

Evaluating the Impact of Canal Restoration in Kotagala, Nuwara Eliya District, Sri Lanka



INITIATIVE ON
Climate Resilience

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Summary

The impact evaluation of the canal restoration project in Kotagala, Nuwara Eliya District, Sri Lanka, highlights the significant benefits of locally led adaptation measures in addressing climate risks, particularly flooding. The restoration, completed in 2023 by International Water Management Institute supported through the CGIAR initiatives on Climate Resilience "ClimBeR" ACTION grant and supported by Japan's Ministry of Agriculture, Forestry and Fisheries, focused on rehabilitating a 2 km stretch of the canal running through the Chrysler's Farm. The initiative aimed to improve water flow, reduce flood risks, and enhance the resilience of the local community, which had faced recurring floods due to heavy rainfall, sedimentation, and waste mismanagement.

The project resulted in a substantial reduction in flood vulnerability. In the year following its completion, no flood events were recorded, marking a transformative change for the community. Improved water drainage, enhanced canal capacity, and reduced sedimentation significantly mitigated the impact of heavy rains. Social and economic benefits were notable, with fewer disruptions to tea estate operations, increased school attendance, and reduced damage to homes and infrastructure. Community-led efforts also contributed to the project's success, with active participation in canal maintenance and waste management fostering a sense of ownership and accountability.

Environmental gains were another critical outcome of the restoration. Water quality in the canal improved, and soil erosion was minimized due to enhanced water flow and sediment control. Awareness campaigns and monitoring initiatives effectively reduced waste dumping into the canal, promoting a healthier local ecosystem. These immediate outcomes underscore the success of the restoration in addressing key environmental and social challenges.

Despite these successes, long-term sustainability remains a concern. The evaluation revealed gaps in maintenance mechanisms, financial sustainability, and consistent stakeholder collaboration. While subcommittees for maintenance and waste management were formed, ensuring their continued activity requires stronger financial and institutional support. A robust maintenance fund, supported by estate management and community contributions, is essential to preserve the project's benefits over time.

Key lessons from the locally led adaptation include the importance of community-centered approaches, integrated governance, and anticipatory actions. Active involvement of local communities, from planning to implementation, proved essential in aligning the project with local needs. Strengthening communication between stakeholders and implementing early warning systems are also critical for enhancing climate resilience. Additionally, the project successfully promoted gender-inclusive practices, ensuring equitable benefits for all community members.

This canal restoration initiative serves as a model for locally led climate adaptation, showcasing the potential for collaborative, inclusive, and sustainable development. However, continuous efforts in maintenance, capacity building, and stakeholder engagement will be critical to sustaining and scaling its positive impacts.

1 Introduction

Sri Lanka is highly vulnerable to the impacts of climate change, with its diverse topography and climatic zones exposing the country to a range of climate-related hazards. Among its most affected regions are the Central

Highlands, characterized by steep slopes, high-intensity rainfall, and frequent landslides and floods. As global temperatures rise, these areas are increasingly classified as climate hotspots, where communities face escalating risks to their livelihoods, infrastructure, and ecosystems. The interplay of erratic monsoonal patterns and unplanned development has exacerbated vulnerabilities, particularly for rural and economically disadvantaged communities' dependent on agriculture and natural resources.

In response to these challenges, Sri Lanka has begun prioritizing investments in locally led adaptation initiatives to build resilience and safeguard vulnerable communities (World Bank, UNDP). These programs emphasize community-driven approaches that integrate traditional knowledge with innovative climate solutions. By focusing on inclusive planning, gender equality, and stakeholder collaboration, locally led adaptation offers sustainable pathways to mitigate risks and adapt to changing climatic conditions. The initiatives such as canal restoration in flood-prone regions not only address immediate hazards but also foster long-term resilience through enhanced disaster preparedness, ecosystem restoration, and socio-economic empowerment. This approach aligns with global calls for equitable and locally driven climate action to tackle the escalating challenges posed by climate change.

1.1 Floods in Kotagala

The Central Highlands of Sri Lanka experience a tropical montane climate due to its elevation. The region's steep slopes contribute to rapid runoff during intense rainfall, increasing the risk of flash floods. Kotagala, in Nuwara Eliya District, situated above 1,200 meters in elevation, receives substantial rainfall throughout the year, with an annual average of more than 3,000 mm. In 2021, the annual rainfall in Kotagala recorded over 4,000 mm (De Silva, 2014); Wickramagamage, 2016). As highlighted in Figure 01, the months of May and October experienced the highest levels of rainfall. May stands out with the peak rainfall exceeding 600 mm. October also receives a significant amount of rainfall, followed closely by July. The Kotagala region has faced several flood events, primarily due to heavy rainfall during the monsoon seasons. In recent years, the western slopes of the Central Highlands have received heavy rains, causing floods in many low-lying areas of Kotagala. Roads and transportation can be difficult, especially during the rainy season when landslides and flooding disrupt connectivity.

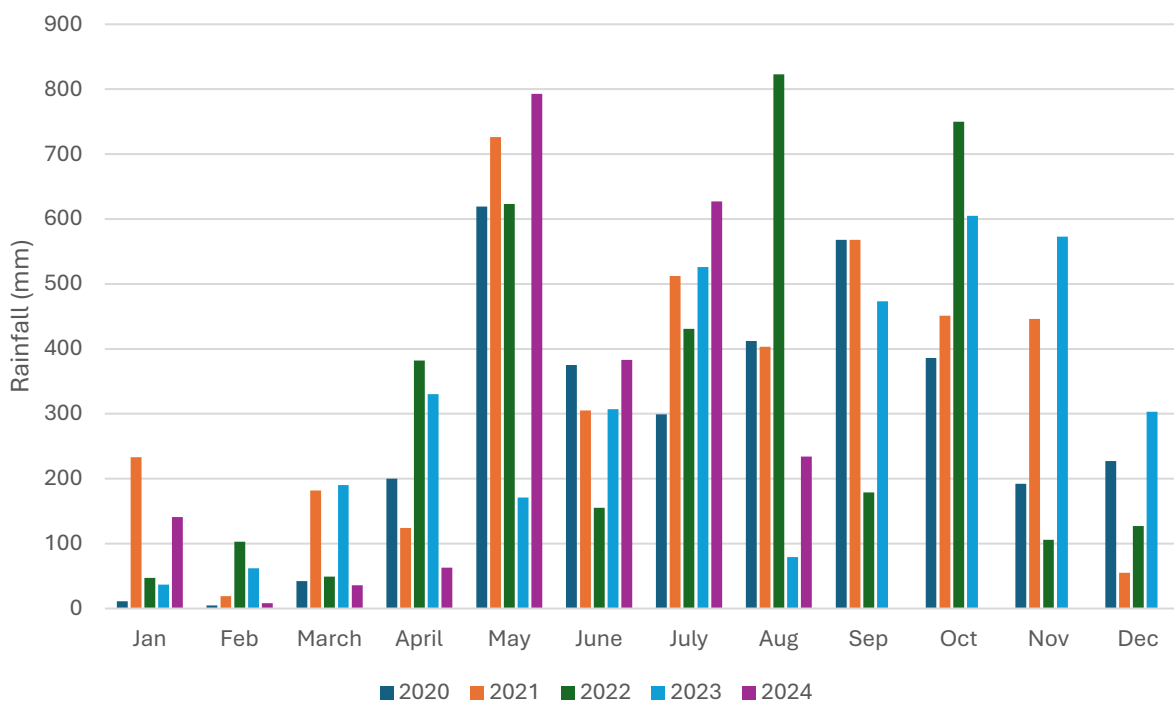


Figure 1: Monthly Rainfall in Kotagala from 2020 - 2024 (Chrysler's Farm rainfall station)

1.2 Flooding in the Chrystler's Farm

Recent flooding in Kotagala, particularly in areas such as Chrystler's Farm, has caused widespread damage and disruption. The Chrystler's Farm Tea Estate, located in this flood-prone region, is particularly vulnerable due to a 2-kilometer-long canal that runs through the estate. This canal, critical for drainage, has become a recurring source of flooding, affecting approximately 25 of the 50 families settled along its banks. The floods not only disrupt daily life—impacting residents, schools, and essential services—but also severely affect the operations of the tea estate, a key livelihood source for the community. Flooding typically occurs twice a year, with the most severe events concentrated during the May-July and October-December periods, leaving the community in a cycle of recovery and vulnerability.



Figure 2: Canal running through the Chrystler's Farm Tea Estate

1.3 Canal restoration

The average width of the canal in Kotagala was approximately 3 meters prior to restoration, a significant reduction from its baseline width of 20 meters. Figure 02 illustrates the canal flowing through the Chrystler's Farm Tea Estate. Over time, the canal's capacity was severely diminished in several areas due to poor maintenance, with contributing factors such as soil erosion and the accumulation of solid waste. Many families living along the canal have used it as a dumping ground for household garbage, largely due to the absence of designated waste disposal facilities or a routine garbage collection system provided by the local authorities.

The lack of a structured maintenance mechanism has exacerbated the problem. Although the canal had been cleaned sporadically by various parties using machinery over the past decades, the absence of regular upkeep allowed debris to accumulate, obstructing water flow and contributing to frequent flooding. This situation

underscores the critical need for consistent maintenance and effective waste management strategies to restore and sustain the canal's functionality and mitigate the risks of flooding in the community.

The canal running through the Chrysler's Farm Tea Estate underwent a 2 km stretch restoration in December 2023 as part of the CGIAR Initiative on Climate Resilience 'ClimBeR' ACTION grant. This restoration, supported by Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) under the Locally Led Community Adaptation Program, involved widening the canal, allocating the canal reservation, and clearing debris to enhance rainwater flow from upstream and reduce flood risks during heavy rains. The project was based on technical assessments and community consultations, and it aimed to improve water flow management and mitigate flood risks for the local community. This initiative was successfully handed over to communities at Chrysler's Farm in Kotagala.

2 Objectives of the study

The impact evaluation, conducted in September 2024, aimed to assess the effectiveness of the locally led adaptation measures in reducing the vulnerability of the Kotagala community to climate-related hazards, particularly floods. Additionally, the evaluation assessed the initiatives contribution to improving community resilience and adaptive capacity. Furthermore, the assessment delved into the adaptation intervention success in fostering community ownership and participation throughout its implementation. It also analyzed its effectiveness in promoting gender equality and social inclusion by ensuring that the benefits of climate adaptation measures were equitably distributed among all community members. The sustainability of the intervention outcomes was assessed, particularly the continued operation and maintenance of infrastructure, the adoption of climate-smart practices, and the capacity of the community to manage future climate risks. The evaluation also identified lessons learned and good practices that can inform future climate adaptation initiatives in similar contexts. This evaluation would provide valuable insights into the Kotagala community's ability to cope with climate impacts and the long-term effectiveness of community-led climate adaptation strategies.

3 Methodology of the study

The impact evaluation was based on a mixed-methods approach, which included field observations, qualitative data collection following a semi-structured semi-questionnaire survey, and focus group discussions to gain a comprehensive understanding of the project's impact. Further, this study attempted to understand how stakeholder interactions, management processes, and norms evolved, and how governance processes developed over the past year.

3.1 Questionnaire survey with the local stakeholders

Semi-structured interviews were conducted with local stakeholders, including community representatives, including members from committees, residential communities, tea estate management, school teachers, and government officials at both local and regional levels. Figure 03 illustrates the questionnaire survey conducted with the management representatives at Chrysler's Farm Tea Estate to assess their perspectives on flood risk management strategies. The primary objective of these interviews was to gather insights on operational support, as well as to assess the level of collaboration and support for the canal restoration project.

The questions were designed to explore several critical areas. First, the impacts of flooding in the locality were assessed both before and after the canal restoration project. The community's ability to face climate extremes was also examined, along with how the project has helped reduce vulnerability to these risks. The interviews focused on community involvement and stakeholder interaction throughout the project, particularly in the planning,

implementation, and monitoring phases. In addition, the interviews explored any changes made to the project during its execution and how these adjustments impacted its overall success.

Another key area of focus was enhancing the community's capacity to adapt to future climate risks and challenges. The adoption of climate-smart agriculture practices was assessed, including how these practices have been integrated into the community's daily routines. The long-term benefits of the canal cleaning project were also discussed, with an emphasis on environmental, economic, and social improvements. Additionally, the interviews explored the catalytic impact the project has had beyond its original scope, influencing other sectors, communities, or areas.

Our commitment to ensuring the equitable distribution of benefits was a key focus, with particular attention given to whether all community members—irrespective of gender, social status, or other factors—were able to benefit from the initiative. Efforts to address gender inequality and promote social inclusion were carefully examined, highlighting the importance of creating opportunities for all groups within the community. Additionally, the interviews assessed the community's capacity to manage future climate risks, emphasizing the sustainability of the implemented climate adaptation measures over the long term. A total of 32 individuals participated in the questionnaire survey, including 24 local community members, four estate management and welfare division representatives, five school teachers, and four local government officers, ensuring a diverse range of perspectives were captured. The verbal consent form was administered prior to participants completing the survey questionnaire.



Figure 3: Questionnaire survey conducted at Chrystler's Farm Tea Estate

3.2 Focus Group Discussion with the Local Community

Focus Group Discussions (FGDs) were conducted with local community members, with particular attention to understanding women's experiences and participation in the canal restoration project. Figure 04 shows the focus group discussions held with the local community at Chrystler's Farm Tea Estate to collect their perception on flood

risk management and resilience strategies. The discussions also explored the challenges faced in maintaining the canal and managing waste disposal within the community. Participants were encouraged to provide suggestions for improving the canal cleaning initiative and ideas for enhancing ongoing community engagement and participation in future efforts.



Figure 4: Focus group discussions were held at Chrysler's Farm Tea Estate with the local communities

3.3 Field Observation

Site visits were conducted to observe the current state of the canal and surrounding areas post-cleaning, assessing maintenance activities, compliance with cleaning schedules, and evidence of community ownership and responsibility (e.g., signage and waste disposal practices). Additionally, some families living along the canal have relocated their properties slightly away from flood-prone areas and raised the foundation height of their new homes.

Figure 05 illustrates the relocation of some houses from flood-prone areas and the upgrading of their conditions, highlighting one of the families that has elevated the foundation of their house.



Figure 5: Relocation of some houses from flood-prone areas and the upgrading of their conditions

3.4 Analysis of data

The collected data were analyzed through quantitative analysis of closed-ended questions to assess frequencies and determine how many respondents selected each answer option. Additionally, thematic analysis was carried out to identify patterns and themes within the qualitative data.

4 Results

The first part of the results describes the impacts of the project initiatives and the current progress of the actions. Stakeholder perception serves as a valuable tool for evaluating the progress of a project, offering insights into how different stakeholders view its implementation, outcomes, and alignment with community needs. By gathering feedback from stakeholders such as local residents, government authorities, and tea estate management, these assessments help identify strengths, gaps, and areas for improvement in the project. The second part of the analysis chapter describes the perceptions of each stakeholder regarding the project's impacts.

4.1 Assessment of Flood damage before canal restoration

4.1.1. Flood inundation

Before the canal restoration, the impact of floods was severe during the heavy monsoon season. Residents reported that lower-lying areas were frequently inundated, with small streams and tributaries spilling over their banks.

During the focus group discussions with residential communities and the tea estate management, it was highlighted that in December 2023, the flood extended 100 to 150 meters from the canal, rising to a height of approximately 3 feet above the canal bridge. The road adjacent to the canal was submerged under 2 to 3 feet of water, with excess water from the canal spreading nearly 100 to 150 meters and reaching similar heights on either side of the canal.

. For example, the flood height at the tea estate buildings, located 150 meters from the canal, was around 1.5 feet. Chrystler's's Farm Tea Estate experienced an average flooding frequency of twice a year, primarily during the May-July and October-December periods. These floods typically lasted 1 to 2 days.

According to the questionnaire survey and focus group discussions, the flood damage during these periods was significant, affecting homes, local infrastructure, and livelihoods. There were a total of 450 families in the estate. Nearly 25 families were highly vulnerable to flooding and regularly experienced it. During floods, many roads became inundated, severely impacting accessibility to the locality. Consequently, all communities relying on these roads were disconnected from the town center. This disconnection significantly affected school functions and the overall functioning of the estate.

4.1.2 Damage to buildings.

The assessment indicated that the damage to buildings in the area was significant. Many local community members reside in row houses provided by the estate management, some of which have been upgraded in recent years. However, several houses near the canal remain submerged. Additionally, the staff quarters of the tea estate, as well as infrastructure facilities—including parts of the tea factory building, the estate nursery, and the school—were also submerged during these floods.

4.1.3 Damage to Roads and Bridges

Flooding significantly damaged the roads and bridges in the locality. The water inundated the roads and impacted all the bridges in the area. This situation resulted in interruptions to vehicle movement, affecting community transportation and activities, including the commutes of school children and estate workers. Consequently, the daily activities of the entire community were hindered.

4.1.4. Damage to properties and assets loss (furniture, vehicle, etc)

The assessment indicates a predominantly high level of damage, particularly affecting schools and houses near the canal, with significant impacts on home furnishings, community infrastructure, and residents' belongings.

4.1.5. Damage to Infrastructure

Damage to utilities, such as drinking water, electricity, and communication lines, was also significant. The assessment reported high levels of damage associated with current cuts and pipeline issues. Occasionally, electricity outages resulted in disruptions lasting 2 to 3 days due to these current cuts. Overall, the situation reflects a high impact on infrastructure and community service.

4.1.6. Economic impacts

During the floods, estate workers were unable to attend work, and at times, the number of working hours per day is reduced. Once the roads and buildings, including staff quarters, become inundated, staff members were occupied with cleaning and evacuation efforts. The average loss of working days in the tea factories was between two to three days, during which workers were unable to work effectively. Nearly 200 workers lose their income during these periods. The loss of working days for the tea estate community was a serious issue. Local communities reported a severe impact on livestock due to flooding, resulting in the loss of cattle, goats, and other animals. Additionally, the flooding destroyed and inundated grasslands, leaving farmers without sufficient forage to feed their livestock for several days.

4.1.7. Social impacts

Flooding was a critical stressor for the elderly community in this locality. The community faced the challenge of not having a safe shelter to move into during flooding situations. There were no designated evacuation centres. The common buildings used for evacuation, such as the nursery, the Kovil (Hindu temple), and the church, were also submerged during floods. The water quickly reached the houses, causing significant damage in a very short time. All the participants highlighted that the impact of flooding on livelihoods was high. Flooding had significantly impacted the number of school days. The school was also submerged, with water levels reaching about 1.5 feet. In several instances, the assessment of lost school days revealed that disruptions ranged from 3 to 4 days, and in some cases, as long as 1 week. Local communities reported that access to essential services—such as clinics, hospitals, healthcare, and markets—was severely impacted. At times, disruptions lasting one day or more made reaching these services difficult or even impossible. The local community highlighted that changes in food prices during the flooding period were moderate. In particular, the prices of essential items such as rice, coconuts, and vegetables tended to increase for a few days. According to the local communities, some essential items became unavailable during the flooding period. Community members noted that in some years, they were unable to celebrate Diwali in October due to flooding.

4.1.8. Environmental impacts

The impacts on vegetation were significant during the flooding events, with many of the fodder crops destroyed. Local communities do not utilize this canal for fishing. All respondents highlighted that soil erosion is significantly heightened during flooding events, identifying it as a critical impact associated with flooding.

4.2 Assessment of flood Impacts after the Canal Restoration Project

The canal restoration project brought transformative benefits to the environment, economy, and community. The survey results indicate that, due to the canal restoration project, the flood vulnerability of these communities has been significantly reduced. No floods were recorded following the project. All respondents emphasized that after the restoration, there was a significant reduction in the depth of the canal water during heavy rains compared to previous periods. Additionally, they observed a considerable decrease in the velocity of floodwaters and a reduction in sedimentation-related impacts. Moreover, water channels were enhanced, allowing for improved water flow during heavy rainfall. This enhancement facilitated better drainage and reduced the risk of flooding, contributing to the overall effectiveness of the canal restoration project.

The communities reported that damage to housing, infrastructure, and livestock has been significantly reduced. Furthermore, the number of working days and school days have increased, and the roads and transport systems functioned without interruptions during the last monsoon season following the canal restoration. Respondents also highlighted that solid waste disposal in the canal has significantly decreased after the restoration, along with a reduction in wastewater discharge into the water channel. Many respondents noted that the quality of the water in the canal has improved, further indicating the intervention success in enhancing the local ecosystem. However, a gap remains in awareness among local community members regarding the fish varieties present in the canal, and

many still lack a clear understanding of their experiences with drought. These impacts, individually and collectively, demonstrate the broad-reaching positive effects of a well-executed canal restoration project.

4.3 Local Community Initiatives to manage flood risk

4.3.1. Subcommittee for Canal Cleaning and Restoration

4.3.1.1. Committee members

At the start of the intervention, local communities recognized the importance of regular canal cleaning and proper management of solid waste and wastewater. In response, committees were established to oversee these efforts, including a Canal Cleaning and Restoration Subcommittee composed of five community members and representatives from the estate management. It was agreed to hold a general meeting with all estate community, the Grama Niladhari officer¹, the Public Health Inspector (PHI), Police, District Disaster Management Center (DMC) officials, and Estate Management representatives. The objectives of this meeting are to discuss sustainable canal maintenance and waste management practices, raise community awareness, and establish actionable plans to address these issues.

4.3.1.2. Key Stakeholder Roles and Responsibilities in the Canal Restoration Project

Roles and Responsibilities of Estate Management in the Canal Restoration Project

- Oversee regular cleaning and maintenance of the canal to prevent flooding.
- Facilitate garbage collection and allocate resources for effective waste disposal solutions.
- Engage community members in the planning and execution of the project.
- Provide machinery and tools required for maintenance activities.
- Establish a maintenance fund to cover ongoing labor and upkeep costs, ensuring fair contributions from all families.

Roles and Responsibilities of the Residential Community in the Canal Restoration Project

- Participate in planning and implementing strategies for flood prevention and waste management.
- Monitor the canal and report any instances of illegal dumping or areas needing maintenance.
- Collaborate with estate management and local authorities to enhance waste collection services.
- Contribute regularly to the maintenance fund and adhere to agreed-upon community guidelines.

Roles and Responsibilities of the Government officers in the Canal Restoration Project

- Supply technical guidelines and specifications for canal cleaning and maintenance.
- Partner with local communities and organizations to support project implementation.
- Ensure that canal maintenance activities comply with environmental regulations.
- Identify and pursue funding opportunities to support community contributions and the project's sustainability.

4.3.1.3. Financial Mechanisms for Sustaining the Canal Restoration Project

¹ The Grama Niladhari (GN) division is the smallest administrative unit in Sri Lanka, serving as the foundational level of local government. A Grama Niladhari, appointed by the central government under Act No. 2 of 1993, is a public official entrusted with a wide range of responsibilities crucial to local governance and community welfare. The GN's duties include maintaining civil records, overseeing community welfare, managing public health concerns, and supporting disaster response efforts. These responsibilities are defined by 46 legislative enactments in Sri Lanka, ensuring the Grama Niladhari plays a vital role in maintaining order and fostering development at the grassroots level.

An initial proposal was made to secure funding from organizations like World Vision and IWMI to establish a maintenance fund, providing sustainable financial support for ongoing canal cleaning efforts. Under the proposal, residential families were expected to contribute a fixed amount, such as Rs 100 per month, to this dedicated fund. It was proposed that non-working families contribute Rs 100 (0.34 USD) per month, with working families providing written consent to the estate management for payroll deductions. Non-working families would nominate a representative to collect their contributions. The estate management would provide matching funds in a 60/40 ratio to community contributions. For every unit the community contributed, the estate management would contribute 40% of that amount. The project planned to work closely with local authorities to obtain additional resources and assistance. Therefore, government support was also expected, which would further enhance the long-term sustainability of the canal restoration efforts.

The fund would be managed through the estate welfare mechanism, responsible for the collection and disbursement of funds to cover labor and maintenance activities, ensuring effective and transparent use of resources for the project's sustainability.

The primary purpose of this fund was to hire laborers on a regular basis for canal maintenance, ensuring it remained clear of debris and could efficiently manage rainwater flow, thereby reducing flood risks. The funds would cover the cost of labor and their payments for cleaning and maintaining the canal. Estate management was expected to facilitate the employment of laborers for canal cleaning activities. By organizing and coordinating the workforce, they would ensure that adequate human resources were available for maintenance tasks. However, the funding mechanisms were not implemented as initially proposed.

4.3.1.4 Communication Among Stakeholders

The estate management can play a crucial role in facilitating communication between community members and local authorities, ensuring that the needs and challenges of the canal maintenance project are effectively addressed.

4.3.2 Subcommittee for Solid Waste Management

At the beginning of the project, awareness sessions were conducted on garbage disposal and composting for home gardening. The local community was expected to dispose of their garbage properly and support better management of solid waste. Community leaders took the initiative to arrange regular garbage collection with the support of local authorities.

A team of community members agreed to monitor and report any garbage dumping into the canal either to the estate management or the Public Health Inspector (PHI). They divided sections of the canal among themselves to ensure thorough monitoring. Thus, the community members agreed to monitor specific segments, reporting any illegal dumping or issues to the estate management or relevant authorities. Volunteers from the community stepped forward to join the monitoring committee.

The estate management was expected to provide facilities for garbage disposal and composting initiatives. The estate management also agreed to supply polypropylene bags for plastic waste collection and to explore partnerships with plastic recycling organizations in the area. Additionally, they agreed to display signboards along the canal with the message, 'Dumping garbage into the canal is a punishable offense,' to discourage improper waste disposal.

The local authority was responsible for the regular collection of garbage and for providing facilities for plastic recycling. It was also tasked with conducting awareness programs for communities.

Initially, the Divisional Secretary (DS) was briefed on the project, focusing on its long-term mitigation actions as a climate resilience measure. The DS expressed commitment to supporting the project by integrating Chrysler's Farm

into the regular garbage collection system, connecting the community with local plastic recycling operations, and instructing the area's Grama Niladhari to participate actively in the project activities. These actions aimed to improve waste management and reduce flooding risks.

4.3.3. Disaster Management Committees

Disaster management committees were established within each Grama Niladhari Division with the support of the disaster management officers. The Anticipatory Action initiative conducted at Chrystler's Farm Tea Estate aimed to mitigate flood risks through proactive measures. A drill held in July 2023 engaged the community and raised awareness about flood preparedness. Another anticipatory program was conducted in October 2024 in collaboration with the Disaster Management Unit of the Nuwara Eliya District. Last year, an Anticipatory Action drill was conducted to prepare the community for flood response. This year, the DMC has organized another awareness session and simulation program further to educate the community in a more organized way. The session will include guidance on pre-preparing evacuation bags, relocating animals to safety, and other essential measures for flood preparedness. These proactive efforts aimed to ensure the community is better equipped and more resilient in the face of potential floods.

The district-level Disaster Management Center (DMC) Officer highlighted the critical importance of being aware of social inclusion issues, particularly concerning vulnerable groups. They emphasized the active involvement of women in anticipatory disaster management actions. However, the participation of women from the Chrystler's Farm Tea Estate has been particularly commendable, with strong engagement in disaster preparedness and response efforts.

The community faces the challenge of not having a safe shelter to move to in the event of flooding. The common buildings used for evacuation during the drill, including the nursery and the Hindu temple, are both prone to flooding. As a result, it was suggested that the community propose an alternative shelter location, but they were unable to identify a suitable option. A subcommittee was proposed to clean and maintain the canal to minimize flood risks regularly. Additionally, established communication mechanisms were to be used in case of a flooding emergency and evacuation.

The need for a community-based early warning system was discussed with the Disaster Management Center (DMC) officers, as flooding in the local canal is not connected to national or district-level early warning systems. Nationally linked rain gauges do not currently monitor rainfall data specific to this area, although the tea estate management records daily precipitation. The DMC also planned to engage schoolchildren by distributing rain gauges to monitor local rainfall. The DMC agreed to collaborate on developing a localized early warning system, and this issue would be presented at the next 'Monsoon Forum' for further discussion. Additionally, the IWMI was proposed as a potential partner in this initiative.

The disaster management committee is crucial for maintaining community resilience against floods and effective waste management. However, these committees are not regularly active.

4.4 Involvement of Local Communities in Implementation Processes

Involving the local community in every phase of a canal restoration project is crucial to ensuring its success. Active community participation not only aligns the project with local needs but also fosters a sense of ownership and long-term investment. This assessment details the role of local community engagement in the canal restoration project, emphasizing how stakeholders actively contributed to aligning the project with the community's environmental, social, and economic needs.

Residential communities were actively engaged in the initial stages of the project, but their involvement significantly decreased during the implementation and monitoring phases. Tea estate management officers have continued to play a key role throughout the project, particularly in coordinating efforts with local government officials and external funding agencies. While school teachers and principals were involved early on, their participation in the monitoring

and evaluation stages has been notably minimal, indicating a gap in sustained engagement. On the other hand, local government officers, especially the Grama Niladari and disaster management officers, have maintained strong and consistent involvement throughout all phases of the project. This consistent engagement underscores the importance of local governance in ensuring the project's continuity. This pattern highlights the need for targeted strategies to boost community participation across all phases of the canal restoration, ensuring that residents remain actively engaged and invested throughout the entire project lifecycle.

The community is aware of the issue of solid waste dumping in the canal and is growing increasingly concerned about its environmental impact. While members of the community in Chrystler's Farm are part of the disaster management committees, they are not always consistently active. Nevertheless, the community showed a willingness to participate in another anticipatory action session, demonstrating their ongoing commitment to addressing local challenges. However, a strong initiative has not been undertaken to further enhance and monitor the project activities and their outcomes.

4.5 Stakeholder Interactions

The stakeholders comprised local community leaders, factory workers, female workers, canal bank residents, Grama Niladhari (GN) officers, local authorities, school teachers and principals, tea factory management, welfare societies, the Disaster Management Center (DMC), the district secretariat, and various NGOs. Throughout the canal restoration project, various stakeholders interacted at different levels and stages, which influenced the overall collaboration and effectiveness of the initiative.

The analysis highlighted that the female workers from the tea estate and canal residents demonstrated particularly strong interaction, fostering positive relationships and cooperation. Their consistent involvement was crucial in maintaining effective communication and collaboration, especially in discussions and hands-on activities related to the restoration. Local communities, particularly women, showed a clear commitment to participating in these engagements, actively contributing to meetings and project-related activities.

However, the local residential community exhibited only moderate interaction with the tea estate management regarding the canal restoration. Additionally, communication between the community and local government officers was infrequent, particularly on technical matters. School teachers, while initially involved, did not maintain strong interaction with the project stakeholders. Their engagement significantly decreased as the project progressed, limiting their contribution during later stages such as monitoring and evaluation.

The tea estate management, while playing a central role in coordinating the project, did not maintain frequent communication with other stakeholders, particularly with estate workers regarding day-to-day activities and updates on the restoration efforts. Nevertheless, they established moderate relationships with all relevant parties throughout the project.

Additionally, government officials, including those from the district secretariat, maintained moderate communication with the broader stakeholder group. The lack of frequent interaction with both the local community and other project partners limited the exchange of vital information and delayed responses to emerging issues.

This weak interaction among the stakeholders during the implementation process highlights the need for improved dialogue and stronger collaboration between these key stakeholders to address community concerns better and ensure more comprehensive participation. This analysis underscores the importance of enhanced and consistent communication across all stakeholders, particularly between the tea estate management, local government officers, and the community. Strengthening these relationships and fostering open lines of dialogue will be crucial to ensuring the project's effectiveness and long-term success.

4.6 Norms and consensus established during canal restoration Project.

Residential Communities in the tea estate actively participated in discussions and awareness programs, demonstrating their commitment to the project, and fostering a sense of ownership and responsibility among residents. School Teachers' involvement encouraged students and parents to participate, thereby promoting a culture of environmental stewardship and community engagement. The tea estate management played a crucial

role in communication and exploring funding sources for the canal restoration project. By collaborating with local residential communities and government officials, they helped establish transparency and shared responsibility norms, ensuring that all stakeholders were informed and engaged throughout the project. Government officers contributed to the project's success by providing regulatory support and resources.

4.7 Any changes to the actions or decisions related to the project that were originally planned.

The assessment showed that the actions and decisions initially planned for the canal restoration project remained unchanged throughout its implementation.

4.8 Community Capacity to Adapt to Climate Risks

Currently, the canal system has increased its capacity to cope with flood occurrences. All respondents demonstrated a significant capacity to adapt to flood events, showcasing strong readiness to address the challenges posed by changing climatic conditions.

They pointed out that other canals in the area require restoration due to flooding, which affects houses and toilets in various locations. Discussions with the local communities highlighted ongoing challenges in specific areas that still need to be addressed to ensure effective climate adaptation across the locality. The community has learned valuable lessons and recognized the importance of canal restoration from the project initiatives. For example, they emphasized the need to restore the beginning of the canal. The tea estate management is currently exploring additional funding sources to implement restoration efforts in these areas. Figure 06 illustrates the future proposal for the restoration.



Figure 6: Future Proposal for the Restoration (marked in red)

4.9 Long-term Benefits and the Sustainability of the Project

The evaluation of long-term benefits from the canal restoration initiative shows promising results across various stakeholder groups, including residents, estate workers, estate management, school teachers, and government officers. Significant number of respondents believe the project has sustainable benefits, emphasizing that regular maintenance will ensure their continuation. Figure 07 shows a comparison of part of the canal before and after restoration, with the recently restored sections now better equipped to manage flooding. However, government officers expressed considerable uncertainty about the sustainability of the project's benefits, highlighting the need for greater residential community engagement.

In general, the month of November in Kotagala receives more than 600mm of rainfall, making it one of the months with heavy rains. However, in November 2024, following the implementation of the project initiatives, the Chrystler's

Farm Tea Estate community was not affected by any flooding events, unlike in previous years. The following Figure 08 illustrates that the Chrystler's Farm Tea Estate community did not experience any flooding events in November 2024. Most stakeholders agreed on the positive impact of the canal cleaning initiative, recognizing its role in improving environmental conditions and reducing flood risks. However, they also acknowledged that the long-term success of the project depends on consistent maintenance. Regular upkeep is crucial to prevent debris buildup, ensure proper water flow, and preserve the improvements made. This ongoing commitment is essential to sustaining the project's benefits, ensuring the community remains resilient to climate risks, and that the canal functions effectively in the future.



Figure 7: Part of the canal before and after restored sections are now better equipped to handle flood situation.



Figure 8: The Chrysler's Farm Tea Estate community did not face any flooding events in November 2024

4.10 Catalyzing Change

The initiative catalyzed change by facilitating the cleaning and widening of adjoining canals connected to the main branch channel. Recently, the community collaborated with the tea estate management to explore opportunities for canal restoration in other parts of the locality. Additionally, some residents relocated their homes to elevated areas to mitigate the risks associated with flooding.

4.11 Efforts Toward Social Inclusion in the Project

Most of the respondents highlighted that the benefits of the canal restoration project are equitably distributed among all stakeholders. This impact evaluation indicated that the efforts made to address gender inequalities were highly significant, with all respondents highlighting that all activities were conducted on an equal basis, without distinction between men and women. The project provided equal benefits for everyone in the community, both men and women

4.12 Functioning of Adaptation Measures

The local residential community, school teachers, government officers, and estate management are highly pleased with the project and its impact. Despite this positive sentiment, there are no success stories regarding the maintenance and continuation of practices such as regular cleaning, waste management, and mechanisms like composting. The responses indicate a mixed attitude toward climate adaptation measures' operational status and maintenance. While some residential communities and tea estate management recognize their functionality, a significant portion believes that the maintenance and implementation of proposed project activities are lacking. Overall, there is a clear need for improved maintenance efforts and regular discussions among all stakeholders to ensure these adaptation measures remain effective and sustainable.

The evaluation indicates that residential communities are actively engaged with climate-smart agriculture initiatives, with a significant majority reporting widespread participation and enhanced agricultural activities.

4.13 Community Preparedness for Future Climate Risks

- **Strong Awareness of the community**

The assessment indicated that all community members are aware of the flood risks and the importance of canal restoration, waste management, preparedness, climate data monitoring, and other related actions. It also reveals that residential communities feel largely equipped to adapt to and respond to potential challenges related to future climate risks.

- **Anticipatory Action for Floods and Continuous Support from the DMC**

Community members, tea estate management representatives, and disaster management officers held detailed discussions regarding anticipatory actions for floods. They focused on how to communicate the threshold criteria for rainfall and the importance of relocating to safer areas before floods occur. However, tea estate management indicated a need for more targeted training and resources. While some awareness has been raised regarding flood response strategies, significant room for improvement remains in overall preparedness and the capacity to manage future climate risks effectively. Government officers also feel they are not well-equipped to handle future climate risks, highlighting a critical area for development and support.

- **Initiatives of Tea Estate Management**

Chrystler's Farm Tea Estate has implemented soil erosion management practices to preserve the land's health and sustainability. It holds Rainforest Alliance certification, which signifies the estate's commitment to environmental

sustainability, social responsibility, and economic viability. It reflects the estate’s dedication to adhering to rigorous standards that promote the protection of ecosystems, the welfare of workers, and the well-being of local communities.

Chrystler’s Farm Tea Estate is actively seeking funding sources and is engaging with various agencies, NGOs, and community organizations. The tea estate management has established better communication with schools, disaster management officials, and tea estate workers regarding the implementation of this canal restoration project.

4.14 Evaluation of Stakeholders’ Perception of Project Impact and Processes

The second part of the report presents stakeholders' views on the success of the project initiatives in enhancing adaptive capacity and flood resilience. Understanding the differing perceptions of success factors among stakeholders is critical for refining project actions and processes. These perceptions were evaluated from the perspectives of various groups, including residents, tea estate management, government school teachers, and local and regional government officers.

4.14.1 Evaluating the stakeholder perception on Sustainability of Economic, Social, and Environmental benefits from the project activities

This project introduced nature-based solutions, such as canal restoration, community awareness to enhance flood resilience. However, the long-term sustainability and success of these measures are inherently tied to securing and maintaining stakeholder acceptance of the project’s impacts, benefits, and overall outcomes. It reviewed the stakeholder satisfaction, sustainability, and long-term impact have been analyzed to provide a comprehensive assessment of the project’s effectiveness. Table 1 presents the assessment of stakeholder perceptions, determining whether project activities, such as canal cleaning and widening, etc. provide sustained economic, social, and environmental benefits, based on data collected through a questionnaire survey. The stakeholders were asked about the sustainability of the project's benefits through a questionnaire survey.

Table 1: Stakeholder perception on Sustainability of Economic, Social, and Environmental benefits from the project activities

Stakeholder group	Stakeholder perception (% saying yes or no)	
	Yes	No
Residential communities	80	20
School teachers / school	80	20
Tea estate management	70	30
Government officers	70	30

The data, based on responses from a questionnaire survey, showed that most stakeholder groups perceived the project’s benefits as sustainable. The majority of stakeholders—residential communities, school teachers, tea estate management, and government officers—held a positive view of the project's sustainability, with over 70% expressing confidence in its long-term benefits. Among residential communities, 80% believed that project initiatives, such as canal cleaning and widening, would bring long-term socio-economic benefits. However, 20% remained uncertain about the sustainability of these benefits. These stakeholders emphasized the importance of regular maintenance to ensure the benefits were sustained. Similarly, 80% of school teachers acknowledged the positive impact of the initiatives, reflecting a perception similar to that of the residential communities. This suggests that both groups believed the project would continue to positively impact their daily lives and well-being in the long term. 70% of tea estate management also believed in the sustainability of the project’s benefits. Additionally, 70% of government officers expressed satisfaction with the sustainable impacts of flood risk management strategies. However, despite these positive responses, government officers raised concerns regarding the community’s preparedness and the continuity of the project’s initiatives.

4.14.2 Evaluation stakeholders' perceptions of adaptive capacity to changing climatic conditions

Adaptive capacity refers to the availability of resources, governance structures, processes, and other critical factors that collectively determine the inherent ability of a system or community to adapt to climate change. In addition to these objective factors, stakeholders' perceptions play a crucial role, particularly regarding flood risks and the feasibility of adaptation initiatives. These subjective perceptions not only shape their understanding of the risks posed by climate change but also significantly influence their willingness, ability, active involvement and ownership to take adaptive actions. The following Table 02 highlights local stakeholders' perceptions regarding the adaptive capacity for future flood occurrences. The table categorizes the perceptions into four levels: "Well equipped," "Moderate," "Somewhat," and "Not," reflecting the varying degrees of confidence in their ability to adapt to flooding risks.

Table 2: Stakeholders' Perceptions of Adaptive Capacity for Future Flood Occurrences

Stakeholder	Stakeholder perceptions (%)			
	Well, equipped	Moderate	Somewhat	Not
Residential communities	80	7	13	
School teachers	60	30	10	
Tea estate management	70	30		
Government officers		60	40	

The responses from stakeholders regarding their readiness to manage future climate risks in a sustainable way reveal varying levels of confidence across groups. Residential communities and tea estate management exhibit the highest levels of confidence in their adaptive capacity, with over 70% of respondents in both groups rating themselves as "well equipped. Residential communities stand out, with 80% considering themselves well-equipped, reflecting their strong belief in their capacity to manage future flood occurrences. This shows a predominantly positive perception among residents, with a small proportion feeling less prepared for potential future floods. 60% of school teachers feel "well equipped" to manage future floods, indicating a solid level of confidence. None of the tea estate respondents rated their preparedness as "somewhat" or "not," indicating a generally positive perception of their ability to adapt to future flood risks. Only 60% of government officers feel "well equipped" to handle future floods, while 40% rated their preparedness as "moderate". A majority of stakeholders (60-80%) across all groups feel well-equipped, indicating a general confidence in adaptive capacity. The "Well Equipped" percentages (60-80%) suggest the project has had a positive impact on building adaptive capacity.

4.14.3 Involvement of Stakeholders in Project Actions

The increasing frequency and intensity of floods have significantly affected the lives and livelihoods of local communities. Flood risk management projects often fail when they ignore the needs and priorities of local stakeholders. This analysis focuses on the involvement of stakeholders in various project initiatives, particularly the engagement of local residential communities. The role of local communities in planning and implementing adaptation strategies is emphasized, as recent research and policy reports suggest that adaptation efforts are more effective when designed, executed, and evaluated by the communities themselves. Table 03 highlights the multiple stakeholders involved in the planning and implementation process.

Table 3: Multiple Stakeholders Involvement in Planning and Implementation of Project Activities

Project activities	Stakeholders	
	Local Stakeholders	Regional and national
Canal Widening and Desilting	Tea Estate Management Local Authorities Local Communities Grama Niladari Public Health Inspector	District secretariat Disaster Management Center IWMI

Solid Waste Management	Tea Estate Management Local Authorities Local Communities Grama Niladari Public Health Inspector	
Awareness Campaigns	Tea Estate Management Local Authorities Local Communities School teachers and students Grama Niladari	IWMI World Vision
Climate Data and Monitoring	Tea Estate Management Local Communities Grama Niladari	District secretariate Disaster Management Center IWMI
Establishment of Social Networks	Tea Estate Management Local Authorities Local Communities Grama Niladari Public Health Inspector	
<ul style="list-style-type: none"> • Canal cleaning • Solid waste management • Disaster preparedness • Monitoring of canal properties 		

Table 03 highlights the participation of multisector stakeholders in various project activities. Diverse flood risk management strategies were implemented with the involvement of stakeholders from local, regional, and national levels. Especially, tea estate residential communities and estate working communities actively contributed to these efforts alongside other stakeholders, reflecting a collaborative approach to addressing flood risks.

Community engagement in project development has become increasingly recognized as fundamental to fostering sustainable development. Substantial community involvement can lead to significantly higher success rates and notable improvements in project sustainability, compared to initiatives with limited community participation. Researchers emphasize the importance of engaging local community stakeholders at all stages of project development to ensure long-term success. The stakeholders' perceptions regarding their active engagement in project activities were analyzed. Table 04 below presents the questionnaire survey results on local stakeholders' participation during each stage of the project. The level of involvement of each stakeholder across the different project stages was analyzed, with their perceptions assessed using three categories: to a greater extent, to some extent, and not at all.

Table 4: Perceptions of Local Stakeholder Engagement Across Project Stages

Project stage	Stakeholder	Perception on level of involvement (%)		
		To a greater extent	To some extent	Not at all
Planning and designing	Residential communities	67%	28%	5%
	School teacher	100%		
	Tea estate Management	100%		
	Government officers	100%		
Implementation of the project	Residential communities	6%	81%	13%
	School teacher	100%		
	Tea estate Management	70%	30%	
	Government officers		100%	
Monitoring of the project	Residential communities	6%	70%	24%
	School teacher	100%		
	Tea estate Management	66%	34%	
	Government officers		100%	

Table 04 highlights stakeholders' perceptions of their engagement in project activities throughout the project period. The analysis shows varying levels of involvement by different stakeholders across the stages of planning, implementation, and monitoring of flood risk management project activities. However, it is evident that there was a significant decline in the level of participation and active involvement as the project progressed. Specifically, minimal participation occurred during the monitoring phase, which became one of the key drawbacks of the initiative.

The analysis of residential community perspectives revealed that they were actively involved in the planning and design phases, with 67% reporting significant participation. However, their involvement dropped considerably during the implementation (6% to a greater extent) and monitoring (5% to a greater extent) phases. For instance, it was agreed to organize a general meeting with the entire estate community, Grama Niladhari officers, the Public Health Inspector (PHI), the Police, District Disaster Management Center (DMC) officials, and Estate Management representatives. The goal of this meeting was to discuss sustainable canal maintenance, waste management practices, raise community awareness, and develop actionable plans. However, focus group discussions revealed that these meetings were not held as planned.

Tea Estate Management was actively engaged in all project stages, with the most involvement in the planning and designing phase. Their participation decreased slightly during the implementation and monitoring phases. School teachers were fully involved in all stages of the project, with 100% participation in the planning, implementation, and monitoring phases. Their consistent involvement throughout the project highlights their important role in supporting and contributing to the project's success at every stage. Government agencies were fully involved in the planning stage, however, their involvement during the implementation and monitoring phases was more limited, with participation to some extent, indicating that their role may have been more supportive in nature during this stage.

4.14.4 Evaluation of stakeholder awareness regarding the progress of project activities.

Stakeholders' awareness of the operational status of the project activities, including whether they are ongoing or progressing, was analyzed. Awareness encourages stakeholders to monitor and evaluate the actions of those involved in the project, ensuring they fulfill their responsibilities and meet their commitments. This sense of accountability helps maintain project integrity, promotes transparency, and ensures that tasks are completed as planned. Stakeholder awareness of the progress of the project was analyzed. Their perception of whether the climate adaptation measures are still operational and well-maintained was assessed, and their responses were recorded as 'Yes' or 'No'. The Table 05 highlights the results (%) of each stakeholder's perception regarding their awareness of the progress of project activities.

Table 5: Stakeholder Awareness of the Progress of Project

Stakeholder	Stakeholder Awareness of the Progress of Project Activities (%)	
	Yes	No
Residential communities	40	60
School teachers	50	50
Tea estate management	70	30
Government officers	50	50

As shown in Table 05, stakeholders' awareness of the operational stage of management measures has been assessed. More than 50% of the residential communities are unaware of the status and progress of the project activities. Similarly, both tea estate management and government officers lack significant awareness regarding the progress and status of the project activities.

4.14.5. Evidence of Marginalized Groups' Engagement in the Project Initiative:

- Collaborative Decision-Making:

Project actions were identified through discussions with local communities. Participants included flood-affected residents, tea estate workers, school staff (teachers and principals), tea estate management, government officers, local authorities, and representatives from the International Water Management Institute (IWMI).

Active Community Participation:

Community members actively participated in canal cleaning and the maintenance of reservation areas, with a strong emphasis on including women. Solid waste disposal mechanisms were implemented through subcommittees formed within the community, where women played a significant role.

- Addressing the Needs of Vulnerable Groups:

The project area encompassed a diverse population with unique vulnerabilities, as follows:

Elderly and Children: Approximately 10% of the population consisted of elderly individuals or those with specific needs, while 6.7% were children under five years old (51 males and 54 females).

Female-Headed Households: A total of 19 families (4.2%) were led by women.

Pregnant Women: This group faced distinct health and safety challenges. Anticipatory actions were specifically designed to address the needs of these vulnerable groups, ensuring their challenges were considered at every stage of the project’s planning and implementation.

4.14.6. Evaluation of women participation to the project initiatives.

Women are more likely to be injured or suffer significant harm during disasters compared to men. Women also tend to have lower coping capacities, which can hinder their ability to recover effectively. In the questionnaire survey, data was collected on how each stakeholder perceives women's involvement in the project, including their views on the benefits, challenges, and potential improvements regarding women’s participation. The following Table (06) records the survey results.

Table 6: Addressing Gender Inequalities – Efforts Toward Social Inclusion in the Project

	Yes	No	Not sure	Remarks
Residential communities	100%			All projects were done on a shared basis, without distinction between men and women
School teachers / school	100%			Women are keen on the project activities
Tea estate management	100%			A program with equality benefits for everyone
Government officers	100%			Women participated enthusiastically in all the awareness programs.

All stakeholders unanimously agreed (100%) that there is no gender inequality in the participation and distribution of benefits from the project activities. According to the focus group discussions, women played a significant role, freely expressed their views on how they were taking on responsibilities during the planning and implementation stages. Women were actively included in various committees throughout both the planning and implementation phases. Discussions with the District Disaster Management Centre (DMC) officer and the tea estate management officer confirmed that district disaster management teams have also convened with the residential community regarding adequate awareness of social inclusion in disaster management projects.

Not only have increased rainfall intensity, soil erosion, canal bank encroachment, and improper solid waste disposal contributed to intensified flood damage on Chrystler’s’ farm tea estate, but the tea estate management and neighboring residential communities had also not recognized the importance of the canal system and its restoration for effective flood management until the project initiatives began in 2023. Since the implementation of this project, local residential communities and tea estate management have acknowledged the critical role of the canal system and the need to preserve areas for floodwater management. Flood risk management requires more space for water. Moreover, implementing Natural Flood Management (NFM) necessitates the participation and support of multiple stakeholders, including landowners, statutory agencies, local authorities, and broad acceptance from local

communities. This project has successfully motivated local communities, including tea estate management to promote the restoration and sustainable management of water systems to effectively mitigate flood impacts.

4.14.7. Evaluation of stakeholder’s perception on adaptive actions

It has also analyzed whether the project initiatives encouraged local communities to develop adaptive capacities to address flood risks. It has been asked whether the local stakeholders have changed and learned from the actions of this project, and whether this initiative has created an impact beyond its original scope. Table 07 highlights the community perceptions regarding these adaptive capacities and the impact of the project.

Table 7: Stakeholders’ perception of Catalyzing Change and increase the adaptive capacity of community

Stakeholder	Stakeholders Perception (%)	
	Yes	No
Residential communities	60	40
School teachers / school	100	-
Tea estate management	66	33
Government officers	50	50

As highlighted in Table 07, most of the local community members feel that the project has initiated adaptive actions. The community has also initiated the restoration of another adjoining part of the canal network, and they are attempting to replicate the same process across the entire canal network which is running through their locality.

The local community has acknowledged the importance of knowledge related to disaster management and emphasized that increased preparedness is crucial for flood resilience. They recognize the significance of canal restoration, maintenance, and solid waste management in improving flood resilience. Additionally, the tea estate management is actively seeking external funding sources to further support these efforts. All school teachers (100%) believe that the project has had a positive impact in terms of initiating adaptive actions. This could indicate that schools perceive the project's value, potentially through its influence on community education and awareness about climate resilience. These actions indicate a positive shift towards sustainability and resilience within the community, with active participation and ongoing efforts to further enhance flood management practices.

Further, the local residential communities highlighted the importance of Climate-Smart Agriculture (CSA) as a key strategy for enhancing flood resilience and ensuring sustainable livelihoods. The following Table 08 below summarizes stakeholder perceptions regarding the adoption of climate-smart agriculture (CSA) initiatives.

Table 8: Engagement with Climate-Smart Agriculture Initiatives

Stakeholder	Perception of stakeholders (%)			
	Widely	Moderate	Limited	Not
Residential communities	79	14	7	
School teachers / school		100		
Tea estate management	66	33		

Local communities emphasized CSA as a key strategy for enhancing flood resilience and ensuring sustainable livelihoods. Among the surveyed residential communities, 79% expressed widespread appreciation for CSA practices. Among the tea estate management stakeholders, 66% expressed widespread appreciation for CSA practices, while 33% demonstrated a moderate understanding of their importance. This suggests that local stakeholders, particularly the residential community and tea estate management, have recognized the value of maintaining buffer zones along the canal and utilizing these areas for sustainable agriculture.

5. Way Forward

The project at Chystlers Farm Tea Estate has made notable progress in reducing flood vulnerability and enhancing community resilience. Successful initiatives such as canal restoration, waste management, and disaster preparedness were carried out with active involvement from multiple stakeholders, including estate management, local communities, and government authorities. The formation of a subcommittee and the implementation of flood risk management strategies have further strengthened these efforts.

Over 70% of stakeholders believe in the long-term benefits of the project, including its socio-economic and environmental impacts. However, government officers have raised concerns regarding the continuity of these efforts, particularly in the maintenance of critical infrastructure like canals and waste management systems. Regular maintenance and sustained commitment are essential to ensuring the project's long-term success.

While stakeholder engagement was strong during the planning phase, it significantly declined during later stages, particularly in the maintenance and monitoring phases. To optimize future project outcomes, it is crucial to ensure continuous and active participation from stakeholders throughout the entire project lifecycle. This should involve a focused effort on monitoring, maintenance, and establishing effective communication networks with stakeholders at all levels.

Moreover, it is vital to develop long-term strategies for the maintenance and sustainability of the initiatives. This includes securing financial and logistical support to ensure the longevity of the project's outcomes, addressing continuity concerns, and promoting collaboration among all stakeholders.

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Appendix 1 -Key informant verbal consent form prior filling the survey questionnaire

Short title of the study Impact evaluation

[09. 09.2024]

Hello, my name is HMM Herath and I am working with the IWMI. I am part of a study team working with the Chystler's Farm tea estate management and the local government institutions. The study is about impact evaluation of canal restoration project which was started in 2023 December. You are being invited to take part in this research allowing us to better understand your views and the challenges you might be facing.

Before we start the interview, I have to provide you with some (i) information and later I will ask for your (ii) consent to be part of the study. In the interview, We like to ask some questions about your work which should not take more than 30 minutes. Feel free to interrupt us at any time to ask questions if we am/are not clear.

The information we compile will help our research institutions to [e.g. formulate solutions that address the challenges you are facing]. There will be **no** costs to you to participate, but you will also **not** be paid for taking part in this study.

We will take notes or record the discussion and might - or might not - record your name or contact details. If we record it, we will keep these data confidential, not share or publish, which should allow you to tell us frankly what you think and know.

Taking part in this study is voluntary. You are free not to answer any or a particular question or withdraw at any time without any negative consequences for you. But if you stay on, we are grateful for your time. Do you have any question so far?

You can also ask questions later, and you can also contact the Principal Investigator [name] at [institute, national phone number], or call [name] at our partner institution [name] under [phone number], for example, if you have any complains about us or the interview.


Based on the information provided, I have now two final questions to understand if you are happy with being part of this study before we start the interview:

Are you willing to participate in the interview?

And are you okay if we take a photo of you, which might be posted on the internet or used in scientific papers or flyers, but without your name and address, unless you wish so? If you wish so, we will only use your first [given] name.

Enumerator to fill:

A) For farmers and other vulnerable participants	
Name of participant (only if needed)	
Contact details (only if needed)	

Code number of participant (to be used on Survey Questionnaire sheet)		
Consent to take part in interview/study	Yes	No
Consent for photo taken and published	Yes	No
Consent to use first (given) name next to photo	Yes	Name: No
B) For officials from partner institutions, authorities, etc.		
Name of participant		
Contact details/affiliation		
Code number of participant (to be used on Survey Questionnaire sheet)		
Consent to cite the person with full name and affiliation	Yes	No
For A) and B)		
Enumerator name and signature on participant's behalf		
Witness name to verify consent obtained (name and signature of supervisor or research partner)		
Date		
Guidelines for storing Consent forms (see document 9) and PII data confidentially (see document 8): https://aqua.iwmi.org/departments/research/research-ethics/#elf_11_Lw		
		

Appendix 2 - Questionnaire survey on the perceived impact of the canal restoration in Kotagala, Nuwara Eliya District of the Central Province, Sri Lanka

Background

An ex-post evaluation of the CGIAR Initiative on Climate Resilience “ClimBeR” ACTION grant and as well as the support of Japan’s MAFF under the Locally Led Community Adaptation Program was successfully handed over to communities in Kotagala to reduce the impact of seasonal flooding and promote long-term flood resilience and sustainability after its completion. The evaluation would examine whether the locally led adaptation measures successfully reduced the vulnerability of the Kotagala community to climate-related hazards like landslides and floods. Additionally, the evaluation would assess the project's contribution to improving community resilience and adaptive capacity.

Furthermore, the evaluation would delve into the project's success in fostering community ownership and participation throughout the project cycle. It would also analyze the project's effectiveness in promoting gender equality and social inclusion by ensuring that the benefits of climate adaptation measures were equitably distributed among all community members. The sustainability of the project's outcomes would be assessed, particularly the continued operation and maintenance of infrastructure, the adoption of climate-smart practices, and the capacity of the community to manage future climate risks. The evaluation would also identify lessons learned and good practices that can inform future climate adaptation initiatives in similar contexts.

Survey questionnaires

1) What were the impacts of flooding in your locality before the implementation of the canal restoration project?

Frequency of flooding in your locality.	Return period
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Annually.	
Every 2 years	
Every 5years	
Every 10 years	
Rarely	

Flood exposure				
Flood Characteristics	High	Moderate	Low	Remarks
Flood Depth				
Flood Duration				
Flood Damage				
Infrastructure Damage				
Type of Infrastructure	High	Moderate	Low	Remarks
Damage to Buildings				
Damage to Infrastructure (road, bridges)				
Property and Asset Loss (furniture, vehicle, etc)				
Damage to utilities (electricity, water, and communication lines)				
Economic Impact				
Aspects of economy	High	Moderate	Low	Remarks
Loss of Working Days				
Loss of Schooling Days				
Reduced Access to Essential Services (healthcare, markets)				
Increase in Food Prices				
Unavailability of Essential Goods				
Livestock Loss				
Disruption of Local Agriculture and Livelihoods				
Health Impacts				
Health Issues	High	Moderate	Low	Remarks
Records of water borne disease				
Records of vector borne diseases				
Social and Cultural Impacts				
Social Issues	High	Moderate	Low	Remarks
Displacement of community				
Damage community networks				
Impact on Cultural and Religious Festivals				
Environmental Impact				
Ecosystem Damage	High	Moderate	Low	Remarks
Impact on terrestrial species				
Impact on aquatic species				
Water Quality in Wells				
Soil Erosion				

Water Quality				
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2)How do you evaluate the impacts of the canal restoration project.

Ability to Face Climate Extremes	Level of impact			If yes Increase or decrease	If increase or decrease		
	Yes	No	Can't say		High	Moderate	Low
Climatic Conditions							
Change in Depth of Floodwaters							
Change in Velocity of Floodwaters							
Change in Sedimentation Impact							
Change in Drought Exposure Period							
Change in Water Availability for Drinking During Dry Months							
Change in Water Availability for Bathing and Washing During Dry Months							

Ecological impacts	Level of impact			If yes Increase or decrease	If increase or decrease		
	Yes	No	Can't say		High	Moderate	Low
Environmental quality							
Change in Canal Fish types							
Change in Canal Fish number							
Change in Terrestrial Fauna (e.g., Birds)							
Change in Invasive Flora							
Change in Heat During Dry Months							
Improving Groundwater Quality and Quantity							
Water Quality Improvement for Bathing, Washing, etc.							

	Level of impact			If increase or decrease	If increase or decrease		
	Yes	No	Can't say		High	Moderate	Low
Economic impacts							
Change in Damage to Housing and Properties							
Change in Damage to Livestock							
Change in Damage to Infrastructure							
Change in Land Value							

Change in Working Days							
Change in Schooling Days							
Change in Food Production (e.g., Fish, Fruits)							

	Level of impact			If yes Increase or decrease	If increase or decrease		
	Yes	No	Can't say		High	Modera te	Low
Social impacts							
Opportunities for Social Interactions (Women, Elder Groups, etc.)							
Opportunities for Recreational Activities (Fishing, Walking, etc.)							
Opportunities for Playing for Kids							
Improved Health Conditions / Reduced Diseases							

	Level of impact			If yes Increase or decrease	If increase or decrease		
	Yes	No	Can't say		High	Modera te	Low
Physical infrastructure							
Change in Accessibility to the Locality (Roads, Transport Systems)							
Change in Mechanism of Solid Waste Disposal							
Change in Mechanism of Wastewater Disposal							
Availability of Drinking Water							
Change in Cost of Canal Cleaning							

3) Were the community members actively involved in the planning, implementation, and monitoring stages of the project?

Stage of the project	Level of involvement	Remarks
Have you been involved in the planning and designing of the project?	To a great extent /To some extent/ To a limited extent /Not at all	
Have you also been involved in the implementation of the project	To a great extent /To some extent/ To a limited extent /Not at all	
Have you also been involved in the monitoring of the project	To a great extent /To some extent/ To a limited extent /Not at all	

4) Which of the following stakeholders did you interact with during the planning design, implementation, and monitoring phases of the river restoration project?

Stakeholder	Type of Interaction; sharing resources, sharing information, sharing knowledge, etc.)	Frequency				
		Never	Rarely	Sometimes	Often	Always
Local Community Leaders						
Workers in the Factory						
Female Workers						
Canal bank Residents						
Grama Niladari/ GN						
Local Authority						
Irrigation Department						
School Teachers / Principal						
Tea Factory Management						
Welfare Society						
Disaster Management Center (DMC)						
District Secretariat						
NGOs						

5) What rules or norms have been established to help coordinate / negotiate among stakeholders in this river restoration project?

6) Have you made any changes to the actions or decisions related to the project that were originally planned?

- Yes
- No
- Not sure

If yes, what changes were made and why?

7) Has the project enhanced the community's capacity to adapt to future climate risks?

- Significantly enhanced.
- Moderately enhanced
- Slightly enhanced
- No enhancement
- Decreased capacity.

If it has been enhanced, how?

8) Do you think the canal cleaning project will deliver long-term economic, social, and environmental benefits even after direct implementation support has ended?

- Yes
- N
- Not sure

If yes how?

9) Has the initiative catalyzed significant changes beyond its original scope, influencing other sectors, communities, or areas, and contributing to broader resilience and adaptation efforts?

- Yes
- No?
- Not sure

If yes how?

10) Did the project ensure that the benefits of climate adaptation measures were equitably distributed among all community members, regardless of gender, social status, or other factors?

- Yes
- No
- Not sure

If yes how

11) Were there any specific efforts made to address gender inequalities or promote social inclusion within the project?

- Yes
- No
- Not sure

If yes how

12) Are the climate adaptation measures implemented under the project still functioning and being maintained?

- Yes
- No
- Partially

If yes how

13) Have the climate-smart agriculture practices introduced by the project been adopted by the community?

- Widely adopted.
- Moderately adopted.
- Limited adoption
- Not adopted

If it is adopted, how?

14) Is the community equipped to manage future climate risks and continue adapting to climate change?

- Well equipped
- Moderately equipped
- Somewhat equipped
- Not equipped

If it is equipped, how?

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