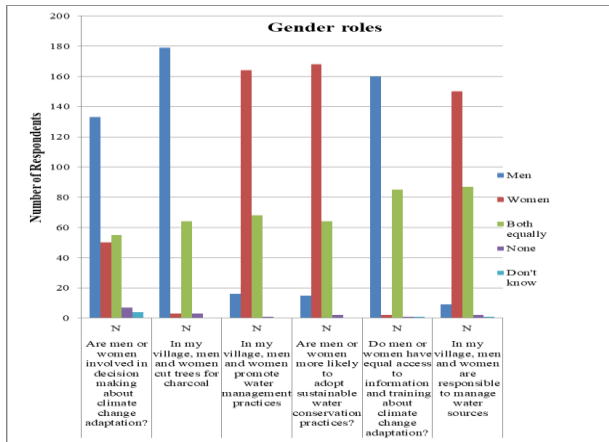


Figure 6: Gender roles influencing climate change adaptation

Although people do not rely on ancestral practices, they confess that people at Sangara village respect socio-cultural values and norms more easily than government rules and modern ones. This is witnessed by their statement, ‘cultural norms and values have got power and people do respect them than government rules’. Therefore, with this view it is important for the government to keep on sensitizing community on cultural values which have positive contribution to community welfares.

3.5 Gender Roles

Gender typically refers to behavioural, social and psychological characteristics of men and women (Pryzgod and Chrisler, 2000). According to the household survey, the involvement of men in decision making about climate change adaptation is higher than women since results indicated 133 (53.4%) men over 50 (20.1%) women do take part in decision making on matters related to climate adaptation. Surprisingly, men who lead in decision making than women are champion in cutting trees for charcoal making where men 179 (71.9%) engage in environmental degradation. For promoting water conservation practices the findings indicated that women 164 (65.9%) are good than men 16 (6.4%). This indicates

that women empowerment in the community should be continued. Moreover, women are likely to adopt the sustainable water conservation practices than men because during survey, results showed women 168 (67.5%) are likely to adopt while men were only 15 (6%). The emphasis still falls on the need to empower women for sustainable environmental conservation (Figure 6). Gender roles are contributing factor to climate change and their related effects although men are leading in degrading environment particularly through charcoal making and agriculture activities at Sangara in the community.

3.6 Environmental Factors

On the case of environmental conservation and management, the findings are presented in (Figure 7) where forest is not conserved as only 5 (2%) agreed that they conserve the forest and 237 (95.1%) disagreed. This indicates that nearly the whole community at Sangara is not taking care about their natural environments as consequences sustainability of climate adaptation interventions is brought into questionable. Moreover, results showed that people do not plant trees to restore their destructed environments as only 9 (3.6%) accepted to have been planting trees. Agriculture activity was mentioned to cause serious environmental degradation at Sangara village where 203 (81.6%) mentioned agriculture activity to be a

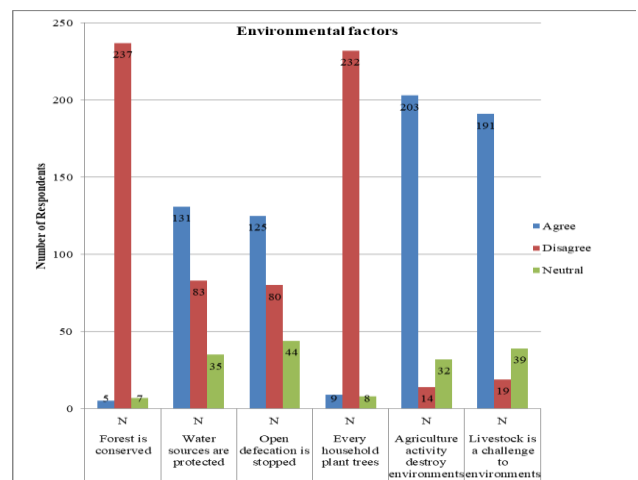


Figure 7: Environmental factors underlining environmental sustainability

problem. Another challenge to environmental degradation was found to be livestock keeping where

191 (76.7%) reported the same. The findings put the environments at high pressure of degradation. The results align with the study conducted by (Mishra et al., 2021; Song et al., 2018; Stern and Kaufmann, 2014) whose findings indicated that climate change impacts were attributed by human activities, as through conventional farming and livestock keeping activities the environments are greatly negatively impacted.

According to the interview with Elders and Climate Champions, they said ‘Village leaders are less



Plate 2: Focus Group Discussion with Elders at Sangara village Office

accountable to protecting our forests and environmental degradation. The forests are being destroyed randomly without serious efforts to stop further destruction’. This shows how the esteemed authority is not taking serious measures to rescue the adverse situation on the environments. People are ready to change their behaviour, but they call an attention from the government authorities to actively continue looking our environments.

4 Conclusion and Recommendations

4.1 Conclusion

The results have described the worthiness of the study because the community is aware about the impacts of climate change and they understand the causes of climate change. The social and cultural values at the community currently play a very low role towards influencing the community on climate change adaptation. However, the elders at the village admit

that social and cultural values have great role in fostering climate change adaptation behaviour as for example of the ‘ghorowa’ people who own local forest called ‘Qayi manda’ for men and ‘ghaye desu’ for women into which they discuss their norms. This culture should be promoted to support the community to protect the environment and the water resources surrounding them. The findings have shown that village leaders are less accountable to protecting environmental degradation instead the forests are being destroyed randomly without serious efforts to stop further destruction. Therefore, the government and stakeholders have a role to play against community leaders such that they can act full responsibilities towards conservation of community welfares. The gender roles are contributing factor to climate change; however, men are leading in degrading environments; and the community considers women as frontier champions in water resources and environmental management.

In the context of sustainability of climate change interventions at Sangara village, the results indicate that the water security is undermined by the community whereas the continual cutting of trees reduces watershed protection, increases soil erosion thus degrading the ecosystems that naturally filter and protect water supplies and hence climate adaptation interventions like constructed rural water supply system become less effective when degradation continues. Therefore, the findings call for behavioural change of the people towards conserving environments otherwise the habitual practices of the people are against supporting the nature. All behavioural factors revealed to harm the ecosystem which is actually dangerous to sustainable climate change interventions. However, the findings indicated that people are ready to incorporate both scientific and indigenous knowledge to enhance sustainability.

4.2 Recommendations

Based on the findings of this research, I do recommend the following actions that if implemented will support the sustainability of rural water supply for climate change intervention and all other measures for combating climate impacts:

- i. The government policy on water security measures has to be prioritized nationally and regarded as an emergency matter toward climate change adaptation behaviour
- ii. Both government and Non-Government Organizations (NGOs) have to closely collaborate in helping sensitization of climate change adaptation through the application of behavioural sciences
- iii. The study of culture, gender, environmental dimensions and Local Indigenous Knowledge (LTK) of our communities towards improving climate change adaptation are required for each community because they are community-specific.
- iv. Gender mainstreaming and implementation of Gender-Integrated Environmental Governance have to be done
- v. The role of Governments in supporting local cultural initiatives that are helpful to conserving the environments need to be determined
- vi. Immediate action and increased focus on inclusion are necessary to bridge the adaptation gap and mitigate the continuing consequences of climate change in the most vulnerable areas and communities.

We therefore conclude that climate adaptation is not just about constructing better infrastructures in place; instead, it is about transforming how the communities interact with their environments for long-term sustainability of the made interventions.

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Conflict of Interest:

I do confirm that there are no conflicts of interest regarding the publication of this Manuscript, and that the Funder did not influence the research findings.

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