

Impact of Integrated Watershed Management Practices on Sustainable Rural Livelihoods of the People of Rwanda: A Case Study of Mwange Watershed in Gicumbi District

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Abstract: *In the year 2000, the government of Rwanda adopted a primary objective of becoming a middle income country by the year 2020, and in line with this, rural districts have recognized Integrated Watershed Management Practices such as terraces, Tree planting as well as infiltration trenches as means for improving rural livelihoods by improving land productivity on which the majority of the population depends on for a living. Even though Gicumbi district adopted integrated watershed management practices eight years back, poverty levels have remained high and there is no any study conducted to assess the impact of integrated watershed management practices on rural livelihoods and filling this knowledge gap could help to provide a proper assessment for the contribution of integrated watershed management practices on sustainable rural livelihoods of the local people, and hence being the reason for the government's continued investment in integrated watershed management practices elsewhere in the country. It is for this reason that the current study sought to assess the impact of integrated watershed management practices on sustainable rural livelihoods in Rwanda taking Mwange watershed in Gicumbi district as the case study. The study adopted quantitative and qualitative analysis and the targeted people was that living in Mwange watershed in Gicumbi which is 51 Km to North of Kigali City Gicumbi mainly in the sectors of Byumba, Kageyo and Mutete, precisely those from the cells of Muhondo, Horezo, Gihembe, Nyamiyaga, Mutandi, Gacurabwege and Nyarutarama. The total population of the area was 78623 inhabitants organized in 17670 households and only 7552 households with 34229 inhabitants was located in Mwange watershed, and it is only this population that a study sample was chosen from using Slovin's formula, and hence 100 questionnaires have been used to collect data which later have been analyzed using descriptive statistics with the help of frequency and percentage tables and summary of community thoughts. The key findings indicate that before the introduction integrated watershed management practices, n=98 of respondents acknowledged a problem of livelihood decline and only 2% (n=2) respondents never perceived a decline in their livelihoods. Before the introduction of radical terraces, tree planting and infiltration trenches there area faced a problem of land degradation which resulted into food shortage, poor nutrition and famine thus affecting economic growth of the area. However, after the introduction of intergrated watershed management practices, conditions of living improved. According to a sample survey conducted, 85% of all the households located in Mwange area have noticed an increase in their household incomes which is being used to fulfill other family needs like medical care, house construction, clothes, cater for school expenses as well as rent farm land. The positive and significant impacts of integrated watershed management practices on the sustainable rural livelihoods of the people of Mwange watershed are evident and essential to the sustainable rural development of the watershed. The enhanced income, improved environmental indices, and reduced vulnerabilities of farmers are recognized as new livelihood assets that will influence the future livelihood strategies in the holistic framework. It is concluded that increased land productivity, increased environmental indices and subsidies income as well as diversified livelihood strategies are essential to the sustainable rural development of the rural people. The impact of integrated watershed management practices success in Mwange watershed strongly supports the future promotion of similar policies elsewhere in the region, as Rwanda continues to experience large-scale transformation within its vast rural areas.*

Keywords: Integrated watershed management, Sustainable rural livelihoods and Rwanda

1. Introduction

The twenty-first century is a time by which the world is getting seriously confronted by issues of sustainable use of water and land resources to improve rural livelihoods for it is clearly argued that a stable livelihood contributes to the harmonious development of related polices, poverty eradication and sustainable use of resources. According to Hannam (2003), these days, water and land ecosystems are being degraded at an alarming rate and the case is worse in developing regions, where the majority of the population depends on these resources for its livelihoods. According to Bekele et al. (2007), conservation and management of land and water resources for sustainable intensification of agriculture and poverty reduction in developing regions has remained one of the most challenging policy issues for a long time, and most local, regional, and international policies, programs, initiatives, covenants, protocols, and conferences pay much attention on land resources such as

soil, water, and vegetation in trying to improve human livelihoods as well as conserving these resources for future generation. It is clearly argued that a stable livelihood contributes to the harmonious development of related polices, poverty eradication and sustainable use of resources.

Since after the genocide against the Tutsi in the early 1994, the Government of Rwanda (GoR) has embarked on rebuilding the country and improving the quality of life for its people and the government has put in place several Strategies and plans to realise this objective. The Economic Development and Poverty Reduction Strategy (EDPRS) identifies rural development as one of the four priority economic sectors for stimulating economic expansion and having the greatest contribution on poverty reduction and national development as a whole and to achieve this, various technologies such as watershed management principles have been adopted in an effort to improve natural resource productivity as well as improving rural livelihoods in rural

districts of Rwanda. The Ministry of Agriculture and Animal Resources (MINAGRI) has expanded vast resources and efforts, crafted a number of initiatives, programs and projects to support farmers, enabling them improve agricultural production levels, create nutritional and food security, raise household incomes and generally improve the livelihoods. One of such initiatives immensely thought to improve agricultural productivity and reduce poverty is integrated watershed management program, a comprehensive program that focuses on sustainable land management to improve rural livelihoods in rural districts whose economy largely rely on agriculture, (MINAGRI, 2013).

In Gicumbi district, 90% of the people live in rural areas and depend on land on which they grow crops for substance and sale, collect grass for their animals, collect water and obtain wood for cooking, lighting, and construction of buildings (homes, institutions and business premises). Land management principles such Integrated watershed management practices like Terraces, Tree planting as well as infiltration trenches have been recognised as means for improving rural productivity in the district for they are believed to improve rural livelihoods by contributing to land productivity on which the majority of the population depend on for a living, (DDP,2013/2018).

Even though the district adopted integrated watershed management practices as a platform for improving the livelihood eight years back, poverty levels have remained high in the district as shown by the recent survey conducted by Rwanda National Institute of Statistics and it is for this reason that the current study sought to assess the impact of integrated watershed management practices on sustainable rural livelihoods in Rwanda taking Mwanze watershed in Gicumbi district as the case study.

1.1 Problem statement

In the year 2000, the government of Rwanda adopted a primary objective of becoming a middle income country by the year 2020, and in line with the country's Vision 2020 objective, the country adopted its second Economic Development and Poverty Reduction Strategy (EDPRS 2) to guide the country's medium-term development aspirations over the period 2013/14 to 2017/18. The overall objective of EDPRS 2 is to increase the quality of life of all Rwandans through rapid and sustainable economic growth (11.5% per annum) and accelerated poverty reduction (to below 30%) ,and rural development is one of the strategies recognized to increase and drive rapid and sustainable growth.

To achieve this, various technologies such as watershed management principles have been adopted in an effort to improve natural resource productivity as well as improving rural livelihoods in rural districts. According to the Rwanda State of environment and outlook report (2015), the poor are able to nurture their environment on a sustainable basis, improving material and social wellbeing for themselves and their off-springs when given the right circumstances. According to NISR (2014), the total population of Gicumbi District counts 395,606, of which 47.7% are male and 52.3% female almost similar to the national ratio and the population

density is 477 people per km² against 415 at national level high. And 90% of the people lives in rural areas and depend on land on which they grow crops for substance and sale, collect grass for their animals, collect water and obtain wood for cooking, lighting, and construction of buildings (homes, institutions and business premises) and the District Development Plan, 2013/2018, recognizes land management principles such as Integrated watershed management practices like terraces, Tree planting as well as infiltration trenches are recognized as means for improving rural productivity in the district for they are believed to improve rural livelihoods by improving land productivity on which the majority of the population depend on for a living, and these practices have been in places and continue to be implemented for the last eight years.

Even though the district adopted integrated watershed management practices as a platform for improving the livelihood eight years back, poverty levels have remained high in the district as shown by the recent survey conducted by Rwanda National Institute of Statistics in 2014, and it is for this reason that the current study sought to assess the impact of integrated watershed management practices on sustainable rural livelihoods in Rwanda taking Mwanze watershed in Gicumbi district as the case study. According to the survey, the levels of poverty in the district are higher compared to the national levels, with 49.3% of the population under poverty line and 33.9% of the population in extreme poverty, national levels being 44.9 and 24.1% respectively, and when compared with other districts of Northern Province, Gicumbi district has the highest percentage of extreme poor. The NISR (2014) survey further revealed that the poor people are directly dependent on their immediate environment and poor households in particular rely heavily on expenditure-saving, labour intensive activities for their subsistence and survival, such as growing food, collecting water, fuel wood or grazing animals and any degradation of their land deepens their poverty, and according to the Rwanda State of environment and outlook report (2015), the continued implementation of integrated watershed management practices like terracing, tree planting and water management in rural districts of Rwanda, will help rural people to access a wide range of livelihood strategies thereby improving their living conditions.

Despite the continued implementation of integrated watershed management practices such as terraces, Tree planting as well as water harvesting to improve rural livelihoods in Rural districts of Rwanda, information concerning the impact of these practices on the livelihoods of the local people is still minimal, for example in Gicumbi district(area under study) there is no any study conducted to assess the impact of integrated watershed management practices on rural livelihoods yet the practices have been in place for the last eight years, and filling this knowledge gap will help to provide a proper assessment for the contribution of watershed management practices on sustainable rural livelihoods of the local people, and hence being the reason for the government's continued investment in integrated watershed management practices elsewhere in the country hence this was another filled by the study.

1.2 Specific Objectives

The study was broken down into the following specific objectives;

- 1) To assess the contribution of terraces on sustainable rural livelihoods of the people of Mwangi watershed in Gicumbi district.

- 2) To examine the contribution of tree planting on sustainable rural livelihoods of the people of Mwangi watershed in Gicumbi district
- 3) To assess the contribution of infiltration trenches on sustainable rural livelihoods of the people of Mwangi watershed in Gicumbi district.

2. Conceptual Framework

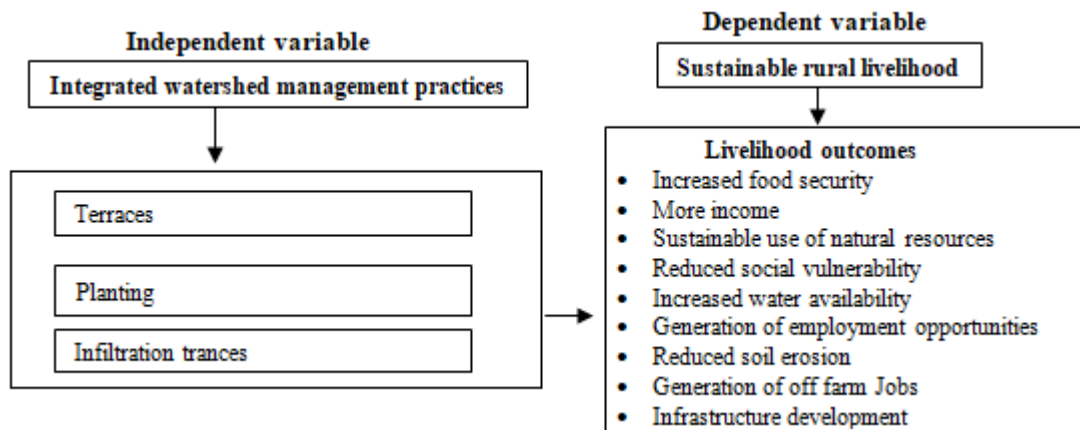


Figure 1: Conceptual framework, 2017

3. Research Design

Research design is a mapping strategy. It is the conceptual structure within which research is conducted. According to Kothari (2008). The study employed exploratory research design, where qualitative and quantitative approaches were used. Descriptive statistics were used in collecting, analyzing and linking qualitative data to provide a better understanding of the impact of integrated watershed management practices on sustainable rural livelihood of the local people of Gicumbi district. A survey approach using Participatory Rural Appraisal tools allowed relatively more data to be collected in a short time, and was used to encourage community participation.

3.1 Target Population

The study targeted people living in Mwangi watershed area mainly in the sectors of Byumba, Kageyo and Mutai, precisely those from the cells of Muhondo, Horezo, Gihembe, Nyamiyaga, Mutandi, Gacurabwege and Nyarutarama. These were areas that shared a common boundary with River Mwangi and have one way or another benefited from integrated watershed management practices applied in the management of Mwangi Watershed in Gicumbi district. The total population of the area was 78623 inhabitants organized in 17670 households. However only 7552 households with 34229 inhabitants were located in Mwangi watershed and it is only this population that a study sample was chosen from using different sampling techniques.

3.2 Sample size and sampling technique

A sample design helps the researcher to obtain representative data which are not biased. A sample design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample

(Kothari, 2004). A sample size of this study was determined largely from the following factors, total number of people living in the area, the acceptable margin of error and the desired level of continuance. The sample size was calculated basing on the following Slovic's formula:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n: required sample size

N: Total number of population living in the area

E: Margin error at 10% (standard value of 0.1)

$$\frac{34299}{1 + 34299(0.1)^2}$$

$$= 99.70929387$$

$$\approx 100$$

The key informants were; District Agriculture Officer, District Social affairs office, at Sector level the key informants will be, Sector Social affairs officer and Sector agriculture officer one from each of the seven Sectors, and at cell level, the key informants will be Cell Executive officer and Cell Social and Economic development affairs officer, and one from each of the seven Cells as well. The respondents were selected using purposive sampling and random sampling methods.

4. Results and Discussion

Table 1: Contribution of terraces on rural livelihoods

Response	strongly disagree	Disagree	Not sure	agree	strongly agree	Total
	Frequency					
Enhanced agricultural productivity through improved soil fertility	-	-		5	95	100
Improved	-	-	1	9	90	100

livestock farming through generation of more pasture						
Creation of off farm Jobs	-	3	2	25	70	100
Generation of technical know how	-	-	2	18	80	100
Reduced risks of natural disasters	-	-	-	-	100	100

Source: Primary data, 2017

The findings revealed that terraces have helped to stabilize the major productive sector of the rural people which is agriculture land by reducing risks of soil degradation. While making terraces, grasses are planted alongside embankments and these provide fodder for livestock. Labour employed in terraces have gained skills of making these terraces and are being hired and Employed in different land management activities elsewhere in the District and the country as well. The fact that Gicumbi district is hilly with high rainfall that majorly caused soil erosion, land-slides and floods which crop land, infrastructure among others, introduction of terraces helped to stabilize land by reducing slops, controlling erosion and floods which claimed lives of the people in the area. And this can be revealed with the highest number of respondents (100% (n=100) who strongly agreed that rural livelihoods improved due to reduced risks of natural disasters (Table 1)

According to the district development plan for five years (2013-2018), the aspect of rural development is an important thematic area to the district where agriculture is dominant and the district focuses rural modernized agriculture, and improves livestock as essential in improving rural livelihoods. The district focuses highly on land consolidation, increased production through application of fertilizers, increased terracing and land management to reduce soil erosion (Increase 10% per year). Rural development has correlation with the level of sustainability in resources management hence the district's focus on guarding the natural resources and ensuring that their exploitation is done sustainably. By giving attention on improving rural livelihoods whose economy depends heavily on land resources, the district prioritized the management of watersheds, rivers and lakes, and develops a mechanism of minimal exploitation for the forest so as to contribute to sustainable rural livelihood. An attempt was also carried out to find out the greatest contribution of terraces to the watershed community.

Table 2: Greatest contribution/achievement of terraces to the watershed community

Response	strongly disagree	Disagree	Not sure	Agree	strongly agree	Total
	Frequency					
Reduced Poverty					100	100
Increased food security					100	100
Developed a network of institutions active in sustainable land management	1	1	-	4	94	100
Increased	-	-	-	-	100	100

household incomes						
Empowerment of stakeholders and local people in use of land resources and related resources to improves their wellbeing.	-		-	2	98	100

Source: Primary data, 2017

All the respondents 100% (n=100) strongly agreed that they reduced poverty and increased food security in the area as well. More so, 94% (n=94) of the respondents strongly agreed that there was a development of a network of institutions active in sustainable land management, 4 % (n=4) agreed with this benefit, 1% (n=1) disagreed and 1% (n=1) strongly disagreed with this benefit as well. On assessing the benefit of terraces on rural livelihoods, all of the respondents strongly agreed that their livelihood improved and on empowering of stakeholders and local people in use of land resources and related resources to improves their wellbeing, 98% (n=98) of respondents strongly agreed with this benefit while 2%(n=2) of the respondent agreed with it.

In the study area 100% of the people live in rural areas and this population largely depends on land for its survival. Land is considered important for production of goods and services. The rural people depend on land on which they grow crops for substance and sale, collect grass for their animals, collect water and obtain wood for cooking, lighting, and construction of buildings (homes, institutions, business premises and so forth.) Management and improvement of land productivity increases livelihood outcomes of the rural people in the area. The study shows that terraces helped to increase agriculture land production and agriculture contributes greatly to poverty reduction.

Analysis of Tree planting and sustainable rural livelihoods

The study intended to establish the main source of fuel wood for the residents of Mwange watershed, and the findings indicated that Watershed residents acquire fuel wood from different sources. Only 99 respondents answered the question.

Table 3: Sources of fuel wood for the residents of Mwange watershed

Major Sources	Before the intervention	After the intervention
	Frequency	Percentage
Own (private) land plantation	73	73
Village (community) plantation	16	26
Buying	-	-
Institutional forests (church)	10	10
Total	99	100

Source: Primary data, 2017

The major objective of the EDPRS for the forestry sector is to provide an adequate and sustainable supply of forest products and manage forestry resources for poverty alleviation by income and employment generation. In this

research, households were asked about the sources of fuel wood from which they get for domestic consumption in all intervention period 73 % of the respondents in the area the source of wood was from their private land holdings. Other sources of wood are community plantations and from church yards. In line with the Constitution, Vision 2020 and EDPRS2, Rwanda is committed to environmental protection, diversification of energy sources, erosion prevention, and reduced fuel wood consumption and implementation of a reforestation strategy. The major objective of the EDPRS for the forestry sector is to provide an adequate and sustainable supply of forest products and manage forestry resources for poverty alleviation by income and employment generation. The study also attempted to establish how the role of fetching wood is felt among the watershed community.

Table 4: The responsibility of fetching wood

Purpose	Frequency	Percentage
Male adult	4	4
Female adult	11	11
Male and female adult	9	9
Female adult and girls	48	48
Female adult and children	12	12
Girls	10	10
Boys	6	6
Total	100	100

Source: Primary data, 2017

In Rwandan culture the kitchen is the domain of women and girls. A significant percentage of their working time and energy involves obtaining and using firewood. The responsibility of collecting fuel was asked. The survey results clearly indicated that the burden of collecting fuel is mainly that of Female adult and Girls' as well as children's responsibility. As shown in table 4.8 above, about 48 percent of Female adult and Girls(women/ wives), 12 percent of Female adult and Girls' and 11percent of female adult

Table 6: Contribution of infiltration trenches on livelihoods of the people

Contribution of infiltration trenches on livelihoods	strongly disagree	Disagree	Not sure	agree	strongly agree	Total
	Frequency					
Raised households' income	-	-	-	5	95	100
Enhanced agricultural productivity through promotion of irrigation	-	-	-	-	100	100
Generation of rural employment	-	-	-	20	80	100
Improved water quality by reducing sedimentations	-	-	-	4	96	100
Reduced waterborne and water related diseases incidences	-	-	-	14	86	100

Source: Primary data, 2017

All the respondents 100% (n=100) strongly revealed that there was an enhancement of agricultural productivity through promotion of irrigation, 96% (n=96) strongly agreed that there has been improvement in water quality by reducing sedimentations, 95%(n=95) Acknowledged strongly for a raise in households' income and 86% (n=86) strongly agreed that infiltration trenches have reduced waterborne and water. A few of the respondents 8.6% of the total respondents agreed with the above contributions of infiltration trenches on their livelihood. According to Hatibu (2003), poverty is mainly caused by inadequate availability of water for crop, livestock and other enterprises. He then argues that the shortage of water is not caused by low rainfall as normally perceived, but rather by a lack of capacity for sustainable management. Thus, adoption of integrated watershed management practices as the platform

female have the task of collecting fuel in the watershed area whereas only 6 percent of boys and 4 percent of Male adult (husbands) share this responsibility and people in the area need trees for producing fuel wood, income Generation, Soil conservation well as construction and fodder for domestic use and commercial purposes and this was revealed in when respondents were asked for reason why they need trees.

Table 5: Benefits of tree planting

Reponse	strongly disagree	Disagree	Not sure	agree	strongly agree	Total
	Frequency					
Raised farm income	-	2	-	-	98	100
Enhanced agricultural productivity	-	2	-	-	98	100
Generation of rural employment	-	2	-	-	98	100
Reduced risk by diversifying crops	-	2	-	-	98	100
Reduced soil loss	-	2	-	-	98	100
Increased land property value	-	2	-	-	98	100
Improved water quality by reducing sedimentations	-	2	-	-	98	100

Source: Primary data, 2017

The findings indicated that 98 percent of the total respondents strongly agreed that tree planting activity raised farm income, enhanced agricultural productivity, generated of rural employment, reduced risk by diversifying crops, reduced soil loss, increased land property value and improved water quality by reducing sedimentations. However, 2 percent of the total respondents disagreed with the above benefits.

for improving the livelihood of community in Gicumbi district is crucial, and hence the present study focused to identify the impact of integrated watershed management practices on the livelihood of the community of Mwange watershed in Gicumbi district.

5. Conclusion

The Mwange watershed experienced a dramatic improvement of the human-land system including farmers' vulnerabilities, livelihood assets, strategies, outcomes, and the environmental indices since the implementation of integrated watershed management practices. These practices included building terraces, Tree planting and infiltration trenches. The vulnerabilities of farmers to shocks have been dramatically reduced by the improved environmental indices

and the enhanced per capita net income derived from agricultural productivity. According to a sample survey conducted 98% of all the households located in Mwange area have notice an increase in their household incomes which is being used to fulfill other family needs like medical care, house construction, clothes, cater for school expenses as well as rent farm land.

The positive and significant impacts of integrated watershed management practices on the sustainable rural livelihoods of the people of Mwange watershed are evident and essential to the sustainable rural development of the watershed. The enhanced income, improved environmental indices, and reduced vulnerabilities of farmers are recognized as new livelihood assets that will influence the future livelihood strategies in the holistic framework. It is concluded that increased land productivity, increased environmental indices and subsidies income as well as diversified livelihood strategies are essential to the sustainable rural development of the rural people. The impact of integrated watershed management practices success in Mwange watershed strongly supports the future promotion of similar policies elsewhere in the region, as Rwanda continues to experience large-scale transformation within its vast rural areas.

6. Recommendation

Stakeholders' involvement/participation: In addition to people participation which is recognized as key to the success of sustainable integrated watershed management practices, all stakeholders, downstream users of watershed resources, government concerned institutions, NGOs and other concerned parties should be involved from the very beginning in watershed management plan. Such involvement/participation should be integrated as a major component in the design/development of relevant plan/policies. This will help ensure that ground rules for operation are made clear to the community as well as consortium partners.

Economic returns: To ensure sustainability and replication of watershed management interventions, there is need to make sure that economic returns are guaranteed. Economic returns which benefit upstream beneficiaries as well as downstream inhabitants/resource users.

Adequate institutional/organizational arrangements: institution building for watershed management has been raised as one of the most neglected part of watershed projects. In this respect, it is being recognized that there is a need for improved understanding and identification of institutional and organizational arrangements required for an effective watershed management. An appropriate legislative framework to support watershed management policies has been also raised as an important tool which needs particular attention.

Long-term vision/commitment: Watershed management is increasingly seen as an appropriate vehicle not only for environmental conservation but also for the improvement of living conditions of rural communities. In this regard, there is a need for long-term commitment, including financial, from all stakeholders.

Watershed management approaches need a paradigm shift: The current watershed management approaches mostly focuses on soil and water conservation, but effective watershed management requires multidisciplinary and innovative approaches based on the local situation. A paradigm shift is needed in order to achieve an effective and sustainable watershed management. The important component of this shift include: increases in net agricultural production on arable and non-arable lands, development of village-level institutions, substantial improvements in the livelihoods of watershed inhabitant, implementation of an approach that has widespread political and public support, decentralize administration to the lowest responsible level, utilize a flexible, responsible and adaptive policy framework and continually involve the watershed community in the planning process, and linkages with credit, market and input institutions and technical/scientific/research support organizations.

Shift the community participation from contractual to a consultative approach

The current system promotes community participation in the watershed for site selection, implementation and planning of activities through formation of watershed committees. Shifting the community participation from contractual to a consultative mode is needed. This can be possible through providing tangible private economic benefits to individuals or group economic benefits to associations. Such benefits can come from off-farm activities like handcraft, establishing forest enterprise, establishing seed supplier, grain mill, min hydropower supply and etc based on the local context leading to increased household asset.

Baseline survey at watershed level

A detailed baseline survey of the watershed is needed before onset of the watershed as this will help to select watershed sites where direct need exists in terms of improving soil and water conservation, enhancing productivity and improving livelihood activities at watershed level to understand and document the impact of intervention.

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