SOIL CONSERVATION, WATERSHED MANAGEMENT AND CLIMATE RESILIENCE

(Program and Activities)

Version - 4

Government of Nepal

Ministry of Forests and Environment

Department of Forests and Soil Conservation

Babarmahal, Kathmandu

2025

SOIL CONSERVATION, WATERSHED MANAGEMENT AND CLIMATE RESILIENCE

Program and Activities

(Definition, Objective, Scope, and Working Strategy)

Green Book (Version-4)

Government of Nepal

Ministry of Forests and Environment

Department of Forests and Soil Conservation

Babarmahal, Kathmandu

2025

Citations:
DoFSC. (2025). *SOIL CONSERVATION, WATERSHED MANAGEMENT AND CLIMATE RESILIENCE: Program and Activities (Definition, Objective, Scope, and Working Strategy)* 4th Edition.

Published By:
Department of Forests and Soil Conservation, Babarmahal, Kathmandu

Supported By:
GON/UNDP/GEF: Developing Climate Resilient Livelihoods in the Vulnerable Watershed in Nepal (DCRL)

Edited By:
Dipesh Guragain, *Agricultural Engineer*
Shanta Kumar Shahi, *Soil Conservation Officer*

Reviewed By:
Badri Raj Dhungana, *Joint Secretary*
Ministry of Forests and Environment

Cover Photo Credit:
Prem Prasad Paudel, PhD.
GON/UNDP/GEF: Developing Climate Resilient Livelihoods in the Vulnerable Watershed in Nepal (DCRL)

Government Of Nepal
Ministry of Forests And Environment
Department of Forests and Soil Conservation
Tel.: 977-1-4227574
977-1-4220303
977-1-4221231
977-1-4221744
977-1-4216379
977-1-4256227
Fax:977-1-4227374
Babar Mahal
Kathmandu, Nepal

Ref. No.

Foreword

It is with great pleasure that I present this document, developed by the Department of Forests and Soil Conservation (DoFSC), to support professionals in soil conservation, watershed management, and climate resilience. In today's world, where sustainable natural resource management is essential, this document offers a comprehensive framework based on the principles of Integrated Watershed Management (IWM).

Nepal's vulnerable landscape and geology require effective management amidst changing political, ecological, and climatic conditions. The Forest Policy 2019 emphasizes managing fragile areas from the Himalayas to the Chure-Terai, while the 2023 National Basin Management Strategy highlights integrated watershed management. The developed guideline, aligned with the nationally endorsed documents, aims to enhance land productivity, livelihoods, ecosystem services, and climate adaptation, supporting governmental and non-governmental efforts in planning, implementation, monitoring and evaluation.

Developed through a participatory process involving extensive consultations with experts, policymakers, and stakeholders, this guideline represents a collective effort. It synthesizes existing policies, addresses identified gaps, and offers practical strategies and actions for field level professionals. By following the approaches outlined in this document, we can achieve sustainable and effective watershed resource management.

The successful completion of this work was made possible through the support and cooperation of various stakeholders, officials, and experts who were directly and indirectly involved in the rigorous process. I extend my sincere appreciation to all of them. Special thanks go to Ms. Sumana Devkota, Er. Dipesh Guragain and Mr. Shanta Kumar Shahi for thoroughly reviewing and coordinating the overall work, including facilitation processes on behalf of the Department. The Department also acknowledges the invaluable support from its line ministries, field-level offices, and personnel. We are particularly grateful to GON/UNDP/GEF: Developing Climate Resilient Livelihoods in the Vulnerable Watershed in Nepal (DCRL) for their technical and financial support throughout the process.

Similarly it will serve as an invaluable resource for technical and academic professionals dedicated to fostering resilience and sustainability in our ecosystems. I hope it will play a crucial role in achieving the DoFSC's goals and support governmental entities at all three levels, as well as non-governmental organizations, in their efforts to conserve soil, manage watersheds, and enhance climate resilience.

Shiva Kumar Wagle
Director General

Government Of Nepal
Ministry of Forests And Environment
Department of Forests and Soil Conservation
Tel.: 977-1-4227574
977-1-4220303
977-1-4221231
977-1-4221744
977-1-4216379
977-1-4256227
Fax:977-1-4227374
Babar Mahal
Kathmandu, Nepal

Ref. No.

Message

This book is designed to assist professionals in soil conservation, watershed management, and climate resilience. This document is aligned with Nepal's National Adaptation Plan (NAP) (2021-2050) and Second Nationally Determined Contributions (NDCs) 2020, reflecting our commitment to sustainable development and climate action.

The document incorporates key approaches in managing soil conservation and watershed management activities such as Climate resilience, Nature-Based Solutions (NbS), Gender Equality, Disability, and Social Inclusion (GEDSI), and Social and Environmental Safeguards (SES). This ensures that solutions are not only environmentally sound but also socially inclusive and responsive to the needs of diverse communities. By adopting these approaches, we aim to enhance land productivity, improve livelihoods, and strengthen the resilience of ecosystems and community to climate change. A central aspect of this document is its emphasis on a participatory and multidisciplinary approach, fostering collaboration among local communities, policymakers, and stakeholders to design and implement effective, context-specific solutions. These approach ensures that the management of natural resources is both inclusive and sustainable.

I trust that this version will serve as a valuable resource for governmental and non-governmental organizations involved in soil conservation, watershed management, and climate resilience. It provides the necessary framework to help achieve national and international goals, particularly those outlined in the NAP and NDCs, and will contribute to the long-term sustainability of Nepal's ecosystems and communities. I am confident that this document will serve as a valuable resource for both governmental and non-governmental organizations, guiding them in their efforts to manage natural resources sustainably and to enhance climate resilience across Nepal's diverse landscapes.

Nevertheless, I would like to express my sincere gratitude to all the members of the Watershed and Landslide Management Division under DoFSC for their unwavering dedication and tireless efforts throughout this process. I also want to acknowledge the invaluable contributions of every individual and institution involved in this endeavor. Their expertise, support, and collaboration have been essential to achieving this progress.

Ganesh Poudel
Deputy Director General

Table of Contents

ACRONYMS AND ABBREVIATIONS

ACTO	American Cooperation Treaty Organization
ADB	Asian Development Bank
BMC	Basin Management Center
CBD	Convention on Biological Diversity
CEEP	Conservation Education and Extension Program
CCA	Climate Change Adaptation
DCRL	Developing Climate Resilient Livelihoods in the Vulnerable Watershed in Nepal
DFID	Department of International Development
DoF	Department of Forests
DNPWC	Department of National Parks and Wildlife Conservation
DoFSC	Department of Forests and Soil Conservation
DRRM	Disaster Risk Reduction and Management
DSCWM	Department of Soil Conservation and Watershed Management
EbA	Ecosystem based adaptation
FAO	Food and Agriculture Organization of the Unted Nations
FRTC	Forest Research and Training Centre
GEF	Global Environment Facility
GESI	Gender Equality and Social Inclusion
GEDSI	Gender Equity, Disability and Social Inclusion
GGI	Global Gender Gap Index
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Flood
GPS	Global Positioning System
IDB	Inter-American Development Bank
IRBM	Integrated River Basin Management
IWM	Integrated Watershed Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
LRMP	Land Resource Mapping Project
MAR	Managed Aquifer Recharge
MoFSC	Ministry of Forests and Soil Conservation
MoHA	Ministry of Home Affairs
MRC	Mekong River Commission
NbS	Nature Based Solutions
NGO	Non-Governmental Organizations

PAP	Public Audit of Project
PES	Payment for Ecosystem Services
PIF	Policy and Institutional Facility
RRA	Rapid Rural Appraisal
SCWM	Soil Conservation and Watershed Management
SLM	Sustainable Land Management
SALT	Sloping Agriculture Land Technology
SPS	Safeguard Policy Statement
SRTM	Shuttle Rader Topography Mission
SWMO	Soil and Watershed Management Office
UNDP	United Nations Development Programme
UNDRR	United Nations Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNISDR	United Nations International Secretariat for Disaster Reduction
WHO	World Health Organization
WM	Watershed Management

About The Book

Background

Department of Soil Conservation and Watershed Management (DSCWM) (Now: Department of Forests and Soil Conservation, DoFSC) recognized a need of guiding document to run the Soil Conservation and Watershed Management (SCWM) activities in Nepal and this recognition led to the preparation of a leading document called "Green book", consisting of the definition, objectives, scope and working strategy for SCWM activities, in 1991. Later, it was updated in 2001 (also known as White Book) and 2015 (Green Book White Book). The Department of Forests and Soil Conservation (hereafter synonymously used as "Department") felt the need of updating and revising of the Green Book White Book and accordingly initiated updating. This book is the 4th version of Green Book. It is a tool aimed at charting the desired direction that the soil conservation, watershed management and climate resilience should follow.

Why is this book ?

DoFSC and its federal field offices, along with the Soil and Watershed Management Offices (SWMO) at the provincial level, have been providing soil conservation, watershed management and climate resilience services based on the Green and White Books. Lately, this book was updated in 2015 and hence the updated version of book is required to address the changing and emerging issues to date. This book is needed to embrace essence of these documents and changing issues and challenges as well. In this context, this book is envisaged to be a guided document for SCWM and climate resilience programs/activities implementation in the field.

How was this book developed ?

This report was formulated with the update on previously available green book white book. The issues not well represented in the previous versions such as climate change and innovative approaches of watershed management are added to address the current issues faced during the implementation of watershed management and soil conservation activities. Financially, Developing Climate resilient Livelihood in vulnerable watersheds of Nepal (DCRL) project assisted for the successful updates and revision of books, with the technical and institutional support from the officials from DoFSC.

Who is this book for ?

The book "Soil Conservation, Watershed Management and Climate Resileince: Programs/ Activities" in Nepal includes all soil conservation, watershed management and climate resilience related programs and activities in the country. The major users of this book are professionals and technicians of soil conservation and watershed management, who plan or implement the activities in the field, either through the direct involvement of community

groups or through professional construction companies or non-governmental organizations (NGOs), depending on the sensitivity and complexity of the activities. Mainly, this book will be helpful to the field level offices and their units working in the soil conservation and watershed management for the planning and implementation of activities at watershed/ sub-watersheds level. The book is equally useful to the academics, researchers and other stakeholders working in the field of soil conservation, watershed management as well as climate resilience.

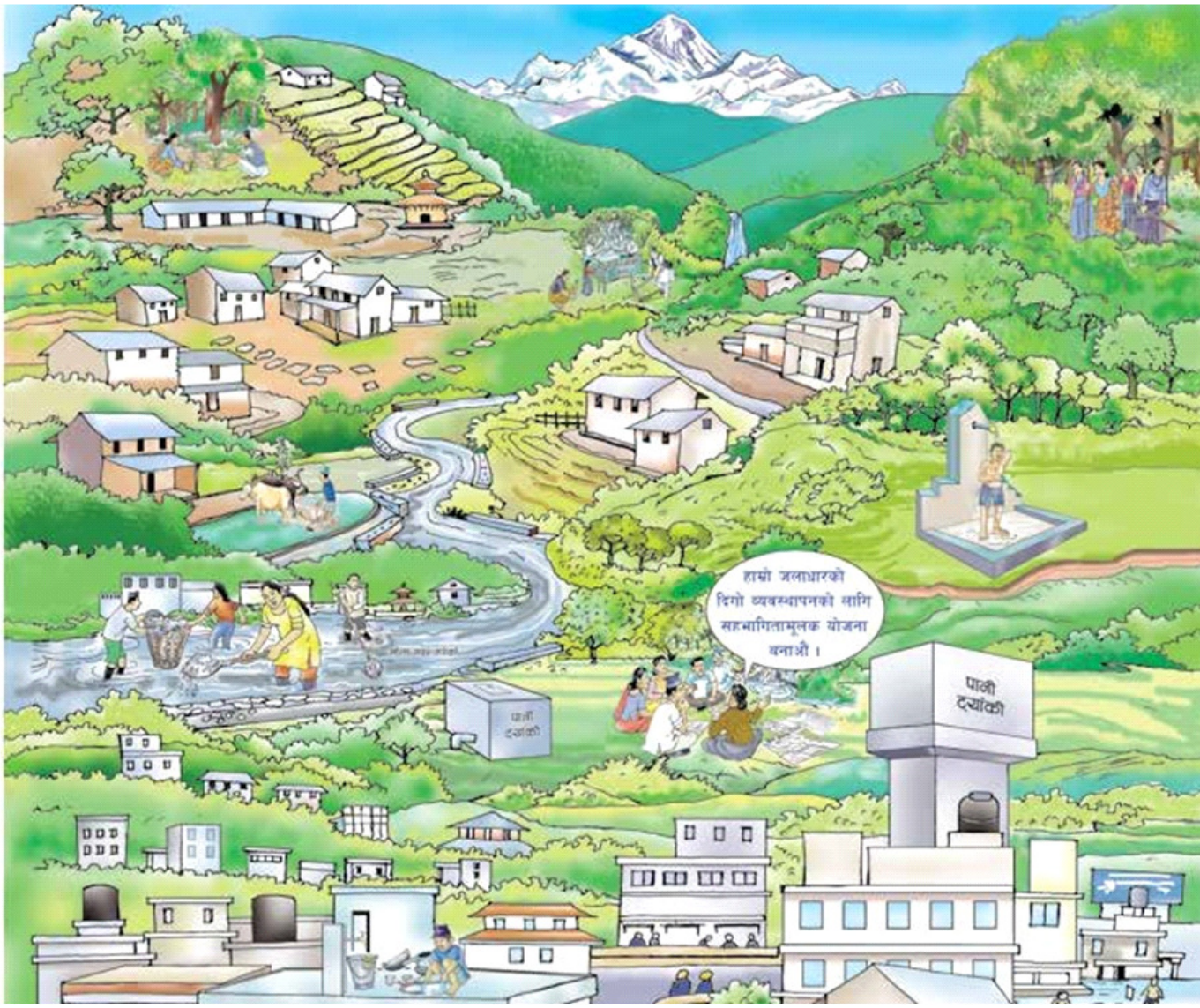
How to use this book in the best way ?

This book is divided into 4 Sections: SECTION 1: describes basic introduction of watershed management and climate resilience; SECTION 2: focuses on watershed management and climate resilience principles and practices; SECTION 3: focuses on watershed management planning; SECTION 4: focuses on soil conservation, watershed management and climate resilience programs/activities.

Feedback and Revision

This book will be periodically reviewed and updated to incorporate new knowledge generated in the field and address emerging issues in our domain, alongside the lessons learned from the implementation of SCWM and climate resilience activities.

1. INRODUCTION



1.1 Watershed Management

Watershed is the topographically differentiated land unit which drains into the common outlet. The volume of water collected within the watershed is collected on a common stream and is drained out of the hydrological system to the other. The term watershed and catchments are synonymously used. However, Gichuki & Tiffen, (1999) distinguished the terms as "catchment" being piece of land draining through a specific pathway to a common outlet point either artificial structures such as dams, water supply takeoff point, etc. or natural water bodies such as lakes, large rivers or sea and "watershed" being whaleback land unit with the hydrological linkages to lower part of catchments. Watershed is a hydrological unit that has been described and used as a bio-physical unit and, on many occasions, as a socio-economic-political unit for planning and management of natural resources.

Understanding the scale and scope of watersheds is crucial for effective management. Watersheds function within a nested hierarchy, where smaller units contribute to the dynamics of larger systems. Primarily they are classified based on their geometry and stream order. However, different countries and organizations have their own system of watershed classification. According to Darghouth et al., 2008 watershed classification is based on the size of the catchment and includes Micro- watershed, Sub- watershed, Watershed, Sub basin and Basin. Similarly, Negi, 2002, classified watershed based on the stream order with the same nomenclature. These classification helps to distinguish the units for the effective management of watershed resources.

Watershed management is a rational utilization of the land for optimum production with minimum hazard to natural resources. It includes the planning and implementation of course of action with the manipulation of watershed resources including land and water, to attain the goods and services provided by nature in a sustainable way. The process involves the consideration of social, economic and institutional factors within and outside of watershed boundaries (Sheng, 1990). Effective watershed management emphasizes the balance between ecological integrity and human development needs. It focuses on soil and water conservation, including sustainable land use practices that prevent degradation, maintain soil fertility, conserve water for farming, manage local water for drainage and flood protection, reduce sediment, and enhance productivity across various land uses.

1.2 Climate Resilience

The Intergovernmental Panel on Climate Change (IPCC) defines "Climate Resilience" as the capacity of social, cultural, economic, and environmental systems to endure hazardous events, trends, or disturbances by responding or reorganizing in ways that maintain their core functions, identity, and structure while fostering adaptation, learning, and transformation

(IPCC, 2014). Environmental systems, being highly sensitive to climate variations, are critical to the sustainable functioning of ecosystems and human communities. Climate change significantly impacts watershed dynamics, altering water availability and quality, disrupting ecological health, and affecting surrounding human populations. Key challenges include shifting precipitation patterns, rising temperatures, increased frequency of extreme flood events, and risks to biodiversity and essential ecosystem services. These challenges can undermine both the environment and the human populations that depend on these critical resources.

To address these challenges, Nepal's Second Nationally Determined Contribution (MoFE, 2020) emphasizes integrated watershed management as a strategy to enhance water security and build resilience against climate-induced hazards like floods and droughts. This includes promoting sustainable practices and developing climate-resilient infrastructure. Similarly, Nepal's National Adaptation Plan (MoFE, 2021) prioritizes watershed restoration and management to mitigate water stresses while fostering community-based adaptation and ecosystem conservation.

In this context, effective catchment management becomes indispensable. It necessitates a deep understanding of the interdependence between social, ecological, and economic systems, recognizing that these dynamics evolve across both temporal and spatial scales. Building resilience within catchments—defined as the ability to absorb disturbances, maintain critical functions, and adapt sustainably—offers a pathway to address the multifaceted challenges posed by climate change (Walker et al., 2009; Adger et al., 2021). By ensuring ecosystems can recover, reorganize, or transition to alternative regimes without compromising essential functions, catchment resilience safeguards water supplies, flood protection, and overall ecological health. Moreover, integrating social dimensions into this process is crucial for achieving holistic, sustainable governance capable of reinforcing resilience in the face of ongoing climate impacts.

1.3 Integrated Watershed Management

Watershed management provides the framework to implement the management alternatives bounded by the socioeconomic constraints, integrating the aspects of forestry, agriculture, hydrology, ecology, soils, physical climatology and other sciences (Achouri, 2005). The interaction of the watershed area with the other land units along with the interaction within the upstream and downstream of the watershed needs to be considered for effectiveness of management works. This integrity of management components ensures comprehensive management of land and water resources along with the goods and services obtained from the watershed.

Integrated Watershed Management (IWM) is the comprehensive planning and implementation of sustainable and participatory watershed management activities with the prompt identification of resources including the opportunities and issues associated with it. It emphasizes collaborative approach where various stakeholders including local communities, government agencies as well as non-governmental organizations play an active role in decision-making and implementation. It focuses on implementing watershed management programs/activities with the aim of land improvement, soil and water conservation, and forest management. This holistic approach allows organizations and stakeholders to consider the system in the context of the higher levels in which it is embedded and provide insight into the significance of phenomena at lower levels. This approach supports the integration of various soil and water management practices to achieve balanced and sustainable outcomes across different scales.

IWM deals with the management of natural resources along with community development and improving economic activities. Engaging local communities in watershed development programs leverages indigenous knowledge to address ecological imbalances and improve the effectiveness of management strategies. IWM emphasizes the necessity of an integrated approach for conserving, upgrading and using land, water, plant, animal and human resources. This integrated strategy ensures that environmental management is aligned with economic and social development goals, promoting overall sustainability. Therefore, the integrated watershed management approach has become an increasingly important concept in many mountainous countries, including Nepal.

1.4 Monitoring and Evaluation System

As per the basic principle of management, the implemented activities need to be monitored and evaluated for effectiveness and better performance. The implemented SCWM activities bear some uncertainties during the planning and implementation phase. The specific sources of uncertainties include initial field level information collection, issues during the field level work and change in the anticipated output due to working conditions. Because of these uncertainties, it is necessary to closely monitor and evaluate watershed management programs/activities. The effects of uncertainties on resources and environment, and impact on human welfare determine the necessity for changes in policies, practices and activities required to meet the desired goals.

Continuous monitoring provides early detection of potential issues, enabling prompt corrective actions and adjustment to improve the program effectiveness. This also ensures continuous maintenance of implemented activities such as land productivity conservation, natural hazard prevention and development infrastructure protection in the short term and sustainability of natural resources in the long term of the watersheds. Furthermore, the evaluation process

helps in identifying the best practices and lessons learned which can be used to improve future projects and enhance overall program effectiveness. To support adaptive watershed management, monitoring and evaluation of implementation, operation and maintenance, management and utilization and benefit sharing are integral parts of the DoFSC and associated offices. These monitoring and evaluation systems ensure comprehensive oversights and accountability, facilitating the continuous improvement of watershed management efforts.

1.5 Soil Conservation and Watershed Management in Federal Context

With the realization of the importance of SCWM activities in the disaster-prone areas of Nepal, the Department of Soil and Water Conservation was established in 1974 under the Ministry of Forests. The department continued to provide essential service in the name of Department of Soil Conservation and Watershed Management (DSCWM) with establishment of District Soil Conservation Offices (DSCOs) in 61 districts of Nepal.

The Constitution of Nepal 2015 serves as the foundational framework for conserving, managing, and utilizing environmental resources, including water. Clause 51 emphasizes poverty reduction and shared prosperity through integrated river basin management. Annex 5 to Annex 9 of the constitution of Nepal ensures a division of responsibilities along with the cross cutting issues among federal, provincial, and local governments for policymaking and the sustainable management of watershed resources. In line with this constitutional mandate, the 2018 “Organization and Management Study” recommended adopting a basin-based approach, replacing the existing political boundary-based approach, for implementing the SCWM program.

At the Federal level, the mandate of watershed management lies with the DoFSC. Watershed and Landslide Management Division of the DoFSC designs the programs of watershed management to be implemented by federal offices in different basins of Nepal. Whereas under the provincial level, respective SWMOs are established under the provincial line ministries responsible for forests and watershed management activities. The cross-cutting activities within provincial and federal offices are categorized as per the scales and are carried out independently.

Under the Department there are five field offices including one basin management center (BMCs) in Udaypur, Pokhara, Jajarkot and Baitadi for the Koshi, Gandaki, Karnali and Mahakali River basins respectively and Federal Watershed Management Resource Center (FWMRC) located in Kulekhani, Makwanpur District. FWMRC carries out watershed related research and demonstrates watershed management technologies and conducts extension program of soil conservation and watershed management. Federal level offices such as

DOFSC, BMCs, and FWMRC and Provincial level SWMOs have multi-disciplinary staff with expertise in forestry, agriculture, and engineering, to provide the services necessary to carry out IWM programmes.

Local governments play a crucial role in effective watershed management by formulating policies focused on water and soil conservation, climate adaptation, and sustainable land use. They develop integrated sub-watershed plans, coordinate with stakeholders, and implement conservation measures like erosion control and water-saving technologies. They are tasked with implementing soil and water conservation measures and climate change adaptation strategies tailored to local needs. Additionally, local governments act as critical feedback mechanisms, providing insights to provincial and federal authorities, refining policies, norms, and guidelines to ensure adaptive, sustainable watershed management aligned with broader environmental goals.

2. WATERSHED MANAGEMENT PRINCIPLES AND PRACTICES

2.1 Principles of Watershed Management

Watershed management is based on the basic principle of management of resources in a sustainable way to attain substantial watershed services. The major principles of watershed management adopted in Nepal have been described in this section.

2.1.1 Participatory Approach

Participatory watershed management is a key approach that empowers local communities to actively engage in the management and conservation of their watershed resources, ensuring more sustainable and contextually appropriate outcomes. By involving a diverse range of stakeholders, individuals, groups, and institutions—this approach ensures that local issues, which directly impact watershed functions, are identified and addressed effectively. Proponents argue that involvement of local stakeholders results in more locally relevant solutions that consider each community's unique social, economic, and environmental conditions and values. Effective community engagement fosters collaboration among diverse groups, leading to more holistic and sustainable management practices. Stakeholder participation fosters a sense of local ownership over identified issues and solutions, promoting sustained support for management plans. Furthermore, this involvement helps to build capacity within communities to address future challenges and adapt to the changing conditions. Since 1974, participatory watershed management projects in Nepal have positively impacted the success and sustainability of watershed programs.

2.1.2 Multidisciplinary Approach

A multidisciplinary approach in watershed management involves integrating knowledge and methods from various disciplines, such as watershed management, hydrology, forest management, ecology, agriculture, and socio economics—to address the complex and interconnected challenges of managing watersheds. Watersheds are complex ecosystems where water, soil, vegetation, and human activities interact dynamically. Addressing the diverse issues within a watershed, from water quality and erosion control to habitat conservation and sustainable land use, requires input from multiple disciplines. By drawing on diverse expertise, a multidisciplinary approach ensures comprehensive planning, improves decision-making, and enhances the resilience of watersheds to disturbances such as climate change and land-use changes.

2.1.3 Upstream and Downstream Linkages

Watershed management emphasizes the interconnectedness between upstream and downstream areas, recognizing that actions taken in one part of a watershed can directly impact other areas, often in unexpected ways. In Nepal, where diverse topographies and climates contribute to complex water and sediment dynamics, managing these linkages is

essential. Upstream activities such as deforestation, agriculture, and construction can accelerate erosion and reduce water quality, leading to increased sediment and pollutant loads that flow downstream, affecting drinking water, agriculture, and habitat. As watershed resources degrade, conflicts between upstream and downstream users of land, forests, and water intensify, highlighting that long-term protection of downstream riverbanks depends on sustainable management of upstream watershed resources.

An effective approach to managing these upstream-downstream linkages is the Payment for Ecosystem Services (PES) mechanism, where downstream "beneficiaries" compensate upstream "providers" for maintaining essential environmental services. There is increasing interest in such incentive-based mechanisms with growing demand for food, drinking water and energy combined with pressure on natural resources. For a payment scheme to succeed and endure, the actions and changes brought by upstream land and water managers should result in identifiable benefits for downstream water users. Therefore, clear cause-and-effect relationships between upstream land and water use practices and the provision of watershed services for downstream users need to be identified.

In Nepal, the PES of watershed system is implemented formally for the supply of drinking water from the upstream (remote villages) to the downstream of highly populated areas, examples includes Sundarijal water supply project for Kathmandu valley, Kathmandu Upatyaka water supply project for Kathmandu valley, Dhulikhel water supply project for Banepa and Dhulikhel in Kavrepalanchowk district, etc. Similarly, the watershed inhabitants are getting PES from large projects of Nepal Electrical Authority (NEA) for the conservation and development of the upstream watershed area of the project such as Kulekhani watershed in Makawanpur district.

2.1.4 Top-down and Bottom-up Approach

The top-down and bottom-up approaches to watershed management provide different ways to address environmental issues and include stakeholders. The top-down strategy involves decision-making by government bodies or international organizations, which set policies and regulations to manage the watershed. This approach ensures resource allocation for large-scale initiatives and consistency in long-term planning. Lack of enough local involvement makes communities feel left out of the decision-making process. On the other hand, the bottom-up strategy places more emphasis on local involvement and gives communities the tools they need to actively manage their resources. Using local expertise and encouraging a sense of responsibility, this strategy can result in more pertinent and flexible management techniques. However, it might run into problems with scarce resources and competing local interests. Hence, combining both approaches enhances watershed

management by grounding plans in scientific knowledge while addressing local needs. This integration ensures more effective, inclusive, and adaptable management strategies.

2.1.5 Adaptive Management

Adaptive management is a flexible, iterative approach to resource management that emphasizes learning from experience and adjusting strategies based on new information and changing conditions. It involves assessing the effectiveness of management interventions—such as erosion control, water quality improvement, and habitat restoration—through regular data collection and stakeholder input. As conditions evolve, such as shifts in climate patterns, land use, or community needs, management practices are adjusted to ensure the sustainability of the watershed's resources, improve ecological health, and enhance resilience to natural disasters like floods and droughts. This dynamic process allows for the incorporation of uncertainty and complexity, ensuring that decisions remain relevant and responsive to evolving environmental, social, and economic factors, ultimately enhancing resilience and sustainability. By implementing incremental interventions and using decision support tools like models and GIS, adaptive management reduces risks, improves sustainability, and ensures that watershed management remains effective and resilient to evolving conditions.

2.1.6 Environmental and Social Safeguards

Environmental and social safeguards in watershed management are crucial for preserving ecosystem integrity, conserving biodiversity, promoting sustainable resource use, and protecting the rights and livelihoods of local communities. These safeguards are designed to prevent the negative, often irreversible, impacts of unregulated development within watersheds, which are vital ecosystems that provide essential services. Environmental safeguards address issues such as deforestation, soil erosion, and water pollution, focusing on biodiversity conservation and sustainable land and water management. Social safeguards, on the other hand, ensure inclusive development by involving local communities in decision-making, protecting livelihoods, and resolving resource-use conflicts.

The integration of these safeguards is key to balancing development with conservation, promoting ecological resilience, and supporting community well-being. Environmental safeguards protect ecosystem integrity by addressing risks like deforestation and water contamination, while social safeguards promote equity by respecting indigenous rights and fostering local involvement. Together, these strategies mitigate both environmental and socio-economic risks, enhancing adaptive capacity in the face of climate change and development pressures. This holistic approach ensures the long-term sustainability of both natural resources and community livelihoods.

2.1.7 Gender Equity, Disability and Social Inclusion (GEDSI)

Gender equity, disability inclusion, and social inclusion are essential principles of watershed management in Nepal to ensure equitable access to resources and decision-making processes for all community members. Women, people with disabilities, and marginalized groups often face barriers to participation and resource access in rural areas. Promoting gender equity involves ensuring women's involvement in decision-making and addressing their specific needs, while disability inclusion focuses on making infrastructure accessible and ensuring participation of people with disabilities. Social inclusion ensures that marginalized communities have equal opportunities in resource management and benefit equally from watershed projects.

Integrating GEDSI principles fosters sustainable, resilient, and equitable watershed management, benefiting both ecosystems and communities in the long term. GEDSI strategies in watershed management ensure that all community members, regardless of gender, disability, or socio-economic status, are able to both contribute to and benefit from the resilience and health of watershed ecosystems. These inclusive policies facilitate equitable participation, enabling diverse groups to engage in decision-making processes and resource management. By promoting such inclusiveness, GEDSI strategies enhance the long-term sustainability of watershed ecosystems, while simultaneously improving both social and environmental well-being, thereby strengthening the overall resilience of the system.

2.2 Watershed Approach for Climate Resilience

Climate change is exerting increasing pressure on ecosystems and socio-economic systems, particularly in Nepal's vulnerable landscapes. Rising temperatures, altered precipitation patterns, and more frequent extreme events like floods, landslides, and droughts are destabilizing watershed hydrology. To address these challenges, watershed management must prioritize climate resilience through adaptive land-use practices, enhanced water storage systems, and the integration of predictive climate models. These strategies are vital for maintaining hydrological stability, protecting ecosystems, and reducing disaster risks.

An effective approach to climate-resilient watershed management requires sustainable use and conservation of water and land resources. Combining natural and socio-economic systems is key to minimizing climate change impacts and ensuring successful adaptation. Community involvement is crucial for long-term resource stewardship, while strengthening climate-resilient infrastructure and improving water governance will promote equitable water distribution and support both environmental sustainability and social well-being across regions.

2.2.1 Ecosystem Resilience

Ecosystem resilience in the context of the "Watershed Approach for Climate Resilience" refers to the capacity of watershed ecosystems to absorb and recover from climate-related disturbances, such as altered rainfall patterns, temperature fluctuations, and extreme weather events. This resilience is bolstered by integrating natural and human systems within the watershed, prioritizing the restoration of degraded habitats, enhancing biodiversity, and strengthening ecosystem services like water purification, flood regulation, and soil stabilization. Specific interventions, such as reforestation, wetland restoration, and sustainable land-use practices, enhance the watershed's ability to mitigate climate impacts, protect water resources, and support local communities' adaptive capacity. By adopting a watershed-scale approach, it ensures that both upstream and downstream ecosystems are connected, enabling a more holistic and effective response to climate change. In Nepal, this can be enhanced by integrating sustainable land and water management practices within watershed management plans, ensuring the protection of riparian zones, promoting agroforestry, and restoring degraded ecosystems.

2.2.2 Climate Resilient Livelihood

Climate Resilient Livelihoods in a watershed approach focus on sustainable water and land management to help communities adapt to climate change. This includes diversifying incomes, promoting climate-smart agriculture, conserving ecosystems, and using efficient water and soil conservation practices. It emphasizes community participation, capacity building, disaster risk management, and access to financial tools like micro-insurance. By protecting natural resources and improving resilience, this approach supports long-term livelihood security in the face of climate impacts.

2.2.3 Nature-based Solution (NbS)

Nature-based Solutions (NbS) in watershed management are approaches that leverage natural processes to address environmental challenges such as water scarcity, erosion, and habitat degradation. They involve actions to protect, sustainably manage, and restore both natural and modified ecosystems to address societal challenges like climate change, biodiversity loss, and food security, while simultaneously providing benefits for ecosystem resilience and supporting biodiversity in an effective and adaptive manner. In Nepal, where diverse ecosystems face increasing pressure from deforestation, climate change, and unsustainable land use, NbS offers a sustainable pathway to restore degraded watersheds, maintain water resources, and reduce flood and landslide risks. Implementing NbS as a guiding principle in Nepal's watershed management can strengthen local communities' resilience, promote sustainable livelihoods, and ensure the long-term health of vital water resources in the country's varied landscapes.

2.3 Watershed Management Practices

Recent decades of practice of watershed management in Nepal has adopted the advancements in the field of watershed management. DoFSC has adopted a holistic approach in its catchment management activities, incorporating diverse variables and concepts. This approach builds insights from past implementations and addresses new knowledge and emerging issues in the field. Few of those approaches and practices are described in the sections below.

2.3.1 Protected Watershed

A protected watershed is an area designated for controlled land-use practices to safeguard water quality, reduce sedimentation, and enhance landscape stability, especially vital in Nepal's fragile topography. These areas prevent overexploitation of watershed resources by limiting activities such as deforestation, overgrazing, and intensive agriculture, which, if unchecked, can lead to soil erosion, flash flooding, and reduced water availability. The fundamental idea is to preserve both the quality and quantity of watershed resources, which is accomplished by adopting rational land use and avoiding actions that can cause contamination or deterioration of the water quality.

The viability of protected watershed depends on striking a balance between conservation and human use, protecting ecosystem services vital to human well-being and resilience to environmental change while guaranteeing the preservation of water resources for future generations. Challenges include limited community involvement in planning, gaps in enforcement, and constrained financial resources, all of which can affect effective implementation. Moreover, without adaptive management practices, protected watersheds may face difficulties in remaining resilient as climate conditions continue to evolve. Thus, while protected watersheds are an essential component of Nepal's water resource management, achieving their full potential requires integrating community participation, consistent funding, and flexible management practices that can respond to evolving environmental pressures.

2.3.2 Water-Induced Disaster Risk Reduction (WIDRR)

Disaster Risk Reduction is the course of action undertaken to strengthen resilience to attain sustainable development by preventing future disasters, reducing existing disaster risk and managing the residual risk (UN General Assembly, 2016). Whereas Disaster Risk Management (DRM) is disaster risk reduction with the inclusion of reduction of disaster losses. Higher frequency of occurrence of disaster, necessitates the introduction of DRR or DRM. To effectively address this challenge, crisis management must be replaced with a proactive risk management approach that focuses on preparedness, mitigation, prediction, and early warning (Sivakumar et al., 2002).

Given Nepal's susceptibility to a range of geophysical, hydrological, climatic, and biological hazards—such as landslides, floods, cloud bursts, droughts, and forest fires—effective disaster risk management must include watershed management as a critical component. Proper management of watersheds can significantly reduce the risk of flooding and landslides, which are prevalent in the country. Integrating watershed management with disaster risk reduction strategies can help mitigate these risks and enhance overall resilience. Nepal's current landscape of disaster governance is guided by its Constitution (2015 AD) and the Disaster Risk Reduction and Management (DRRM) Act (2017 AD). These frameworks emphasize the need for an integrated approach to disaster risk management, incorporating both preventive and responsive measures at all levels of government.

2.3.3 Watershed Management for Resilient Infrastructure

Watershed management is a key strategy for ensuring resilient infrastructure, particularly in the face of mounting challenges posed by unplanned infrastructure development, climate change, and frequent environmental disturbances like floods, landslides, and erosion. Infrastructure resilience is often treated in isolation, neglecting the interconnectedness of water, land, and community livelihoods. A more comprehensive, context-specific approach is needed—one where watershed management not only aims to prevent environmental degradation but also fosters adaptive strategies that align with Nepal's socio-economic realities and future climate scenarios. Key activities in this field focus on managing the land-water interface in fragile hill and mountain ecosystems, which are vital to the nation's hydrology and infrastructure resilience.

Priorities include the restoration of degraded watersheds, road slope stabilization and sustainable land management practices. Community-based watershed management practices, such as gully control, checking dams, and reforestation, play a significant role in reducing soil erosion and improving water retention capacity, ultimately safeguarding roads, hydropower projects, and urban infrastructure. To truly enhance resilience, watershed management must go beyond short-term solutions, promoting long-term adaptive strategies that address both environmental and socio-economic challenges.

2.3.4 River and Riverine Landscape Management

Managing rivers and riverine landscapes in Nepal is essential for sustainable watershed management, focusing on reducing erosion, minimizing sediment loads, and safeguarding water quality and aquatic habitats. Given Nepal's mountainous terrain and intense monsoon rains, riverine areas are highly susceptible to rapid geomorphic changes, which can lead to severe soil loss, landslides, and flooding downstream. These impacts compromise agricultural productivity, infrastructure stability, and community livelihoods, highlighting the

need for proactive river management. Countering these impacts requires implementation of an integrated approach of watershed management. Key practices include stabilizing riverbanks, restoring native riparian vegetation, maintaining ecological flow, implementing sediment retention structures, restoring natural river flows and flood plain, and coordinating upstream-downstream management efforts. Without these measures, unmanaged riverine areas risk degradation due to increasing pressures from land-use changes and hydropower development, further disrupting natural flow regimes and sediment transport. Thus, to achieve sustainable outcomes, river and riverine landscape management in Nepal must adopt an integrated approach that combines structural measures with ecosystem-based practices while ensuring active community engagement.

2.3.5 Water Recharge and Springshed Management

Springs are the outflow of groundwater to the surface naturally, which depends upon the geology of any area. The location of rock pores, fissures, fractures or depressions along with the water bearing capacity of underlying layers, called aquifers, determines the rate of discharge through springs (Shrestha et al., 2018). Spring shed is like a surface-water watershed as it follows pressure gradient, with groundwater flowing from areas of high to low hydraulic pressure. The boundary of the spring shed is determined by geological formations and the locations of fractures and fissures that guide groundwater flow.

The concept of spring-shed management has emerged to address the issue of drying and degradation of springs. Groundwater in the form of mountain springs ensures water security for most of the rural population. Drying of these springs is an emerging issue in the region because of which communities are facing unprecedented water stress. Climate change, land use change, deforestation in the upper catchments, and infrastructure development such as road construction, tunneling etc. are the major causes of this stress.

To address the depletion of groundwater resources, ensuring effective water recharge is essential for securing a continuous and reliable extraction of groundwater. To address the challenges of depleting ground water resources, innovative water recharge techniques such as rainwater harvesting, managed aquifer recharge (MAR), and the restoration of natural recharge areas are being explored. Artificial techniques involve construction such as the recharge wells, infiltration basins, and percolation ponds. Effective spring-shed management involves understanding the recharge zones in the hills, protecting the aquifers that feed the springs, and ensuring the proper functioning of discharge areas. This involves study and management activities (spring baseline study, discharge measurement, spring selection, identifying the spring shed area, spring development, aquifer recharge and water quality and spring source protection) essential for better conservation of resources (Asian Development Bank, 2020).

2.3.6 Wetland Management

Wetlands in Nepal provide essential ecosystem services such as water filtration, flood regulation, biodiversity conservation, groundwater recharge, and recreational opportunities. However, these ecosystems are increasingly threatened by land use changes, agricultural expansion, deforestation, and encroachment, which negatively impact water quality and availability. Effective wetland catchment management is crucial to preserving these services by regulating land use and controlling runoff within upstream catchments. This targeted approach ensures that wetlands maintain their ecological functions, even in the face of growing human populations and climate change.

Key strategies for successful wetland catchment management include establishing riparian buffers, reforesting degraded areas, regulating grazing, and mitigating pollution. These measures help stabilize soil, reduce sedimentation, and improve water quality. By managing wetlands' upstream catchments, flood peaks can be moderated, biodiversity conserved, and groundwater recharge enhanced. Additionally, wetland areas can continue to support recreational activities like bird-watching and eco-tourism, contributing to local economies and raising awareness of wetland conservation. Effective management ensures the long-term sustainability of these vital ecosystems.

2.3.7 Hydro Catchment Management

Hydro Catchment management plays a critical role in integrated watershed management, particularly in safeguarding the capacity of hydropower dams. Sedimentation in reservoirs significantly affects water storage and generation capacity. This issue is well-documented in Nepal's Kulekhani Reservoir, where severe sedimentation was observed during and after the 1993 monsoon. That year, a disastrous storm caused the reservoir's gross capacity to decrease by 12.89 million m^3, with 5.13 million m^3 added in a single event. A further 1.07 million m^3 accumulated during the 1994 monsoon. These alarming rates of sediment deposition underscored the urgent need for effective sediment management practices to sustain the reservoir's capacity.

Effective management maintains both the hydrological and ecological integrity of the watershed, ensuring the long-term performance and resilience of these systems. To mitigate sedimentation, strategies should focus on reducing sediment inflow through comprehensive watershed conservation practices. Key measures include reforestation and grass planting on degraded lands, the introduction of fruit trees, on-farm conservation techniques, construction of sediment retention ponds, stabilization of road slopes, protection of irrigation canals, improvement of trails, and the stabilization of gullies and landslides. Additionally, torrent control, stream bank stabilization, and erosion prevention are vital for hydro catchment

protection. Integrated watershed management strategies must therefore address both sedimentation control and the enhancement of infrastructure resilience against high-intensity floods and droughts, ensuring the long-term sustainability of hydropower operations.

2.3.8 Dryland Management

Almost 41% of the land surface is covered with Drylands cover with 38% of the total population relying on these land units, globally (Reynolds et al., 2007). The drying up of land and drought is associated with the land degradation process which is regarded as a prominent challenge worldwide. IPBES, 2018 reported that global land degradation through human activities negatively impacts the well-being of at least 3.2 billion people, pushing towards the sixth mass species extinction and costing more than 10% of the annual global gross product in loss of biodiversity and ecosystem services.

Persisting droughts in dryland regions exacerbate vulnerabilities, particularly in areas with water stress and limited adaptive capacity, highlighting the urgent need for drought risk reduction. Current dryland management practices in Nepal are reactive, focusing on crisis response and addressing only the symptoms of drought, rather than the root causes of vulnerability. To effectively manage drylands, it is essential to integrate drought risk reduction strategies within a broader framework of water resource management and land use planning. Practices of drought risk reduction include essential water conservation activities like contour trenching, conservation ponds, and conservation plantations. In the Lower Dudhkoshi watershed, the Developing Climate Resilient Livelihood in vulnerable watersheds of Nepal (DCRL) project, funded by the Global Environment Facility (GEF), aims to address climate change impacts in drought-prone areas. Dryland management initiatives are proving effective in enhancing resilience and sustainable dryland management in Nepal

2.3.9 Urban Watershed Management

The rapid urbanization coupled with inadequate infrastructure development exacerbates the stress on existing watershed systems and contributes to environmental degradation. As populations, buildings, infrastructure, and industries become more concentrated in urban areas, the risk of water-induced disasters is expected to rise. In Nepal, urban watershed management focuses on the strategic planning and implementation of practices designed to protect and sustainably manage watershed resources within urban catchments. With rapid urbanization and increasing pressure on natural resources, urban watersheds are highly vulnerable to issues such as pollution, land degradation, and altered hydrological regimes. They often face challenges such as inadequate storm water infrastructure, encroachment on floodplains, and pollution from industrial and residential runoff.

Effective urban watershed management is essential to mitigate flood risks, improve water quality, and preserve ecosystems in the face of urban sprawl. This requires a multifaceted approach that integrates land use planning, sustainable drainage systems, and community engagement to reduce environmental degradation and improve water quality. Effective and integrated management of urban watersheds is essential for tackling the increasing challenges of both water scarcity, such as drinking water shortages, and excessive water, like flooding, in urban areas. This approach helps balance water supply and flood control, enabling cities to better manage these growing issues. Well-managed, healthy watersheds provide crucial goods and services to both urban and rural populations, playing a key role in sustaining urban life and improving overall resilience.

2.3.10 Mountain Watershed and Cryosphere Management

Mountain watershed and cryosphere management is critical for sustaining freshwater resources and preserving ecosystem services in high-altitude regions. Snowpack in mountain ecosystems act as natural reservoirs, gradually releasing freshwater that supplies rivers, aquifers, and agricultural systems. These snowpack play a vital role for maintaining water supply, supporting agriculture, and generating hydropower, particularly in areas where river systems are heavily dependent on glacial melt water. In the context of climate change, mountain watersheds face accelerated snow and glaciers melt, disrupting traditional water cycles and threatening both local and downstream water supplies. Additionally, the complex topography and fragile ecosystems of mountain watersheds make them highly susceptible to soil erosion, landslides, and flooding, which are exacerbated by unsustainable land-use practices such as deforestation and agriculture on steep slopes.

Effective management must therefore prioritize monitoring cryosphere changes, safeguarding snow as a vital freshwater source, and implementing adaptive watershed management practices. These may include enhancing vegetation cover to reduce erosion, restoring natural water flow pathways, and fostering sustainable land-use practices that protect soil health. Comprehensive strategies are essential for building resilient mountain ecosystems, as these regions are not only ecological hotspots but also critical sources of freshwater for millions of people downstream. These strategies not only help in the conservation of water resources but also contribute to disaster risk reduction, biodiversity preservation, and the resilience of local communities.

2.3.11 Livelihood Improvement opportunities

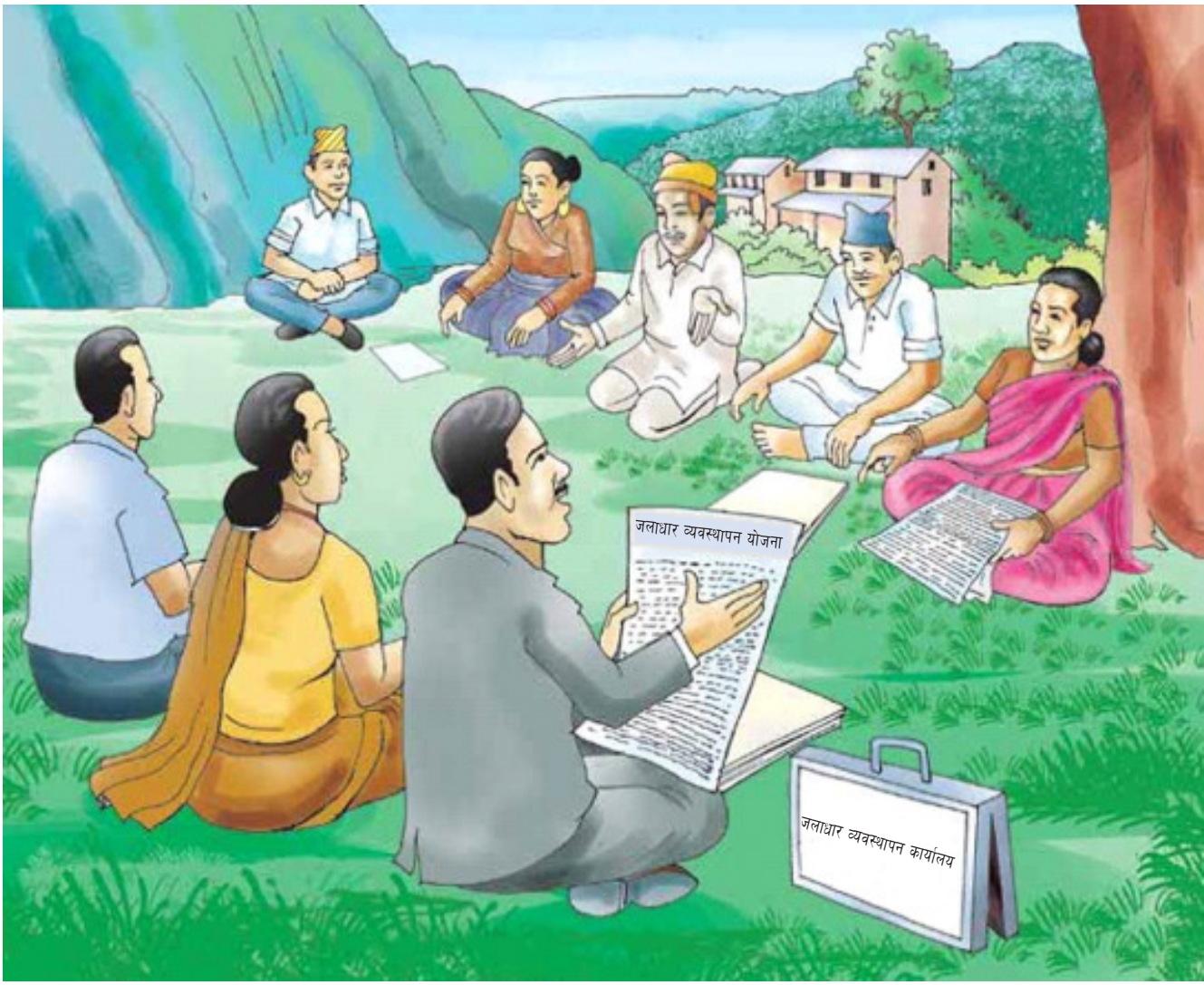
Soil conservation, watershed management, and climate resilience play a crucial role in improving livelihoods through sustainable resource use and environmental protection. Soil conservation practices, such as terracing and agroforestry, enhance agricultural productivity

by preventing erosion and improving soil health, leading to higher crop yields and more stable incomes. Effective watershed management ensures a reliable water supply, supports irrigation, and mitigates the risks of floods and droughts, directly benefiting farmers and communities. Climate resilience strategies, like diversifying crops and improving water storage, help communities adapt to changing weather patterns, safeguarding livelihoods against climate shocks. Together, these approaches create sustainable income sources, reduce poverty, and empower local communities to manage their natural resources, ensuring long-term economic stability.

2.3.12 Agriculture / land productivity enhancement

Enhancing agriculture and land productivity is crucial for effective watershed management and climate resilience. Sustainable practices such as soil conservation, efficient irrigation, agroforestry, and climate-smart agriculture improve soil health, water use efficiency, and biodiversity, reducing the risks of erosion, flooding, and drought. These approaches promote carbon sequestration, restore degraded lands, and increase agricultural productivity, helping communities adapt to climate change. By integrating agriculture with watershed management, these practices ensure long-term food security, safeguard natural resources, and strengthen ecosystem resilience, ultimately fostering both local and global climate adaptation and mitigation efforts.

3. WATERSHED MANAGEMENT PLANNING



Planning is the foremost step towards watershed management. It helps to identify the existing issues, prioritize the problems and implementation of necessary activities to solve the problems. Identification of issues includes the selection of watersheds and gathering the information from primary and secondary sources. Prioritizing includes the identification of key issues, and resources available for implementation of activities and identification of potential measures for solving the existing problems as well. Similarly, implementation includes the construction of structures, plantation and human resources development along with the monitoring and evaluation works. Some of the basic steps towards watershed planning are described in this section.

3.1 Watershed Prioritization

After the identification of watersheds to be considered for watershed management activities, prioritization of the sub catchments with the catchments are carried out. The complexity of various systems within the watershed accompanied by the resource constraints makes it difficult to implement the SCWM activities on the entire catchment. Hence the concept of disaggregating the watershed into the sub watershed for effective management was implemented by DoFSC. The extent of deterioration in the different sub catchments differs within, based on the land use practice, geomorphology and vulnerability to disaster risk. The prioritization of sub watersheds is made based on biophysical and socio-economic conditions and vulnerability of sub watersheds towards disaster risk of the watershed. This approach of watershed prioritization has been adopted to develop further management plans of the prioritized catchments, and to create watershed-based projects. The criteria for watershed prioritization vary depending on the project's objectives. For biodiversity conservation projects, the focus should be on biophysical vulnerability components. In contrast, for hydropower projects, priority should be given to factors such as sedimentation and the resilience of infrastructure.

3.2 Process of Watershed Management Planning

After prioritizing sub-watersheds within the entire catchment, detailed watershed management plans are developed for the selected areas. The process of watershed management involves several systematic steps aimed at sustainable resource management within a watershed. This comprises setting up objectives, defining the rationale for planning, data collection from primary and secondary sources, analysis of problems and formulation of plans for implementation of the project. These processes are iterative and continue till the objective of watershed management is met. This iterative process ensures that watershed management planning is adaptive, inclusive, and geared toward long-term sustainability.

3.2.1 Rationales for Planning

Three important components of watershed planning include watershed resources assessment, people's needs assessment, and implementation capacity. Watershed resource assessment involves evaluating the condition and health of the watershed including its physical, biological, and socio-economic characteristics to understand its current condition and potential problem. The process includes identifying issues like soil erosion, water availability, land use patterns and ecological health using various methods and technologies to address such environmental issues. People's needs assessment incorporates the views of the people and other agencies involved in the field of soil conservation and watershed management in the planned area. Implementation capacity exhibits the planning that can be implemented with the existing human resources, financial resources and state of technology.

Watershed resources assessment is generally a top-down approach of planning, whereas people's needs assessment is a bottom-up approach of planning. Institutional capacity and local knowledge of watershed and water resource management are the realistic aspects of planning and management of watersheds which can establish the bottom-up process. When the institutional capacity is sensitive to the other two components, the plan has a higher probability of success. Very often a plan is a compromised set of intersections of these components.

3.2.2 Objective Setting

Once the issues are clearly defined, the next task is to establish specific, measurable objectives. As described in the previous sub section, various watershed-based projects are based on different goals. Setting up goals/ objectives is crucial for guiding the management activities in a direction. This objective is the outcome of the problems, such as disaster, land degradation, biodiversity depletion, value of infrastructures, etc. in the watershed. Objectives provide a clear framework for the planning process, ensuring that interventions are targeted and effective in achieving long-term sustainability for the watershed and its communities. Some of the key objectives suited for setting are listed below.

- To prepare land use development and improvement plans based upon scientific land capability.
- To protect life and property from natural hazards.
- To lengthen the economic life of development infrastructures such as roads, irrigation canals, dams, reservoirs, lakes, etc.
- To develop knowledge and skills to raise the level of community awareness and participation in conservation activities.

- To enhance the resilience of the ecosystem and community against environmental changes and emerging climate risks by incorporating adaptive management practices.

3.2.3 Data Collection (Watershed Characterization)

The data is collected depending upon the resources available for planning and extent to which data are required to meet the objectives. A detailed socio-economic survey and aerial photo interpretation using Geographical Information System (GIS) and Remote Sensing (RS) along with other geographical information are carried out at places where resources are available. When resources are not sufficient to carry out socio-economic surveys and aerial photo interpretation, data should be generated from secondary data sources. Secondary sources of data include national databases such as Survey Department, Department of Hydrology and Meteorology (DHM) and Land Resource Mapping Project (LRMP) and international databases such as FAO, World Bank, SRTM, ICIMOD, etc. Data from sources like LRMP provides the basis for watershed resources assessment and RRA helps in the people's needs assessment. Data on water management, livelihood resources, climate vulnerability, and disaster risk reduction should be collected.

3.2.4 Data Analysis

Classification/analysis of data is carried out for assessment of watershed resources, people's needs and implementation capacity. Watershed resources assessment generally involves ranking the sub-watersheds in terms of vulnerability and importance. A composite map is prepared by overlaying land utilization and land system maps from the sources as LRMP and the areas are classified as high, medium and low erosion status. Some other methods such as soil loss estimation, erosion hazard classification, disaster risk assessment, and vulnerability analysis and land capability classification can be applied. Guidelines for these methodologies are available in archive of DoFSC. DoFSC encourages assessment of watershed resources by using the technique of classifying the areas as high, medium and low vulnerability status and ranking the sub-watersheds-based watershed condition.

Information displayed in maps provides visual presentation. Maps showing elevation, land use, land system, soil classification, and stream network provide necessary information on hydrological water balance. Major data can be presented individually showing some necessary information such as population distribution, water sources distribution, major infrastructures (Roads, Irrigation canals, buildings, etc.). Since these maps also are drawn up to a scale, their spatial relations have quantitative as well as qualitative representation. Key issues and opportunities within the sub watershed boundary are identified during this phase with the insight of types of activities to be implemented.

3.2.5 Plan Formulation

Identification of key issues and opportunities facilitates the choice of activities for effective watershed management. The adoption of these activities is constrained by the resources available, both in terms of cash and kind, and scale of the activity. The technical specifications, including the costs for the individual activities, need to be estimated and reported. The formulation of plan includes the documentation of the key issues and respective actions for reduction of impacts raised. These plans are periodically reviewed and updated as per the progress of watershed management including the monitoring and evaluation mechanism. The consequences and feedback, both positive and negative, need to be analyzed thoroughly for individual activities.

3.3 Level of Watershed Management Planning

The objective and goals of SCWM activities can be achieved by the rational allocation of resources such as manpower, technology and finance. A plan shows the nature and magnitude of the problems lying within the scope of the DoFSC objectives and the intended hierarchy of planning. Effective planning at each level requires a thorough understanding of local conditions and stakeholder needs, ensuring that the resources are utilized efficiently and equitably. The problem analysis should clearly explain the components and their elements based on which planning process is formed. Effectiveness in the planning can be achieved with the implementation of activities as per the available resources. This can be assured with the selection of appropriate scale/level of watershed. Irrespective of scale/ level of watershed planning, monitoring and evaluation is crucial for effective watershed management. Some of the commonly adopted levels of watershed planning include:

3.3.1 Basin/Sub Basin Level Planning

River basins are the higher level of classification of watersheds considered for Integrated Watershed Management (IWM). Integrated River Basin Management (IRBM) is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, to maximize the economic and social benefits derived from watershed resources in an equitable manner. It intends to preserve and restore the freshwater ecosystem as well. River basin management plans are management tools for IRBM which contain descriptions of the water resources in a drainage basin and water allocation plans. These plans also address regional hydrological trends and socio-economic impacts to guide the sustainable use and conservation of water resources. IRBM provides strategic insight on management of resources available within the watershed.

3.3.2 Watershed Level Planning

Watershed falls under the second level of the hierarchy in the classification of watersheds. Watershed management is an adaptive, comprehensive, integrated multi-resource management planning that seeks to balance healthy ecological, economic, and cultural/ social conditions within a watershed. Watershed management integrates land and water planning, focusing on the interconnected relationships between water, plants, animals, and humans within the hydrological boundaries of a watershed. Watershed management provides a framework for integrated decision-making to help assess the nature and status of the watershed, identify watershed issues, define and re-evaluate short and long-term objectives, actions and goals, assess benefits and costs, and implement and evaluate actions. Adaptive management strategies are essential to respond to evolving environmental and socio-economic conditions and ensure that objectives are met effectively. These plans provide insight on regional to provincial level strategies for integrated watershed management.

3.3.3 Sub-watershed Level Planning

Sub watershed management is the process of creating and implementing plans and programs to sustain and enhance the natural resources and functions of a sub-watershed. This involves a detailed assessment of local resource conditions and community need to tailor interventions effectively. The process has become a generally accepted means of addressing environmental concerns over broad areas of land and contributes to the development of an overall land use management strategy. Reduced areal coverage provides an opportunity for effective management of watershed resources. Sub watershed level planning is most suited and adopted in the context of Nepal.

3.3.4 Micro-watershed Level Planning

Due to the size of the unit, micro watershed is the most appropriate management implementation unit as it addresses the micro level planning related problems effectively. It allows for targeted interventions that directly address the specific issues within the localized areas. However, micro-level planning involves numerous activities to ensure comprehensive treatment and require investment in essential institutional arrangements. Micro-watershed planning and implementation involve integrating technologies within the natural boundaries of a drainage area to optimize the development of land, water, and plant resources. To achieve its objective, IWM suggests adopting land and water conservation practices, water harvesting in ponds and recharging of groundwater for increasing water resources potential and stress on crop diversification, use of improved variety of seeds, integrated nutrient management and integrated pest management practices, etc. This approach seeks to enhance the standard of living by sustainably meeting basic needs and increasing earning capacity through improved production facilities. Community participation in micro-watershed planning ensures that the solutions are relevant and acceptable to local stakeholders.

Table 1: Different levels of Watershed management in context of Nepal

	Basin/ Subbasin	**Watershed**	**Sub-watershed**	**Micro-watershed**
Definition	A basin is a large area where surface water drains into a common outlet, like a river or lake. A subbasin is a smaller division within a basin that drains into a specific tributary or sub-outlet.	A watershed is a land area that channels rainfall and runoff into a common water body, like a river, stream, or reservoir.	A sub-watershed is a smaller section within a watershed that drains water to a specific tributary or localized point.	A micro-watershed is the smallest hydrological unit where water drains into minor streams or outlets.
Scale	Federal level	Provincial level	Provincial and Local levels	Local level
Planning Focus	Strategic Planning	Programmatic level Planning	Activity level Planning	Activity level Planning
Management Approach	Integrated Watershed Management at the federal level. Involves international/ inter-ministerial coordination	Focuses on specific river systems and tributaries. Coordination between provinces and federal authorities.	Coordination between local, provinces and federal authorities.	Coordination between local bodies and local communities
Management Challenges	Transboundary river management, ensuring equitable water distribution between provinces and with neighboring countries	Inter provincial water allocation, disaster risk reduction, sedimentation, and water quality .	Urbanization impacts, agricultural runoff, forest cover loss, and water quality	Localized issues like urban runoff, localized flooding, and stream health

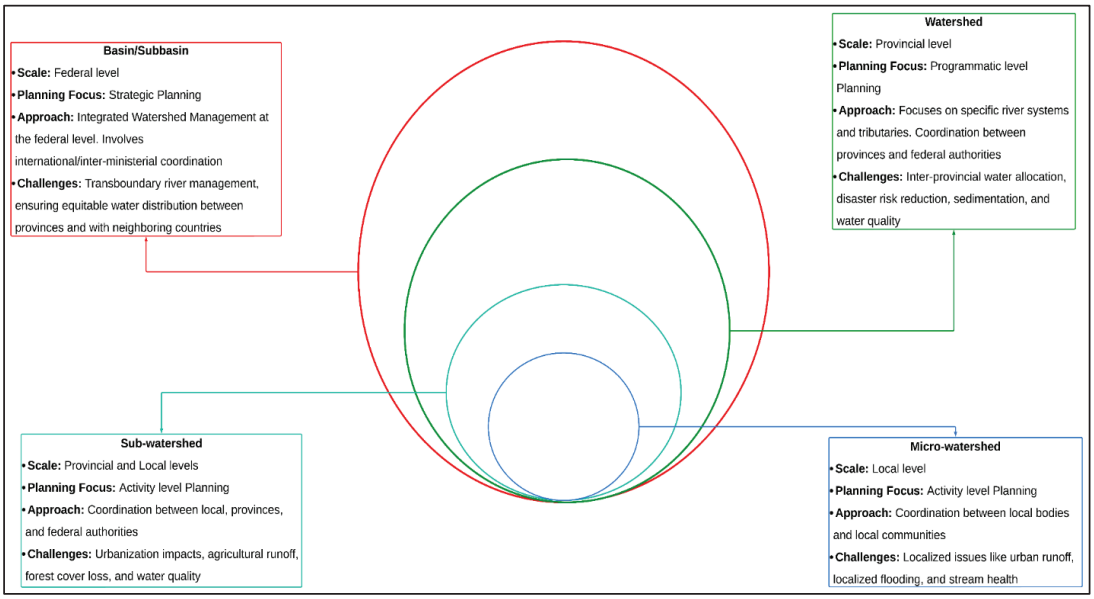


Figure 1: Levels of watershed management practiced in Nepal

4. SOIL CONSERVATION AND WATERSHED MANAGEMENT PROGRAM/ACTIVITIES

4.1 Disaster Risk Reduction and Natural Hazards Management

Inventory and documentation of disaster such as landslide, hazards mapping, gully treatment, landslide treatment, torrent control, and stream bank protection activities using various engineering and vegetative measures may be required for disaster risk management. Check dams, retaining walls, diversion channels, grass sowing, and tree planting are some of the major activities in practice. The selection of activities depends on the land use practice and availability of resources. For instance, construction of gray infrastructures is suited for the urban areas and the region with less ecological disturbance while these interventions possess the negative impacts if adopted in the agricultural or forest land use. The prioritization of activities should be done based on the economic return, land ownership, and minimum disruption to the existing ecosystem. Consideration should be taken for the socio-cultural context of the local community. Community participation should be emphasized and the share of the work for the community should be specified before the commencement of work.

4.1.1 Landslide Inventory and Documentation

Definition

Inventory means the record showing quantity and value of goods and equipment. The inventory of disasters is essential for identification of location and intensity of the disasters which will further help to prepare the vulnerability and risk assessment maps, essential tools for disaster risk management.

A document is a written, drawn, presented, or recorded representation of thoughts that may be preserved or represented to serve as evidence for some purpose. This enables record keeping for institutional memory and enables the effective monitoring and evaluation mechanism.

Objectives

- To document the disasters and acquire knowledge on the prevalence of landslide
- To prepare for the negative consequences of disaster and reduce the risk associated with it
- To ensure the sustainability of development infrastructures

Working Strategy

The landslide, including their frequency in the area, will be identified and recorded with rigorous support from the local people and stakeholders. For uniformity, distinguished inventory sheets are prepared for documentation. For instance, a Landslide inventory sheet is used for the landslide inventory and documentation.

Scope:

Generally, the activity includes:

- Collection of primary information and data inventory and documentation
- Support from the stakeholders concerned for data collection and verification of available secondary data.
- Preparation of maps and basic information using GPS, GIS, and remote sensing tools and techniques
- Production of landslide documentation book
- Revision of landslide book periodically
- Mobilization of local communities, resources

Unit: Number

Symbol: 

4.1.2 Hazard Mappings, Vulnerability Assessment and Risk Mapping

Definition

The UNISDR (2009) defines a hazard as "a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (UNISDR, 2009)".

Vulnerability is the extent to which an 'element' (animate/inanimate) is harmed in the event of a disaster; in other words, is susceptible to a given hazard. 'Elements' are identified as life and property likely to suffer damage in the event of a disaster.

Risk is "the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions" (UNISDR, 2009). Hazards pose no threat until they are exposed to Exposure.

More simply,

$$Risk = Hazard \times Vulnerability \times Exposure$$

Exposure is the number of people, buildings, and structures that are exposed to the hazard

Hazard Mapping

It is a process of developing a hazard map that identifies areas impacted by or vulnerable to a specific hazard (en.wikipedia.org). Hazard maps also provide detailed information about the causes, course, spatial scope, intensity, and probability of occurrence of natural hazard events. It refers to a map describing the areas at risk of natural disasters.

events. It refers to a map describing the areas at risk of natural disasters.

Vulnerability Assessment

It is the process of identifying, quantifying, and prioritizing (or ranking) the vulnerability in a system.

Risk Mapping

It is a procedure for preparing a map considering hazard, exposure (or elements at risk), and vulnerability in addition to the hazard/susceptibility.

Objectives

- To minimize the risk level based on the most vulnerable threatening elements
- To help watershed management planning
- To decrease the magnitude of disasters by using it effectively
- To provide information on the range of possible damage and disaster prevention activities
- To provide information to establish an early warning system and evacuation system

Working Strategy

There are different types of hazard maps e.g. flood hazard maps, debris flow hazard maps, etc. The hazard map will be prepared using GIS, GPS, Aerial photos, Satellite imagery, and Google Earth and with intensive consultation of local people. The map will be created with representations and contents that are understandable to non-professional people for its effective use.

Scope:

Generally, the activity includes:

- Hazard map preparation
- Risk assessment
- Vulnerability assessment

Unit: Number

Symbol: 

4.1.3 Landslide Early Warning System (LEWS) Management

Definition

An early warning system consists of sensors, event detection, and decision subsystems for

transmission systems. Together, they can predict and identify disturbances that negatively impact the physical world's stability, giving the response system time to reduce the negative effects of events and get ready for it.

Objectives

- To alert people before a disaster occurs
- To protect against loss of human and assets
- To take an early safety measure.

Working Strategy

The necessary hardware, including sensors, detectors, and alert systems, is set up. Communities are notified through phone calls, social media, radio, or TV. Education programs should be run to understand the early warning systems and steps to take for safety.

Scope

Generally, the work includes:

- Hazard Detection and Monitoring
- Data Processing and Analysis
- Risk Communication
- Public Awareness and Education
- Preparedness and Response Plans
- Capacity Building and Training
- Continuous Improvement

Unit: Number

Symbol 

4.1.4 Landslide Treatment

Definition

Landslide is the movement downslope of a mass of rock, debris, earth, or soil (soil being a mixture of earth and debris). Landslides occur when gravitation and other types of shear stresses within a slope exceed the shear strength (resistance to shearing) of the materials that form the slope.

Landslide treatment refers to the vegetative and structural measures applied in the landslide area and its influential catchment for preventing its occurrence.

Landslide treatment refers to the vegetative and structural measures applied in the landslide area and its influential catchment for preventing its occurrence.

Objectives:

To reduce soil erosion and mass movement from landslides and reduce devastating effects on the downstream and surrounding area where landslides occur sometimes threatening life and property.

Working Strategy:

The influencing drainage area along with the landslide and immediate downstream vicinity will be taken as working units and all the necessary vegetative as well as structural erosion control measures will be applied as a package throughout the working area. Appropriate land use practices will be emphasized in the drainage area, whereas bioengineering erosion control measures will be emphasized in the landslide and its vicinity. Geological (natural) landslides are not advisable to be treated with expensive structures unless and until it affects habitation and rational infrastructures e.g., roads, canals, buildings.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups. In upstream or downstream areas where people's participation is not available, landslide treatment and other natural hazard prevention/control works can be carried out by using contract bidding/ tender and other methods as appropriate according to prevailing financial regulations.

Scope

Generally, the activity includes:

- Water management includes diversion channels around and inside the landslide to drain water from the landslide.
- Structural erosion control measures such as retaining walls and check dams.
- Site stabilization by vegetation such as planting of trees and grass, contour wattling, and slope correction.
- Appropriate land use improvement in the drainage area.
- Conservation pond to store and divert excess run-off.
- Fencing for livestock control.

Unit: Number/area of landslide in hectare/area of drainage area

Symbol: 

4.1.5 Gully Treatment

Definition

A gully is an erosion channel cut by concentrated runoff through which water commonly flows during the period of heavy rainfall. A gully is sufficiently deep that it cannot be crossed by a wheel vehicle or eliminated by plowing.

Gully treatment refers to the vegetative and structural measures applied both in a gully and its catchment.

Objectives

To prevent further degradation of the gully and its watershed through controlling run-off and erosion and to improve water quality and regimen.

Working Strategy

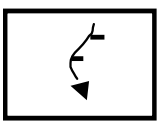
The catchment area of the gully will be taken as a working unit and all the necessary vegetative as well as structural erosion control measures will be applied in a package throughout the catchment area. Appropriate land use practices will be adopted in the catchment. Structures will be made only when the investment is economically justifiable and when the houses, lives and infrastructures are threatened. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope

Generally, the activity includes:

- Gully head diversion ditches
- Gully head plugging
- Gully rim edging
- Gully repair by building structures such as check dam
- Gully, gully bank and its catchment re-vegetation (tree and grass plantation), contour wattling and turfing
- Gully bank slope correction
- Conservation pond to store and divert excess run-off
- Appropriate land use improvement in the catchment
- Fencing of gully and its catchment for livestock control

Unit: Number/gully area in hectares/gully length in meters

Symbol: 

4.1.6 Torrent Control

Definition

A torrent is a stream of water flowing with great velocity or turbulence, generally causing riverbank erosion and flooding during heavy rains.

Torrent Control refers to the vegetative and structural measures applied in the torrential stream and its catchment.

Objectives

To reduce the stream bank erosion and sediment deposit caused by flash flow, by run-off control through water management and erosion control measures.

Working Strategy

The catchment area of the stream will be taken as a working unit and all the necessary vegetative as well as structural erosion control, water management measures, and appropriate land use practices will be applied in a package throughout the stream bank and its catchment area.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope

Generally, the activity includes:

- Structures to protect stream banks from erosion
- Channelization efforts to manage the flood discharge
- Flood plain stabilization through bio-engineering measures
- Re-vegetation of barren lands in the catchment
- Silvi-pasture management in the catchment
- Gully treatment (also if there is any landslide) in the catchment
- Construction of conservation ponds for water management
- Appropriate land use improvement in the catchment

Unit: Number/catchment area in hectare/length of torrent treated in meter

Symbol: 

4.1.7 River/Stream Bank Protection

Definition

River/Stream Bank refers to the land adjoining the stream and/or river, where stream and/or river cutting actively destroys habitation, agriculture and forest land.

Riverbank protection refers to the application of vegetative and structural measures in the area to protect the stream bank.

Objectives

To prevent stream bank erosion and protect the land from river cutting

Working Strategy

The area required to protect the stream bank erosion will be taken as a working unit. This includes at least 5-10 meters distance from the stream bank and reclaimed area on the riverside. "*Nadi Ukas Jagga Upayog Tathaa Darta Sahamati Nirdeshika-2065"* will be taken as reference to assess high flood level area. All the necessary vegetative as well as structural measures will be applied as a package. Use of vegetative measures should be emphasized even with the application of structural measures.

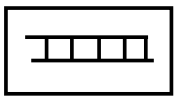
Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope:

Generally, the activity includes:

- Construction of revetments (protection walls)
- Construction of spurs (groynes)
- Construction of flow retarding structures
- Channelization efforts to manage discharge
- Flood plain stabilization through bio-engineering measures
- Vegetative measures (tree and grass plantation) on the bank
- Fencing of the area for livestock control

Unit: Length of stream bank protected in meter/ hectares of area vegetated/hectare of area reclaimed

Symbol: 

4.2 Sustainable Land Management (SLM)

To meet the demands of both the present and the future generations, sustainable land management balances economic, social, and environmental factors. Sustainable land management emphasizes restoring the land and bringing land use in line with rational land utilization. Degraded land rehabilitation, diversion channel construction, on-farm conservation, fruit tree planting, silvi-pasture improvement, nursery development, conservation plantation, and conservation trenching are implemented as sustainable land management measures. It needs to be extensively applied throughout the watershed, on cultivated lands, range and pasture lands, degraded forests, and public lands, and application of these measures may require interruption or change in the existing land use. Thus, while implementing these activities objections from the local people regarding land tenure may be likely. Measures such as terrace improvement and fruit tree planting may result in temporary economic losses and may require the provision of some form of subsidy for the individual who undertakes the activity. The program can be successfully achieved only when it is launched as a part of an integrated approach with a high degree of management and coordination. People's participation, incentives, motivation, education, and extension are essential for the success of the program.

4.2.1 Degraded Land Rehabilitation

Definition

Land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land. It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable.

Land Rehabilitation is a re-engineering process that attempts to restore an area of land back to its natural state after it has been damaged because of some sort of disruption. The process involves such things as removing all man-made structures, toxins, and other dangerous substances, improving the soil conditions, and adding new flora.

Objectives

The general objective of degraded land rehabilitation is to control erosion, restore ecological functionality, enhance soil and water quality, promote biodiversity, and ensure sustainable land use practices that balance environmental health, economic productivity, and community well-being.

Working Strategy

The degraded lands will be the working unit and the plantation of desired tree seedlings along with all the vegetative as well as structural erosion control measures will be applied in a package throughout the working unit.

The degraded lands will serve as the operational unit, where a comprehensive approach will be implemented. This will include vegetative and structural measures to meet the desired objectives. Priorities will be given for the implementation of vegetative measures. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Tree, shrub and grass planting with necessary conservation techniques such as contour terracing, contour trenching, contour bunding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Seedling production/ purchase and distribution to the groups
- Protection of the area (including fencing and watchmen)
- Aerial Seeding using Drone

Unit: Area in hectare/ number of seedlings planted

Symbol: 

4.2.2 Diversion Channel Construction

Definition:

Diversion channel is an excavation for diverting overland flow away from exposed slopes, conveying the water to where it can be safely discharged through a stabilized outlet or to a sediment basin. They are man-made channels built to offer a different route for excess water to flow further mitigating the effects of flooding and restoring rivers to their natural water level. Typically, diversion channels are built around communities or economic centers to prevent extensive flood damage; it mitigates the impacts of a flood by offering an alternative route for excess water.

Embankment Diversions***:*** When constructing diversions using earthen berms or swales, minimize erosion and sediment discharges by stabilizing the banks of the diversion channel with an appropriate liner. Consider fluctuations in water depth due to storms or tides. Rip rap may also be useful to hold the liner in place and to dissipate outfall velocity.

Culvert Diversions***:*** When using culverts to divert drainages or streams, ensure that culverts are constructed as per the applicable standard and specification for the type of pipe being used. To minimize water loss along with diversion, joints need to be watertight.

Objectives

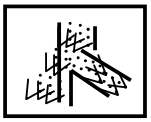
- To collect and divert runoff by making diversion channels at the top of slopes, at the bottom of slopes or embankments, in material sources, and at waste sites
- To reduce the length of an uninterrupted slope face by using temporary diversion channels on the lower side of cleared areas that are awaiting excavation or along the benches on large slope faces, and
- To discharge concentrated flows by a diversion channel and dike using chutes, flumes, or slope drains and using a diversion channel in conjugation with a dike.

Working strategy

Once water is diverted from the water course, ensure that the following strategies will be adopted.

- River /channel flow will be diverted to the desired directions and downstream will be safe by the overland flow.
- Stream bank cutting will be reduced downstream due to diversion of discharge to the safe direction.
- The diverted water will be utilized as an irrigation facility of the locality and quality and quantity of crop production will be increased.
- The velocity of diverted water in the channel will be reduced and river bed scouring will also decrease either in the main channel or diversion.

Unit: Number / length in meter

Symbol: 

4.2.3 Agroforestry Development

Definition

Agro-forestry ("*krishiban" in Nepali) is* a unique land management approach that intentionally blends agriculture and forestry to enhance productivity, profitability, and environmental stewardship. Agroforestry can be a key tool for farmers, ranchers, woodland owners, communities, and others who want to use sustainable strategies that enhance agricultural practices and protect natural resources.

Objectives

- To manage land efficiently so that its productivity is increased and restored.
- To use available resources efficiently and economically

- To preserve the humidity in cultivable lands, check soil erosion, and increase land productivity.
- To improve rural development by increasing fuel access, expanding small timber supply, and increasing the production of food crops, legumes, vegetables, pulses, milk, and meat.
- To help in obtaining an ecological balance in rural areas

Working Strategy

- Develop Partnerships: Sharing information through new agro-forestry partnerships and networks will address emerging needs and continue to encourage wider participation by underserved and minority audiences.
- Educate Professionals: Natural resource professionals will gain the education and training necessary to provide technical, educational, financial, and marketing assistance to help landowners considering agro forestry as an opportunity.
- Engage Globally: Nepal and the international agro-forestry community will exchange information about agro-forestry's role in supporting sustainable food, and fiber production in light of global issues such as climate change and population growth.

Scope

Agroforestry system in Nepal is diversified and integrated with livestock, trees and crops. Any change in any component of the whole system will have effects on the other components. Hence, generally the activities include:

- Plantation of fruits, fodders and grass species
- Land productivity enhancement activities such as composting, green manuring, mulching, etc.

Unit: Hectare/place

Symbol: 

4.2.3.1 On farm conservation

Definition

On-farm conservation is the sustainable maintenance of landscape and replaces the traditional cultivation system by growing them in conformity with sustainable and environment friendly cultivation using modern, scientific and conservation technologies. It implies management of the farm resource to conserve soil and water and improve production through scientific measures. The activities conducted by DoFSC include vegetative, structural

measures and land surface treatment activities applied in the farmland, which includes leveling of terrace if necessary.

Objectives

- To reduce erosion and increase productivity on the farmland

Working Strategy

Farmland of one or more farmers will be considered as the working unit and all necessary vegetative as well as structural erosion control measures and land surface treatment activities will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought from initial planning through implementation. Individual farmers will be dealt with for participation.

Scope

Generally, the activity includes:

- Planting of trees, herbs, or grass on marginal lands or unused lands in between and/or within farmlands/ risers.
- Slope correction/modification of the terrace
- Stabilization of riser
- Construction of safe drainage and disposal of water
- Construction of conservation ponds for water management
- Distribution of vegetable and grass seeds and grass and tree seedlings and other types of vegetation as appropriate
- Erosion control measures such as micro-gully plugging, contour Watling, strip planting along the contour and structures such as check dam, retaining wall as needed
- Drainage and irrigation system improvement
- Terrace improvement
- Bamboo rhizomes distribution

Unit: Hectare/no. of households

Symbol: 

4.2.3.2 Fruit Plantation

Definition:

Fruit plantation refers to the planting of fruit / seedlings with the purpose of soil conservation and watershed management in the marginal lands with an aim of improving the livelihood of the communities where agricultural practice is susceptible.

Objectives:

- To reduce erosion and increase productivity of overused private agriculture land and communal land by introducing fruit / trees.
- To reduce pressure on forest areas by fulfilling the local people's demand for fodder, fuel wood and timber.

Working Strategy:

The overused agricultural land of farmers or communal land will be considered as working unit and planting of desired fruit/tree seedling along with all the necessary structural erosion control measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups in case of communal lands and individual farmers in case of private farmlands.

Scope:

Generally, the activity includes:

- Distribution of fruit / tree seedlings
- Fruit tree planting with necessary conservation techniques such as contour -terracing, contour trenching, contour bunding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Grass planting, construction of diversion channels and safe drainage
- Seedling production or procurement
- Protection of the area (including fencing and watchmen)
- Technical backstopping required for the maintenance
- Purchasing the seedlings and distribution to the groups

Unit: Hectare/no. of fruit trees

Symbol: 

4.2.3.3 Fodder/grass Plantation

Definition

Fodder/grass plantation refers to the plantation of grass and fodder species to increase the access of farmers to feeding materials for livestock along with minimization of soil erosion from the cultivated lands

Objectives

- To reduce erosion and increase the availability of grass and fodder from the individual's overused agriculture land and communal land by the plantation of grass and fodder species

Working Strategy

Grassland, shrub land and private non-cultivated areas will be considered as working unit and plantation of desired fodder tree, grass and leguminous seedlings along with other erosion control measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user group.

Scope

Generally, the activity includes:

- Seed acquisition and storage
- Construction of nursery beds (seed, seedling and transplant beds)
- Production of planting stock of trees (fuel wood, fodder, fruit trees), hedge, shrubs, legumes, herbs and grasses
- Water management
- Maintenance and protection of nursery
- Distribution of planting stocks
- Maintenance of nursery records
- Purchasing of seedlings and distribution to the groups

Unit: Number/area in hectare

Symbol: 

4.2.3.4 Nursery/Seedling Production

Definition

Nursery refers to an area where plants are raised for planting and has both seedling and transplant beds. Nursery is either permanent or temporary. Nursery and seedling production involves growing seedlings for plantation in either private cultivated land or community and inclusion areas, specifically for soil conservation and watershed management purposes. Specially, it refers to all activities required to produce planting stocks.

Objectives

- To produce required planting stocks of trees (fuel wood, fodder, fruit and timber), hedge, shrub, legumes, herbs and grass.

Working Strategy

All the activities required for raising planting stocks will be included. Raising planting stocks will be carried out with maximum people's participation. Emphasis will be given on raising the planting stock through individuals and user groups as well.

Scope

Generally, the activity includes:

- Seed acquisition and storage
- Construction of nursery beds (seed, seedling and transplant beds)
- Production of planting stock of trees (fuelwood, fodder, fruit trees), hedge, shrubs, legumes, herbs and grasses
- Pest management
- Water management
- Maintenance and protection of nursery
- Distribution of planting stocks
- Maintenance of nursery records
- Nursery construction
- Placement of leader for nursery operation (*Nursery Naike)*

Unit: Number of seedling /area of nursery

Symbol: 

4.2.3.5 Conservation Plantation

Definition

Conservation Plantation refers to the vegetative measures as well as structural measures applied on the degraded lands including forests, barren lands, and graveled and sandy riverbeds, for sustainable land management.

Objectives

- To reduce erosion and increase productivity of degraded lands through soil and moisture conservation
- To enhance life of structural measures through combination of vegetative structures

Working Strategy

The degraded lands will be the working unit and plantation of desired tree seedlings along with all the vegetative and structural erosion control measures will be applied in a package throughout the working unit. Structural measures will be less emphasized. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Tree, shrub and grass planting with necessary conservation techniques such as contour terracing in moisture stress sites, contour trenching in nutrient and moisture constraint areas, contour bunding in waterlogged areas, basin pit planting in dry and harsh soil condition
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Construction of diversion channel and safe drainage
- Seedling production, purchasing, and distribution to the groups
- Protection of the area (including fencing and watchmen)

Unit: Hectare/no. of structures treated

Symbol: 

4.2.4 Conservation Farming

Definition

Conservation farming encourages the least amount of soil disturbance, the preservation of permanent soil cover, and the diversity of plant types. It improves soil and water retention, aids in reducing soil erosion, and boosts crop productivity. Enhancing biodiversity and naturally occurring biological activities both above and below the ground surface helps boost and sustain crop yield by increasing the efficiency of water and fertilizer usage efficiency. It is predicted on three notions: 1. Species diversification; 2. Permanent soil cover; and 3. Minimal mechanical soil disturbance. This activity is separated from on –farm conservation to emphasize that it is to be applied as demonstration only with emphasis on tillage, cropping and manuring.

Objectives

- To conserve soil, water, and soil organic matter resources
- To reduce the need for costly inputs while maintaining or improving crop yield and profits

Working strategy

The farmland of individual or group of farmers are selected as a working unit and improved farming practices such as conservation tillage is practiced.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing.

Scopes

Generally, the activity includes:

- Using green manure as a fertilizer
- Reducing tillage impact on soil
- Cultivating diverse crop species

Unit: Hectare

Symbol: 

4.2.5 SALT Plot Establishment and Management

Definition

Sloping Agriculture Land Technology (SALT) plot is the plot established for the purpose of demonstration and wider dissemination of the conservation technologies used for sloppy land management. It includes the management of sloppy lands.

Objectives

- To widely disseminate the conservation technologies at strategic locations
- To utilize marginal and unused land
- To organize the communities for income generation through SALT
- To produce diversified products for food security

Working Strategy

The marginal/unused sloppy land of one or more farmers or communal land will be considered as working unit and planting of desired tree seedlings along with all the necessary vegetative

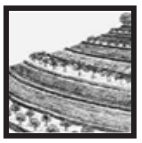
as well as structural erosion control measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups in case of communal lands and individual farmers in case of private farmlands.

Scope

Generally, the activity includes:

- Site selection with local community consensus
- Vegetative measures with minor structural measures if required
- Species selection to be planted
- Maintenance of the site through community participation
- Bamboo rhizomes, broom grass plantation

Unit: Number of plots

Symbol: 

4.2.6 Sustainable Soil Management

Definition

Sustainable soil management refers to a variety of practices and operations with respect to soil that aid the production of crops; normally they are planned to allow for sustained yield in the future. The soil sustains most living organisms, being the ultimate source of their mineral nutrients. Good management of soils ensures that mineral elements do not become deficient or toxic to plants, and that appropriate mineral elements enter the food chain.

Objectives

- To improve production technologies adopted by small holders and disadvantaged groups
- To help small holders and disadvantaged groups understand the benefits of sustainable soil management practices and get access to inputs and other relevant proven technologies
- To ensure that farmers are linked with market opportunities and programming benefits reach the most disadvantaged

Working Strategy

Sustainable soil management (SSM) will be a core component of sustainable land management (SLM), focusing on enhancing soil health, fertility, and resilience. Practices

such as regular soil testing, erosion control through contour farming, and the use of cover crops will be implemented to maintain soil structure and prevent degradation. Organic materials, agroforestry, and green manuring will enhance soil fertility, while conservation tillage and proper machinery use will reduce compaction. Efficient water management techniques like rainwater harvesting, drip irrigation, and mulching will be employed to conserve moisture. Integrated pest management and crop rotation will ensure biodiversity and minimize chemical input. Policies will incentivize sustainable practices, and farmers will be educated through extension services. These efforts, combined with climate change adaptation strategies and economic incentives, will ensure the long-term health and productivity of soils, fostering resilient ecosystems and sustainable agricultural practices.

Scope

Generally, the activity includes:

- Promotion of the improved use of local resources
- Establishing linkages, collaborations and synergies
- Sharing of experiences through knowledge management
- Management of soil moisture and conservation/cover crops through mulching
- Inclusion of green manuring system with farm yard manure (FYM) and legumes in crop rotation
- Focus on organic products and commercialization in crop production, cattleshed improvement
- Improving biological processes through sustainable management of the soil
- Minimizing chemical fertilizer and maximizing the use of compost in cultivation
- Capacity building of farmers on sustainable crop production through soil management, etc.

Unit: Hectare

Symbol: 

4.2.7 Conservation Trenching

Definition

Conservation trenches are ditches dug along a hillside in such a way that they follow a contour and run perpendicularly to the flow of water. Water flowing down the hill is retained by the trench and is infiltrated in the soil below. Conservation trenching relates to retaining each unit of water on land for a long time through constructing ditches particularly in sloped areas.

Objectives

- To retain rainwater for agricultural, livestock, and domestic use while controlling its volume and velocity to reduce runoff and enhance evaporation.
- To reduce soil erosion, conserve fertile soil particles, and increase groundwater levels to improve water balance and agricultural productivity**.**

Working Strategy

The trenches will be dug in sandy soil and sloppy areas for multipurpose use of water. Upside of the trench should be protected against erosion by means of grass, shrubs and other vegetative structures. Depending on the slope of the hill, more than one parallel trench will be constructed closer or farther from one another. The dimensions and the format of the trench will be based on climate and soil conditions.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Digging ditches in contour/Contour trenches for water recharge
- Mulching to enhance evaporation and control rainwater volume/velocity
- SALT implementation
- Vegetative structures construction for dug soil stabilization

Unit: length in meter

Symbol: 

4.2.8 Shelterbelt Development

Definition

Shelterbelt development refers to a belt of trees, shrubs and grass maintained to protect soil resources from wind erosion and conserve moisture to increase productivity of the agricultural lands. It relates to the planting of trees, shrubs and grass vegetation in rows mostly across the general wind direction of locality.

Objectives

- To reduce wind erosion and conserve the soil and moisture for better production of crops.

Working Strategy

Strip of land required for protection will be considered as a working unit and all the necessary vegetative and structural erosion control measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups or individual landowners.

Scope

Generally, the activity includes:

- Surveying and preparing location/orientation of strip,
- Identification and selection of preferred species,
- Planting of trees, shrubs, hedge and grass in the shelter belt in pre-designed pattern of spacing and height
- Protection of vegetation in the shelter belt
- Seedling production
- Erosion control measures in the case of erosion prone area

Unit: Length in meters/area in hectare

Symbol:

4.2.9 Buffer Strip Development

Definition

Buffer Strip refers to a strip of grass and/or other erosion resisting vegetation (trees, shrubs and hedge).

Buffer Strip Development refers to the planting of grass and other vegetation (tree, shrub and hedge) in rows mostly along the contour and all structural erosion control measures applied in a package throughout the buffer belt.

Objectives

- To reduce erosion of up slope and sedimentation of down slope areas by increasing surface friction component

Working Strategy

Strip of land required for protection will be considered as a working unit and all the necessary vegetative and structural erosion control measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation.

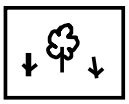
Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups and individual landowners.

Scope

Generally, the activity includes:

- Planting of trees, shrubs, hedge and grass in the buffer strip
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Protection of vegetation in the buffer strip Seedling production

Unit: Length in meters/area in hectare

Symbol: 

4.2.10 River Bed Farming (River bed upliftment management)

Definition

Riverbed farming typically involves cultivating crops on the land that has emerged from previous river channels, meanders, or floodplains once the river has altered its course. These areas may be nutrient-rich due to the sediment deposition, making them suitable for farming. Riverbed farming can be used to increase household income and to improve the food security of landless and land-poor households. Riverbed farming provides landless and land- poor households with the possibility to earn an income from on-farm activities close to home.

The approach described here allows the farmers to utilize most of the large fallow land near river beds which are normally unclaimed and cultivated. Since the lands near riverbeds have alluvial soils and sufficient moisture, they are suitable for seasonal vegetable cultivation during the dry season. In order for these landless and land-poor households to be able to farm these riverbed areas, they need to have access to suitable plots and the necessary agricultural inputs and training.

Objectives

- To utilize the marginal land of the locality for the improvement of economic status and technical knowledge of local people
- To uplift the socio-economic status of landless people living on the banks of nearby rivers

- To promote market linkage for the agriculture products focusing on fruits and vegetables
- To create opportunities of self-employment at the local level by utilizing locally available resources

Working Strategy

The riverbed land along the riverbank will be taken as a working unit. All the necessary vegetative as well as structural erosion control measures, will be applied in a package throughout the working unit. This land will be used to promote income, to adapt to climate change and to promote food security.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Reclaiming riverbed using vegetative as well as structural measures
- Organizing poor people into groups and encouraging them to cultivate the riverbed area for income generation
- Using the land for riverside forest development
- Growing off-season vegetable

Unit: Hectare/number of plots

Symbol: 

4.3 Development Infrastructure Protection

Development infrastructure protection measures protect and stabilize the basic development infrastructures such as roads, canals, and others, to improve socio-economic status of the people. These measures require more investment and a higher degree of technology to design and maintain. Irrigation channel protection, trail protection, road slope stabilization, water source conservation, shelter belt and buffer strip come under infrastructure protection measures. Under these activities various engineering and vegetative measures may be required. Check dams, retaining walls, diversion channels, grass sowing, tree planting, are the main types of works under these activities. Most of these activities would be related to the daily life of the people; therefore, while implementing these activities people's higher participation should be expected.

4.3.1 Irrigation Channel Protection

Definition

Irrigation channel protection refers to the vegetative and structural measures applied to manage and improve water use and to reduce sedimentation in the irrigation channel and reduce erosion in the adjoining area.

Objectives

- To protect and enhance sustainability of the channel from erosion and sedimentation and to manage water use.
- To reduce erosion (including gully and landslide formation) caused by irrigation channel

Working Strategy

The irrigation channel, upslope and downslope of the channel affecting its stability and the catchment area at close vicinity of the intake will be taken as working unit and all the necessary vegetative as well as structural measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Improvement and construction of irrigation channels using scientific measures
- Vegetative and structural erosion control measures on up slope and down slope of the irrigation channel
- Re-grade and/or reroute irrigation channel
- Construction and improvement of intake, distribution and sediment trap system
- Erosion control measures of the catchment in the close vicinity
- Use of pipes instead of channelizing in case of difficult areas such as continuous landslide areas

Unit: Number/length of irrigation channel/hectares of command area

Symbol: 

4.3.2 Trail Improvement

Definition

Trail Improvement relates to the vegetative and structural measures applied to protect the trail, which has potential for gully formation, susceptible to damage by erosion upslope and

downslope, causing erosion upslope and downslope and not convenient for the general human and livestock traffic.

Objectives

- To reduce erosion from unmanaged trails, protect trails from erosion and to improve the trail for general human and livestock traffic

Working Strategy

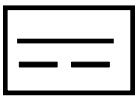
The trail and up slope and down slope of the trail affecting its stability will be taken as a working unit and all the necessary vegetative as well as structural measures will be applied in a package throughout the working unit. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope

Generally, the activity includes:

- Improvement and construction of trail
- Provision of diversion channel and safe drainage along the trail
- Re-grading and or rerouting the trails where erosion is advanced
- Revegetating abandoned trails, while rerouting
- Constructing stone steps on steep trail segments
- Vegetative and structural erosion control measures required up slope and/or down slope of the trail
- Construction and protection of small bridges and other minor structures wherever needed (within the trail segment)

Unit: Length of the trail in meter

Symbol: 

4.3.3 Road Slope Stabilization

Definition

Road slope stabilization refers to the vegetative and structural measures applied in the road slope to maintain stability of road from erosion.

Objectives

- To reduce erosion in the road slopes.

Working Strategy

The road slope affecting the roads' stability will be taken as a working unit and all necessary vegetative and structural measures will be applied in a package throughout the working unit.

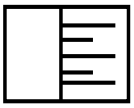
Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Tree and grass planting with necessary conservation measures such as contour terracing, contour trenching, contour bunding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Improvement of roadside drainage system
- Protection of cross drainage system
- Silvi-pasture management
- Fencing of road slope for livestock control

Unit: Kilometers of Road Protected/Hectare of Road Slope Stabilization/Number of sites

Symbol: 

4.4 Water and Sediment Management

Water is the fundamental resource of the watershed area to be managed for better output and outcome. Sediment is the product associated with water, and it creates problems in both upstream and downstream dwellers, settlements, infrastructures, livestock, agriculture, etc. Water, if managed properly, gives positive results; otherwise, it creates havoc. Hence, water and sediment need proper attention to make watershed management effective and fruitful. Rainwater harvesting, runoff harvesting, ground water recharge and siltation management are some of the measures of water and sediment management. These measures usually require more investment and a higher degree of technology to design

and maintain. Most of these activities would be related to the daily life of the people; therefore, while implementing these activities, people's participation should be expected more.

4.4.1 Siltation Management

Definition:

Siltation is the pollution of water by fine particulate terrestrial clastic material, with a particle size dominated by silt or clay. It refers both to the increased concentration of suspended sediments, and to the increased accumulation (temporary or permanent) of fine sediments on bottoms where they are undesirable. It is the preferred term for being unambiguous, even if not entirely stringent since it also includes other particle sizes than silt.

In rural areas the first line of defense is to maintain land cover and prevent soil erosion in the first place. The second line of defense is to trap the material before it reaches the stream network (known as sediment control). In urban areas the defense is to keep land uncovered for as short a time as possible during construction, and to use silt screens to prevent the sediment from being released in water bodies. During dredging the spill can be minimized but not eliminated completely through the way the dredger is designed and operated. If the material is deposited on land, efficient sedimentation basins can be constructed. If it is dumped in relatively deep water there will be a significant spill during dumping, but not thereafter, and the spill that does arise will have minimal impact if there are only fine-sediment bottoms nearby.

It is desirable to minimize the siltation of irrigation channels by hydrologic design, the objective being not to create zones with falling sediment transport capacity as that is conducive to sedimentation. Once sedimentation has occurred, in irrigation or navigation channels, dredging is often the only remedy.

Objectives

The general and long-term objectives of the siltation management are to protect the natural resources of the basin and to conserve its hydrological potential to foster development, decrease food insecurity and poverty and preserve local ecosystems. Specific objectives are as follows:

- To alleviate the effects of desertification and to slow down the silting process
- To assist in developing programs against hydraulic erosion
- To strengthen the institutional capacity in collaborative management of basin shared resources
- To promote participation and involvement of affected local populations and communities.

Working Strategy

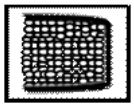
- Developing emergency plans of sediment management of the river system
- Making information available to the public about civil protection matters
- Maintaining arrangements to warn, inform, and advise the public in the event of an emergency
- Sharing information with other local responders to enable greater coordination
- Co-operating with other local responders to enhance co-ordination and efficiency
- Providing advice and assistance to businesses and voluntary organizations about business continuity management
- Work collaboration and improve resilience
- Improving understanding and awareness
- Enhancing the natural and historic environment
- Encouraging suitable development and use of resources effectively
- Promoting riparian responsibilities

Scope

Generally, the activity includes:

- Siltation dam construction to trap deposits
- Check dam construction
- Protection of infrastructures from siltation
- Siltation extraction and utilization
- Structures construction associated with siltation management

Unit: Hectare/place

Symbol: 

4.4.2 Water Source Identification, Inventory, Mapping and Assessment

Definition

Water sources provide water for the ecosystem and human wellbeing. Springs, ponds, wetland areas are the major water sources in Nepal besides the water contributed from the snow melting. Comprehensive assessment of water sources including their identification, inventory and mapping is the primary step for the sustainable management of water sources.

Objective

The main objectives of water source assessment are:

- To identify the water sources in any locality
- To document the status of water sources

- To map the distribution of water sources
- To aware people about the water sources

Working Strategy

The water sources in the area will be identified and recorded with rigorous support of the local people and stakeholders. Different formats can be used for water source assessment based on the types of water sources and their usefulness.

Scope

Generally, the activity includes:

- Preparation for inventory and documentation
- Concerned stakeholders' support in data collection
- Reconnaissance survey using transect walk
- Use of GIS, GPS, Landsat Imagery, Google Earth, different maps
- Water source status documentation
- Production of water sources documentation book
- Mobilization of local communities, resources

Unit: Number

Symbol: 

4.4.3 Springshed management

Definition

Springshed management is the set of activities carried out for regenerating the groundwater in aquifers with the application of engineering, vegetative and social measures in water recharge areas. The concept of springshed management has emerged to address the issue of drying and degradation of springs.

Objectives

- To delineate the boundary of Springshed
- To identify the location of springs and factors affecting their flow, and quality.
- To identify the recharge zones of the groundwater for enhancing the groundwater quantity
- To identify issues and implement remedial measures for protection and conservation of springs.

Working Strategy

Springshed will be delineated by the assessment of soil properties, geological structure, topography, and remote sensing information, involving the local community. They will be thoroughly analyzed using GIS. The issues relating to the water quality and quantity should be addressed with the implementation of activities and programs assisting in conservation and management of springs resulting in higher discharge.

Scope

- Field survey to gather data on land use, spring locations, topography, and geology.
- Recognize surface water, groundwater, and their interrelationships along with their recharge areas.
- Record-keeping.
- Identification of socio-cultural challenges and issues.
- Implementation of management activities with suitable engineering and vegetative measures.
- Emphasis on vegetative measures .

Unit: Number/ Area

Symbol: 

4.4.4 Water Recharges Structure Construction

Definition

Groundwater recharge or deep drainage or deep percolation is a hydrologic process where water moves downward from surface water to groundwater. This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table surface. Recharge occurs both naturally (through the water cycle) and through anthropogenic processes (i.e. “artificial groundwater recharge”), where rainwater and/or reclaimed water is routed to the subsurface. It is recharged naturally by rain and snow melting and to a smaller extent by surface water (rivers and lakes).

Objectives

The objectives of constructing recharge structures on roadsides and open spaces are:

- To harvest the run-off rainwater and utilize it to recharge underground aquifers
- To prevent flooding, erosion, and water stagnation

Working Strategy

- Demand side management interventions related to communities

- Supply side engineering structures belonging to the project and government
- Implementation of concept of real water savings
- Rainwater harvesting, aquifer recharge enhancement and urban waste water rescue.

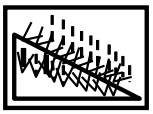
Scope

Recharge may be impeded somewhat by human activities including paving, development, or logging. These activities can result in loss of topsoil resulting in reduced water infiltration, enhanced surface runoff and reduction in recharge. Use of groundwater, especially for irrigation, may also lower the water tables. Groundwater recharge is an important process for sustainable groundwater management, since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged. Recharge can help move excess salts that accumulate in the root zone to deeper soil layers, or into the groundwater system. Tree roots increase water saturation into ground water reducing water runoff.

Generally, the activity includes:

- Greenery promotion such as conservation plantation
- Conservation pond construction
- Contour trench/ditch construction
- Diversion channel construction to retain and percolate water to the ground

Unit: Number

Symbol: 

4.5 Climate Resilience

Climate change is one of many challenges globally that must be recognized and responded to in planning for the future. Climate impacts pose significant challenges to development goals by increasing risks to human health, welfare, natural resources, and ecosystems. These challenges can hinder efforts to reduce poverty, expand access to education, improve health outcomes, combat diseases, and sustainably manage natural resources. Climate-resilient development ensures that people, communities, businesses, and other organizations are able to cope with current climate variability as well as to adapt to future climate change, preserving development gains, and minimizing damages. Climate-resilient development is about adding consideration of climate impacts and opportunities to development decision-making in order to improve development outcomes, rather than implementing development

activities in a completely new way. Climate risks cannot be eliminated, but negative impacts on people and economies can be reduced or managed. Climate-resilient development helps minimize the costs and consequences of climate impacts so they do not hinder progress toward conservation and development of the country. The major activities under this section are as follows.

4.5.1 Rainwater Harvesting System

Definition

Rainwater harvesting (RWH) is the accumulation and deposition of rainwater for reuse on site, rather than allowing it to run off. Its uses include water for gardening, livestock, irrigation, treated domestic water, and indoor heating etc. Rainwater harvesting is a technique of increasing the recharge of ground water by storing rainwater locally, through roof water harvesting, refilling of dug wells, recharging of hand pumps, construction of percolation pits, trenches around fields and bunds or dams on small rivulets. In many places the water collected is just redirected to a deep pit with percolation. Commonly used systems are constructed of three principal components: namely, i) catchment area, ii) collection device, and iii) conveyance system.

Rainwater harvesting (RWH) systems can be installed with minimal technical skills. However, the system must be adequately sized to meet water demand throughout the dry season, ensuring it supports daily consumption needs. The catchment area, such as building roofs, sunken zones, or designated collection sites, should be large enough to capture sufficient rainfall and maintain a consistent water supply. The water storage tank should be large enough to contain the captured water.

Objectives

The main objectives of rainwater harvesting are:

- To meet the increasing demand of water
- To reduce the runoff which chokes the drains
- To avoid the flooding of roads
- To raise the underground water table
- To reduce soil erosion
- To reduce groundwater pollution, and
- To supplement domestic water needs.

Working Strategy

The working strategies for the rainwater harvest are:

- Educate and train the local people

- Demonstration facilities and legislature support
- Local government support
- RWH equipment sourcing
- Cost competitiveness

Scope

Generally, the activity includes:

- Data collection, overview, and background of building-scale rainwater harvesting relative to other available water supply strategies
- Review of backup water supply strategy to drought-proof the building-scale of rain water harvest system
- Examination of impacts of the rain water harvest strategy on local hydrologic environment
- Cost analysis and comparison with conventional water supply
- Evaluation of impacts on rain water harvest water supply
- Review and analysis of sustainability issues
- Construction of Ferro-cement jar, masonry jar, or use polythene jar to store collected rainwater
- Livelihood improvement activities like horticulture, floriculture etc. to maximize the harvested rainwater uses.
- Stakeholder consultations to obtain information, inputs and insights
- Outreach activities to disseminate the findings and the results

Unit: Number

Symbol: 

4.5.2 Water Source Protection and Development

Definition

Water source protection refers to implementation of the various structural and vegetative activities for sustainability and proper utilization of the water source, such as springs, *kuwas* and ponds. It is applied in the source and catchment of the water source and distribution system.

Objectives

- To improve the quality and regime of water through soil conservation and watershed management.

Working Strategy

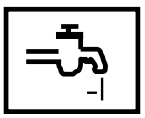
The water source, its catchment, and the distribution system will be treated as integrated working units. A comprehensive package of measures, including both vegetative and structural erosion control strategies, will be implemented across the entire unit, ensuring effective management of the distribution system. . Implementation will be carried out with maximum people's participation. Active participation will be encouraged at every stage, from planning to implementation, maintenance, and benefit sharing, with a focus on executing activities through user groups.

Scope

Generally, the activity includes:

- Tree and grass planting with necessary conservation techniques such as contour terracing, contour trenching, contour bunding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Construction of water storage tanks and water distribution system
- Construction of diversion channel and safe drainage
- Protection of the area (including fencing and watchmen)
- Appropriate land use treatment in the catchment
- Control of contamination by surface flow of water e.g. fertilizer, disease/ pathogens from animal and human waste
- Protection of water sources against infrastructural development such as road, building, etc.

Unit: Number/catchment area in hectare/no. of household

Symbol: 

4.5.3 Catchment Restoration

Definition

Catchment Restoration refers to a range of activities aimed at rehabilitating and enhancing the ecological integrity, functionality, and sustainability of a catchment area. It involves strategies and interventions to address environmental degradation caused by factors such as deforestation, erosion, pollution, altered hydrology, and climate change. It often involves actions like improving water flow, stabilizing soil, and addressing human impacts on the landscape.

Objectives

- To reduce erosion and increase the productivity of catchment areas with the preference of vegetative conservation measures of soil and moisture conservation.
- To enhance water quality, restore hydrological functionality, control erosion, improve biodiversity, and promote sustainable land use by integrating conservation with community needs.

Working Strategy

The catchment will be a working unit and plantation of desired tree seedling along with other vegetative as well as structural erosion control measures will be applied in a package throughout the working unit based on the requirement of the sites.

Scope

Generally, the activity includes:

- Reforestation and afforestation of tree, shrub and grass with necessary conservation techniques such as contour terracing, contour trenching, contour bunding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Seedling production and plantation
- Wetland Restoration

Unit: Hectare

Symbol: 

4.5.4 Conservation Pond

Definition

Conservation pond refers to a runoff water collection/perennial water collection area which is constructed with the purpose of reducing the soil erosion and storing water for use in various sectors. It is used to store run-off water during excess rain to reduce erosion and for later use. The activity refers to all the necessary vegetative and structural measures applied in the pond and its catchment.

Objectives

- To manage water for erosion control and multiple purpose use.

Working Strategy

The pond and its catchment will be considered as working units. All the necessary vegetative as well as structural erosion control measures including construction of the pond will be

applied in a package throughout the working unit. If such a pond is used for irrigation purposes (though this will be on a small scale only), the distribution channel will be considered as a part of the working unit.

Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope

Generally, the activity includes:

- Construction of new pond or improvement of old ponds
- Water harvesting
- Tree and grass planting with necessary conservation techniques such as contour terracing, contour trenching, contour bonding
- Erosion control measures such as micro-gully plugging, contour wattling and structures such as check dam, retaining wall as needed
- Construction of inlets and outlets
- Construction of diversion channel and safe drainage
- Protection of the pond
- Appropriate land use treatment in the catchment

Unit: Number

Symbol: 

4.5.5 Multipurpose use of water

Definition

Multipurpose water use involves integrating activities like irrigation, hydropower, drinking water, and ecosystem support to optimize water resources and enhance resilience against climate change impacts. By diversifying water use, it ensures availability across sectors during droughts, floods, and other climatic extremes, fostering sustainable resource management. In Nepal, where agriculture is monsoon-dependent and climate vulnerability is high, multipurpose water projects are crucial. Initiatives like combining small hydropower with irrigation or urban water supply systems, such as the Melamchi project, enhance water security and adaptability. Expanding such projects, especially in rural areas with community involvement, is vital for sustainable development and climate resilience.

Objectives:

- To enhance the multiple use of limited available water.
- To increase the water productivity ensuring the equitable distribution amongst the multiple users.

Working strategy

A watershed or specific area with limited water availability will serve as the fundamental working unit for implementing multipurpose water use strategies. Within this unit, the focus will be on optimizing the use of available water resources through an integrated approach. Activities such as wastewater treatment will be promoted to maximize resource efficiency. The strategy will also prioritize water-saving technologies and practices, such as micro-irrigation systems and rainwater harvesting, to conserve and extend water availability.

Participation will be a core principle in this approach. Local communities, water user groups, and stakeholders will actively engage in decision-making, planning, and implementation. By involving diverse groups, from farmers to municipal authorities, the strategy will ensure equitable water distribution and foster shared responsibility. This participatory model not only enhances the effectiveness of water management but also strengthens community ownership, contributing to long-term sustainability and resilience to climate impacts.

Scope:

Generally activities includes:

- Establishment and extension of water distribution networks
- Construction of water intake and water harvesting ponds,
- Mulching to reduce the evaporative water loss
- Use of bioengineering techniques
- Waterways construction and maintenance

Unit: Package

Symbol: 

4.5.6 Wetland Management

Definition

Wetlands are perennial water bodies that originate from underground sources of water or rains. It means swampy areas with flowing or stagnant fresh or salt water that are natural or man-made, permanent or temporary. Wetlands also mean marshy lands, riverine floodplains,

lakes, ponds, water storage areas and agricultural lands (Government of Nepal, 2003). Wetlands are fertile lands for agriculture and rich from the point of view of biological diversity. Wetland Conservation refers to protecting and preserving areas where water exists at or near the Earth's surface, such as swamps, marshes and bogs.

Objectives

- Reduce siltation and sedimentation.
- To increase groundwater recharge and maintain water quality in wetland catchment.
- To conserve biodiversity and improve human well being
- To support water supply, fisheries, agriculture, forestry, tourism to enhance local economy

Working Strategy

The wetland required to be protected will be taken as a working unit. The selection of wetlands will be based on the documented inventory list of the wetlands. All the necessary vegetables as well as structural measures will be applied in a package. Priorities are given for the vegetative measures rather than structural measures alone.

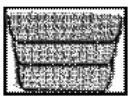
Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through user groups.

Scope

Generally, the activity includes:

- Inventory and documentation of wetlands
- Cleaning catchment area of the wetland
- Planting trees, shrubs and grasses
- Lining of inlet/outlet for waterways management
- Fencing the area
- Constructing contour bund in slope area
- Using bio-engineering techniques.

Unit: Number/hectare

Symbol: 

4.5.7 Run-off Harvesting Structures Construction

Definition:

Runoff harvesting structures are the dams constructed (mostly single) for harvesting the run-off across the rivulet or gullies. It is also called "*Ek Dhara Pokhari*" in Nepali / local

language. Every runoff harvesting system has a run-off area (i.e. catchment) and run-on area (i.e. storage area). Catchment pond is often considered as synonym of Run-off harvesting dams. But they are different in construction, scope and objectives (DSCWM, 2061/62).

Small earthen dams, cement stone masonry dams with earthen cover, and reinforced cement concrete core walls with earthen outer layers are constructed based on site requirement across the gullies, deep valleys, ephemeral stream rivulets, and water channel to store excess runoff water during peak monsoon from the catchments for various use.
There are two types of run-offs harvesting methods:

1. **Reservoir system:** The run-off is stored in a pond or a storage reservoir in gullies, seasonal stream, and rivulets by providing a dam across it.
2. **Soil moisture storage system:** The run-off is stored and directly infiltrated into the soil or sand.

Objectives

- To capture rainwater to recharge groundwater using check dams, to trap silt and debris, and to store water for irrigation, wildlife, and livestock.
- To enhance biodiversity, improve local moisture levels, provide recreational opportunities, and help manage seasonal water imbalances by addressing flood risks in the rainy season and water shortages in the dry season.

Working Strategy

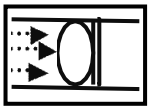
The influencing run-off (upstream area) and run-on (downstream area) area will be taken as working units and all the necessary vegetative as well as structural control measures will be applied as a package throughout the working area. Use of earthen material, stone, cement, concrete and iron rod will be decided to construct the dam depending on site. It will be linked with rural livelihood improvement by supplying water for cattle feeding, irrigation and so on. Simple and cheap technology by integrating scientific techniques and indigenous knowledge for its replication by the communities will be promoted. Bio- engineering techniques will be used for environmentally friendly structures. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation, maintenance and benefit sharing. Emphasis will be given on implementation of the activity through the user group.

Scope

- Construction of earthen dams built of rock, gravel, sand, silt or clay in various combinations by placing, rolling and tamping or hydraulic pudding; cement masonry dam; or RCC dam

- Appropriate land use improvement measures in the upstream area.
- Conservation pond construction or enhancement to store run-off
- Soil moisture enhancement through in-situ and ex-situ run-off harvesting system such as on-farm conservation, water irrigation system.

Unit: Numbers/meter/hectare

Symbol: 

4.6 Community Livelihood Improvement

Effective natural resource management requires interrelated technical practices and social arrangements that are appropriate to a region's biophysical characteristics and that address protection and sustainable management of resources. In general, despite large investments of time and funding, conventional reforestation efforts had little impact. To tackle interconnected technical and social challenges in resource management, this approach involves marginalized groups and establishes monitoring and enforcement systems. This empowers communities to manage land effectively and generate income through sustainable natural resource management. The technical solutions advised should be built on local knowledge and skills and use previously undervalued indigenous management systems. Food security and community resilience to conservation related issues can be markedly enhanced and local incomes can be increased. The experience provides important lessons for approaches to addressing environmental degradation and poverty in the remote areas and facilitating the spread and adoption of conservation systems.

4.6.1 Conservation income generation program

Definition

Any activity that generates extra income from an individual or family or group on top of his/her current income is considered to be an income generating activity (IGA). The activities that provide quick income within a period of one to five years and support in any aspects of integrated watershed management can fulfill the purpose of soil conservation and watershed management.

Objectives

- To sustain soil conservation and watershed management works
- To improve livelihood of pro-poor, women, and marginalized people

Working Strategy

The conservation IGA will be focused on quick income generating activities that give output in one to five-year span of time. Regarding the IGA, the guidelines on IGA for soil conservation and watershed management-2062 will be taken as a reference. Implementation will be carried out with maximum people's participation. Participation will be sought right from planning to implementation and maintenance. Emphasis will be given on implementation of the activity through user group.

Scope

Generally, the activity should contribute to effective watershed management and include:

- Plantation of bamboo and broom grass
- Livestock rearing
- Plantation of fruits and vegetables
- Riverbed cultivation.

Unit: Numbers /groups

Symbol: 

4.6.2 Community Mobilization and Empowerment

Definition

Community mobilization (CM), defined as a broad-scale movement to engage a community in achieving a specific development through self-reliant efforts–those that depend on their own resources and strengths. It involves all relevant segments of society: policymakers, decision-makers, opinion leaders, media, bureaucrats and technical experts, professional associations, religious groups, and all private sectors including NGOs, community members, and individuals.

Objectives

- To foster networking and expand learning opportunities through enhanced conference participation.
- To empower community members, develop leadership, and achieve shared goals by encouraging broader involvement.

Working Strategy

It is a planned decentralized process that seeks to facilitate change through a range of players engaged in interrelated and complementary efforts. It considers the felt needs of

the people, embraces the critical principle of community involvement, and seeks to empower individuals and groups for action. Mobilizing the necessary resources, disseminating information tailored to varying audiences, generating intersectoral support, and fostering cross-professional alliances are part of the process.

Scope

Generally, the activity includes:

- Capacity building training
- Gender and social inclusion training
- Meeting, workshop, interaction amongst different stakeholders
- Good governance training
- Fund and accounting training
- Skill development training
- Low-cost soil conservation technology training

Unit: Numbers /groups

Symbol: 

4.6.3 Conservation Farmers Network Establishment

Definition

Joining different community user groups into one platform is called networking. The development of farmers networks for the purpose of conservation of various aspects is called conservation farmers networks.

Objectives

- To organize farmers into grass root level viable institutions for exploring their potential in conservation initiatives
- To enhance collaboration of farmers for meeting the common goals
- To share groups experience and learn from one another
- To help enhance good governance leading to the bottom-up approach in SCWM.

Working Strategy

The committees of respective groups will select two members both male and female for the representation in the network established at municipality level. The network will be chaired periodically under special advisory of the municipality chairperson. Conservation based

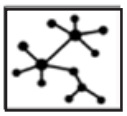
farmers groups will be brought into a single umbrella with the gradual transformation into networks.

Scope:

Generally, activities include:

- Dissemination of knowledge from various stakeholders
- Workshop and meeting organization at ward/ local level
- Interaction at different levels
- Focus group discussion

Unit: Numbers/groups

Symbol: 

4.6.4 Value Addition and market linkage

Definition:

Value addition enhances the economic worth of raw products by improving their quality, functionality, or marketability, enabling better prices and competitiveness. In the context of watershed management and climate resilience, it focuses on transforming natural resource outputs (e.g., agroforestry products, climate-resilient crops, compost) into processed or packaged goods with higher market value.

Market linkage connects producers to reliable markets, ensuring fair access to buyers, supply chains, and competitive opportunities. It facilitates the sale of value-added products from soil conservation, watershed management, and climate-resilient activities through cooperatives, market infrastructure, capacity building, and digital platforms.

Objectives

- Enhance the quality of works and outputs through watershed management and climate resilience activities
- Strengthening local economies with accessible market

Working Strategy

Opportunities will be assessed by mapping the available resources, analyzing value chains, and assessing markets. Product development through processing, packaging, and branding while building community capacity and infrastructure such as processing centers and storage

facilities will be promoted. Producer groups will be organized to facilitate collective marketing, market access, and partnerships, including leveraging digital platforms and developing local market infrastructure. Enabling policies, institutional support, and collaboration with stakeholders will be advocated to strengthen the system.

Scope

Generally, the activity includes:

- Product development through efficient resources mobilization
- Organizing producers and enhance capacity building
- Building connections with traders, processors, retailers, and institutional buyers through forward contracts and partnerships
- Developing local marketplaces, storage, and transport systems to ensure timely delivery and reduced post-harvest losses.
- Developing unique branding and marketing strategies to highlight sustainable, climate-resilient, or organic products.

Unit: Number

Symbol: 

4.6.5 Small Enterprise Development

Definition

Access to decent work is an antidote to social exclusion right across our social economy. Sustained enterprise growth is essential to employment creation, small and group-based enterprises, and the upgrading of micro-enterprises in the informal sector, an area which generates most new jobs.

Objectives

- Promote equity and unity by empowering marginalized communities and integrating socially and economically disadvantaged groups.
- Strengthening local economies through resource mobilization and inclusive opportunities for all stakeholders.

Working Strategy

The Income Generation Activity (IGA) Guideline-2062 will be taken as reference for enterprise development. Marginalized groups of people will be given more emphasis. Conservation

based enterprise with community participation will be supported. The individual will be organized into a group or an already existing group will be utilized for support.

Scope

Generally, the activity includes:

- Ginger and turmeric cultivation
- Vegetable farming
- Fruit tree plantation
- Bamboo rhizomes and broom grass plantation
- Livestock rearing

Unit: Number

Symbol: 

4.6.6 Study Tour/Exposure Visits/ Trainings and Workshops

Definition

A study tour is an award for a development cooperation activity, commonly given to an individual or group of individuals to visit pre-arranged sites and institutions in one or more selected locations. The main purposes are to observe developments, gather information and exchange experiences with counterparts in fields pertaining to specific location. Similarly, training is a flexible arrangement made to meet the requirements of stakeholders working in a project or program. They receive practical training to upgrade skills, or attend specially designed, practical training courses, seminars, symposia, workshops or technical meetings.

Objectives

- To expose the trainees in the relevant subject matters
- To share knowledge, skills and experiences
- To enhance the capacity of the trainees

Working Strategy

Study tours and training are organized for the farmers, including user groups, teachers, and extension workers in the field of soil conservation and watershed management. Preference is given to progressive farmers, user groups and teachers so that they can act as extension workers to create awareness among the rural population regarding soil conservation and watershed management activities.

Scope

Generally, the major activities include:

- Visit to the model places for combined livelihood and SCWM activities.
- Interaction with experts
- Training to handle prevailing and emerging issues
- Extension to utilize barren and degraded land in income generation along with restoration of the site.

Unit: Events/groups

Symbol: 

4.6.7 Conservation Education Campaign

Definition

Conservation Education Campaign refers to an informal education system which is used in schools for students by focusing on the conservation and management of natural resources. The rural people have a low level of awareness on the issues of conservation and management. Conservation Education and Extension Program (CEEP) should form the core of every conservation endeavor so that it can lead to a successful community-based integrated conservation and development programs. A conservation education and extension program will be successful considering the activities that are beneficial to the people involved. Therefore, it is essential to recognize such activities and to demonstrate their benefits. Conservation education and extension activities may be broadly categorized into demonstration, conservation education and extension materials production, study tours and training, audiovisual shows, and exhibitions.

Objectives

- To deliver the message of conservation and development through formal school education with special curriculum
- To spread the conservation awareness message to the students and teachers
- To organize talk, exhibitions, film show, land use judgment contests for conservation awards and others in the premises of the school to create awareness among school children and teachers

Working Strategy

- Coordinate school and other educational institutions for wider dissemination of the conservation messages

- Undertake massive awareness campaigns at school levels
- Incorporate conservation education-based courses in school level curriculum.
- Mobilize school students and teachers as conservation-based change agents.

Scope

Conservation education is adopted for diffusing ideas and conservation messages in the community as well as to bring positive changes in the prevailing attitudes regarding the sustainable use and management of resources. It places emphasis both on formal (school) and informal (out of school) conservation education in school programs to reach a wider range of communities. Use of media to disseminate the message is also adopted. Collaboration with other stakeholders is also emphasized.

Unit: Numbers/schools

Symbol: 

4.7 Research, Technology Development and Extension

Technology is an instrumental action design that lowers uncertainty in the cause-and-effect chain involved in reaching a goal produced via scientific research. According to Rogers, 2003, there are six formal stages in the technology development process: problem, research, development, commercialization, diffusion and adoption, and consequences. An effective and significant research question can be developed using a field-based problem identification process. Researchers and scientists from several disciplines collaborate to create technology that effectively addresses the problem. The developed technology is successfully marketed, spread among farmers and conservationists, and used for the protection of soil and watersheds.

Extension programs play a crucial role in addressing watershed issues by combining education with hands-on conservation efforts. These programs use a variety of tools, including field demonstrations, training sessions, films, posters, newsletters, and study tours, to raise community awareness and provide practical solutions. A key challenge is that many people remain unaware of watershed problems or lack the knowledge to address them effectively. While education is a gradual process, its impact can be long-lasting when paired with complementary efforts. On-farm demonstrations, motivational initiatives, and financial and technical support are essential to translating awareness into action and ensuring sustainable conservation outcomes.

4.7.1 Watershed Monitoring

Definition

The natural phenomena of hydrological and erosion processes are continuously in action with respect to geo-ecological and land use practices. Soil conservation and watershed management interventions have been continuous inputs for the better land use practices and erosion control which bring changes in the hydrological and erosion processes. Run-off plot studies, paired catchment studies and sedimentation surveys in the lake and reservoirs are the main activities in consideration under natural system monitoring.

Watershed monitoring involves systematically collecting, analyzing, and interpreting data about the physical, chemical, and biological components of a watershed. It aims to assess watershed health by monitoring water flow, quality, ecosystem health, soil conditions, and land use changes to identify trends and potential environmental issues. This process is key to informed watershed management decisions. It identifies issues and guides strategies for conservation, policy, and ecosystem protection.

Objectives

- To monitor changes in hydrological and erosion processes influenced by soil conservation and watershed management interventions.
- To systematically track physical, chemical, biological, and land use changes to understand watershed health and sustainability.
- To detect environmental changes, identify threats, and support evidence-based conservation and restoration planning.

Working Strategy

Watershed monitoring will be done within the entire watershed irrespective of land ownership. Run-off plot study, paired catchment studies, sedimentation survey, siltation rate analysis will be done with community people' involvement.

Scope

Generally, the activity includes:

- Soil erosion rate analysis
- Water/ soil quality monitoring
- Gully erosion rate analysis
- Run-off plots establishment and study
- Hydrological monitoring
- Land Use and Land Cover (LULC) monitoring
- Preparation of findings and dissemination of report

Unit: Numbers/plots

Symbol: 

4.7.2 Watershed Management Information System (WMIS)

Definition

Watershed Management Information System (WMIS) is a specialized platform or tool designed to collect, store, analyze, and disseminate data related to watershed resources and management activities. WMIS supports informed decision-making in water resource management, land use planning, soil conservation, and ecosystem restoration.

Objectives

- To consolidate and manage geospatial, hydrological, and ecological data for informed watershed planning.
- To track watershed conditions and model the impacts of land use and climate changes.
- To provide actionable insights to prioritize interventions and promote sustainable resource management.
- To facilitate the sharing of watershed data and management insights with stakeholders through user-friendly platforms and tools.

Working Strategy

The working strategy for the Watershed Management Information System (WMIS) involves a comprehensive approach, starting with the collection and integration of diverse data sources such as field surveys, remote sensing, and hydrological models. The system will be developed and customized to meet the specific needs of watershed management stakeholders, incorporating GIS tools for spatial analysis and decision support. Capacity building through training will ensure stakeholders are equipped to effectively use the system, while real-time monitoring will provide continuous updates on key indicators. Collaboration with local communities, policymakers, and researchers will enhance data relevance and application, and scenario modeling will inform decision-making. Information dissemination will be achieved through accessible reports, maps, and dashboards, promoting transparency and enabling informed decision-making. Finally, continuous feedback will drive improvements to the system, ensuring its effectiveness and adaptability over time.

Scope

- Collect socioeconomic, hydrological, and geographic data and integrate them into a common or central system.
- Analyze the effects of land use, erosion concerns, and water flow modeling.
- Provide information to the stakeholders with reports and maps.
- Provide support for formulating plans, policies, and decision-making.

Symbol: 

4.7.3 Bio-engineering Plots Establishment and Management

Definition

A bio-engineering plot is an area specifically established to demonstrate and promote the use of integrated vegetative and structural conservation techniques. These techniques are applied along roadsides, in landslide-prone areas, and within degraded watersheds to conserve watershed resources. The plot serves as a model for showcasing how these combined methods can effectively restore and protect vulnerable landscapes, preventing further degradation and supporting ecological recovery.

Objectives

- To widely disseminate the bio-engineering technologies at strategic locations

Working Strategy

To promote low-cost indigenous technology, demonstration sites will be developed with all implemented activities on bioengineering as far as possible. Apart from this, demonstration centers will be developed showing bioengineering techniques, methods, sites, etc.

Scope

Generally, the activity includes:

- Bio-engineering site selection
- Site survey for Bioengineering Centre establishment
- Discussion with local communities
- Bioengineering nursery establishment and seedlings production

Unit: Numbers/plots

Symbol: 

4.7.4 Conservation Demonstration

Definition

'Seeing is believing.' So, conservation demonstrations are established/developed to disseminate or transfer the information to the visitors or local peoples. It provides practical illustrations of sustainable watershed management techniques to field-level conservationists, enabling them to implement the measures demonstrated effectively. These demonstrations can serve as a hands-on approach to engaging stakeholders, including local communities, policymakers, and conservationists, in understanding and adopting best practices.

Objectives

- To illustrate the SCWM activities to disseminate the technology

Working Strategy

Demonstration may be categorized into two broad categories:

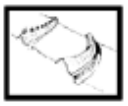
Demonstration Sites:

One or more activities are illustrated. Aggregates of demonstration sites along a trail may serve as demonstration sites.

Demonstration Centre:

- Several activities are illustrated in a composite area and demonstrations can be carried out on the farmer's land and on the community lands or small watershed. Demonstration of activities such as: conservation farming, compost making, stall feeding, fodder storage, improved stoves, treatment of thatching materials, sanitation program, biogas, solar energy, water energy, etc.
- Demonstrations of biogas, solar energy, and water energy are to be carried out on community basis. Demonstration of different soil conservation and watershed management measures may be carried on a small watershed without distinguishing private, communal and government lands.

Unit: Numbers /area hectare

Symbol: 

4.7.5 Action Research on Watershed management and climate resilience

Definition

Action research is a type of study that simultaneously investigates and solves the issues. In other words, it combines study with action. Action research on watershed management and climate resilience examines and resolves conservation as well as management related issues/problems at the same time.

Objectives

- To undertake research simultaneously with action about watershed management and climate resilience

Working Strategy

All the conservation and management measures will be followed by action research while implemented in the field. Watershed management and climate resilience measures and technologies will be taken as action research to enhance their effectiveness.

Scope

Generally, the activity includes:

- Action research along with activities implementation
- Documentation of the efforts
- Publication of the results
- Dissemination of the result
- Continue research on watershed management and climate resilience

Unit: Numbers/plots

Symbol: 

4.7.6 Conservation Exhibition/Extension

Definition

Conservation exhibition is an event for farmers, and user groups, where the conservation professionals will organize a mass gathering to disseminate the conservation education to the people. However, conservation extension is the expanding of information and services for conservation of the watersheds, environment, flora and fauna or biodiversity.

Objectives

- To make stakeholders and beneficiary communities aware of the conservation initiatives.
- To capacitate them for the promotion of conservation.
- To make the stakeholders more responsive towards the conservation initiatives.

Working Strategy

Most exhibitions about conservation highlight successful and dramatic treatments which have led to a significant discovery about a work of art. From paintings to sculpture, manuscripts to furniture, this exhibition explores conservation across the breadth of world-class collections. It considers issues that face the conservator and curator daily when deciding the best treatment for works of art in order to preserve them for the benefit and enjoyment of future generations whilst making them accessible to today's visitors.

Audio-visual shows are organized, and conservation education materials will be distributed during that event. The exhibition will also be an event for other district offices and non-governmental organizations to convey their extension message directly to the local population as well.

Unit: Numbers/days/places

Symbol: 

4.8 Monitoring, Evaluation and Learning

Monitoring is the routine collection and analysis of information to track progress against set plans and check compliance to established standards. Evaluation is an assessment, as systematic and objective as possible, of an ongoing or completed project, program or policy, its design, implementation and results. Monitoring and evaluation (M&E) is a process that helps improve performance and achieve results. Its goal is to improve current and future management of outputs, outcomes and impact. It is mainly used to assess the performance of projects, institutions and programs set up by governments, international organizations and non-governmental organizations. It establishes links among the past, present and future actions.

4.8.1 Coordination and collaboration

Definition

The meetings and workshops organized for coordination and collaboration purposes are called coordination meetings and workshops. Such coordination and collaboration meetings/ workshops are organized for coordination among wide ranges of the stakeholders.

Objectives

- To harness common efforts for collaborative actions
- To make common understanding among the various groups
- To achieve common goals through common understanding

Working Strategy

Coordination and collaboration are a very crucial element in efficient and effective delivery service and hence it should be done according to need and circumstances. All the SCWM programs/ activities will be implemented through better coordination. Green sector line agencies will be especially coordinated for the synergetic effort of the implemented programs.

Scope

Generally, the activity includes:

- Coordination workshop for stakeholders working in SCWM.
- Different seminar organization
- Different meeting organization

Unit: Number

Symbol: 

4.8.2 Joint Monitoring and Learning

Definition

The monitoring done jointly by all relevant stakeholders and donor agencies is called joint monitoring. It also refers to working collaboratively with other stakeholders/ partners. It should be seen as an approach, not a pre-defined system. Joint monitoring must grow organically, based on the circumstances. It is not a substitute for more in-depth evaluations.

Objectives

- To watch and ensure that activities are going on the right track
- To support ownership and mutual accountability among stakeholders
- To support 'alignment' and 'capacity development' objectives
- To generate information about whether development 'results' are being (or likely to be) achieved through a joint investment (to supports results-based management approaches)
- To enhance good governance.

Working Strategy

Joint monitoring is based on assessments of project progress/performance that involve various levels of joint engagement in i) deciding and planning what to monitor; ii) conducting field missions/visits; iii) production of monitoring reports; and iv) results- oriented analysis. The SCWM programs/activities will be monitored involving different stakeholders periodically.

Scope

Generally, the activity includes:

- Joint monitoring of the SCWM programs/activities with different line agencies
- Observation of on-going activities for their effectiveness
- Collection of information and preparation of report
- Dissemination of the report

Unit: Number of events

Symbol: 

4.8.3 Knowledge Management

Definition

A case study is an up-close, in-depth, and detailed examination of a subject (the case), as well as its related contextual conditions. It is a published report about a person, group, or situation that has been studied over time; also, a situation in real life that can be looked at

or studied to learn about something. It serves as a critical evaluation tool in watershed management. Over the years, researchers have extensively employed the case study research method across various disciplines, including natural resource management. Social scientists and environmental researchers frequently use this qualitative approach to analyze contemporary, real-world challenges, providing insights that inform the development of innovative practices and the adaptation of management strategies. In the context of watershed management, the systematic documentation and dissemination of case studies—referred to as case study documentation and sharing—play a vital role in promoting knowledge exchange, fostering adaptive management, and supporting sustainable practices.

Objectives

- To provide a more thorough analysis of a situation or "case" which reveal interesting information to the reader
- To study intensely one set (or unit) of something—programs, cities, counties, working sites as a distinct whole
- To replicate successful case studies
- To disseminate the features of case
- To have institutional memory

Working Strategy

Out of implemented programs/activities, some decent ones will be undertaken for a case study. Information collection, analysis, and findings will be disseminated. Local communities' involvement will be sought during case studies.

Unit: Number

Symbol: 

4.8.4 Public Auditing and Self Evaluation

Definition

Public audits are independent reviews of an organization's finances, operations, or performance to ensure transparency, accountability, and compliance with laws. The findings are made publicly available to promote responsible management of resources.

Public Audits of Projects (PAP) are very important to ensure transparency of budget with quality, quantity and contribution of stakeholders on development activities. Through these events, the public is aware of the costs of the project and prevents any misuse of the funds, as people can control the fund flows. So it strengthens the relationship and trust between the users' committee, user groups and development line agencies or partners.

Objectives

- To initiate improvements in public administration or to provide assurance to management that an activity is being managed effectively, economically and efficiently and in accordance with government policy/ legislation and community norms
- To enhance good governance
- To inform the local community about development works
- To improve individuals as well as institutions based on evaluation

Working Strategy:

The conservation groups/committees will perform public auditing of implemented SCWM activities for final completion and hand it over to them eventually. They will perform their evaluation for their betterment.

Scope

Generally, the activity includes:

- Public auditing of the SCWM activities implemented by the groups/committees
- Developing auditing formats
- Self-evaluation based on spider-web analysis
- Ranking of the groups based on evaluation

Unit: Number of event/number of group

Symbol: 

4.8.5 Activity Profiling

Definition

Profile activity is a strategy for outlining specific tasks and actions throughout the year, aimed at driving continuous improvement and ensuring more effective management of activities and progress over time. It clarifies the tasks, timeframes, resources, and the individuals responsible for each action. Additionally, it details the necessary resources and how they will be utilized.

Objective

- To document annual progress as an institutional memory
- To make a work transparent
- To increase the efficiency of program

- To mark everyone's duties and responsibilities at every stage of program
- To make monitoring and evaluation more easy

Working Strategy

This strategy will include documenting activities with initial and final photos to visually track progress, providing a clear comparison of before and after . It will also involve detailed budget planning and expenditure tracking to ensure financial resources align with the initial budget. Additionally, the modality of work will define the approach, methods, and processes for executing tasks efficiently, with regular reviews to optimize performance. Together, these key elements will ensure continuous improvement, effective resource management, and precise tracking of progress over time.

Scope

- Identification and documentation of activities with detailed locational information.
- Setting performance metrics based on physical and financial progress.
- Assessing beneficiaries, effects and impacts of SCWM.
- Documentation of responsibility and beneficiaries among the stakeholders.

Unit: Number

Symbol: 

4.8.6 GEDSI and SES Auditing

Definition

The process of assessing and examining an organization's or program's policies, procedures, and results from the standpoint of gender equality, disability, and social inclusion (GEDSI) is known as "GEDSI auditing." Gender, disability, and other types of social exclusion are to be taken into consideration to make sure that all plans and activities are inclusive and equitable. Social and environmental safeguards (SES) auditing in watershed management and climate resilience is the systematic assessment of programs compliance with safeguards to ensure social equity, environmental protection, and sustainability. It evaluates measures to protect communities, livelihoods, biodiversity, and ecosystems that are effectively implemented, identifies risks or gaps, and recommends improvements to align outcomes with established safeguards and sustainability goals.

Objectives

- Make sure marginalized groups have fair access to resources and decision-making processes.
- To improve community resilience and watershed health, social disparities must be addressed.

Working Strategy

- Assessing the integration of GEDSI and SES principles into water governance frameworks.
- Ensuring social equity, environmental protection and sustainability
- Empowering local communities in watershed management through participatory processes.
- Enhancing watershed resilience by valuing contributions from diverse groups in resource management.

Scope

- Inclusive Community Engagement
- Capacity Building and Education
- Gender-responsive Policies and Resource Allocation
- Monitoring, Evaluation, and Feedback
- Awareness and Advocacy

Unit: Number of event/number of group

Symbol: 

References

Achouri, M. (2005). FAO Watershed management review, Chapter 1: Preparing the next generation of watershed management programmes. In M. Achouri & L. Tennyson (Eds.), *Proceedings of the European Regional Workshop on Watershed Management* (pp. 11–17). FAO.

Asian Development Bank. (2020). *A Seven-Step Approach for Springshed Development and Management*.

Darghouth, S., Ward, C., Gambarelli, G., Styger, E., & Roux, J. (2008). *Watershed Management Approaches, Policies, and Operations: Lessons for Scaling Up*. http://www.worldbank.org/water.

Gichuki, F. N., & Tiffen, M. (1999). *People, Property, and Profit in Catchment Management: Examples from Kenya and Elsewhere*. https://api.semanticscholar.org/CorpusID:168439393

Government of Nepal. (2003). *National Wetland Policy*. www.lawcommission.gov.npwww.lawcommission.gov.np

IPBES. (2018). The IPBES assessment report on Land Degradation and Restoration (L. . S. R. . and B. A. (eds.). Montanarella, trans.). In *Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (Vol. 744). www.ipbes.net

IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]* (Vol. 218, Issue 2). https://doi.org/10.1016/S0022-0248(00)00575-3

MoFE. (2020). Second Nationally Determined Contribution (NDC) Nepal. *Government of Nepal*, 0–21.

MoFE. (2021). National Adaptation Plan (Nap). *Nap*, 2021–2050.

Negi, G. C. S. (2002). Hydrological research in the Indian Himalayan mountains: Soil and waterconservation. *CURRENT SCIENCE*, *83*(8), 974–980.

Reynolds, J. F., Smith, D. M. S., Lambin, E. F., Turner, B. L., Mortimore, M., Batterbury, S. P. J., Downing, T. E., Dowlatabadi, H., Fernández, R. J., Herrick, J. E., Huber-Sannwald, E., Jiang, H., Leemans, R., Lynam, T., Maestre, F. T., Ayarza, M., & Walker, B. (2007). Global Desertification: Building a Science for Dryland Development. *Science*, *316*(5826), 847–851. https://doi.org/10.1126/science.1131634

Rogers, E. M. (2003). *Diffusion of Innovations 5th Edition*.

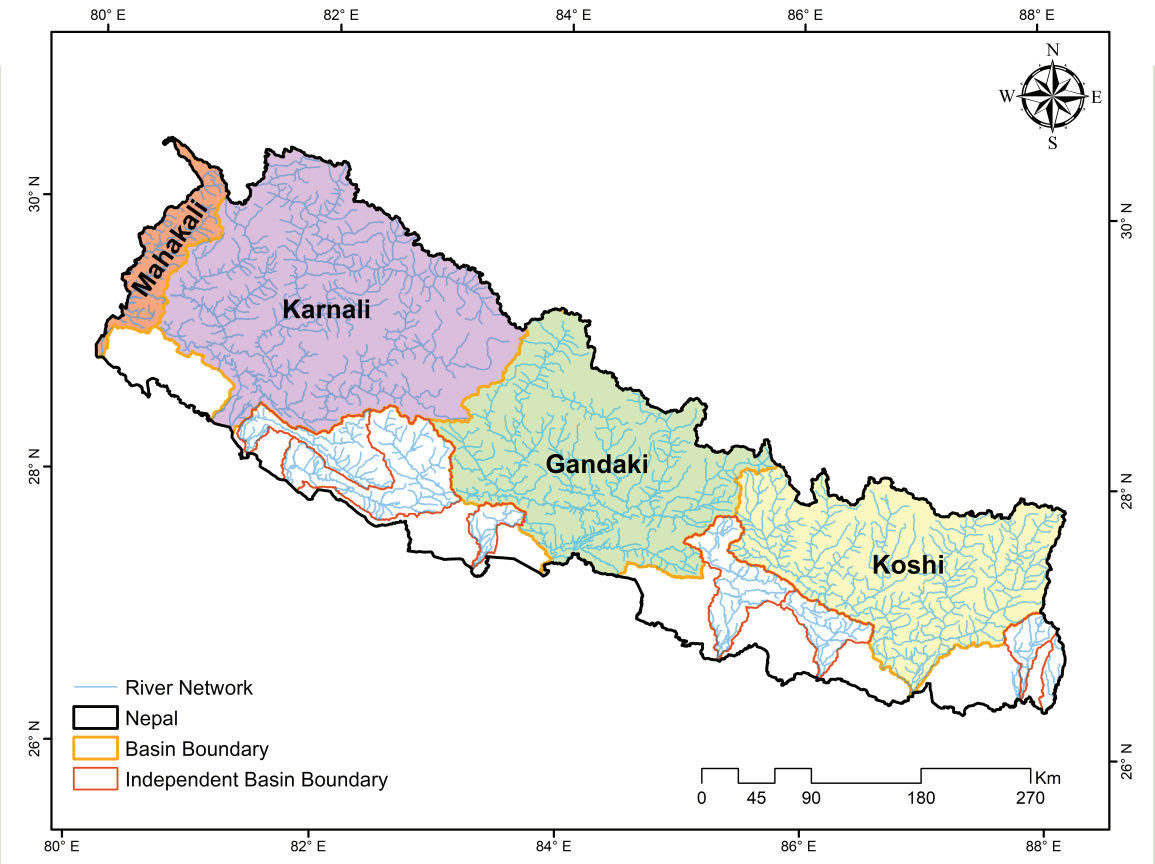
Sheng, T. C. (1990). *Watershed management field manual: Watershed survey and planning*.

Shrestha, R. B., Desai, J., Mukherji, A., Dhakal, M., Kulkarni, H., Mahamuni, K., Bhuchar, S., & Bajracharya, S. (2018). *Protocol for reviving springs in the Hindu Kush Himalaya/ : a practitioner's manual*. International Centre for Integrated Mountain Development.

Sivakumar, M. V. K., Wilhite, D. A., & Wilhite, D. A. (2002). *Drought preparedness and drought management*. https://www.researchgate.net/publication/267362571

UN General Assembly. (2016, December 1). Report of the open-ended intergovernmental expertworking group on indicators and terminology relating todisaster risk reduction. *A/ 71/644 Seventy-First Session Agenda Item 19 (C)*. http://www.preventionweb.net/drr-framework/open-ended-working-group/

UNISDR. (2009). *Terminology: Basic terms of disaster risk reduction*.



After the adoption of federalism in 2015, Nepal transitioned from a political boundary-based approach to a hydrological boundary-based approach for soil conservation and watershed management. The government now delivers these services through three tiers: federal, provincial, and local. At the federal level, the Department of Forests and Soil Conservation (DoFSC) oversees watershed management, supported by Basin Management Centers (BMCs) in four major river basins (Koshi, Gandaki, Karnali and Mahakali) and the Federal Watershed Management Resource Center, Kulekhani (FWMRC), which conducts research and technology demonstrations. At the provincial level, Soil and Watershed Management Offices (SWMOs) operate independently under their respective line ministries. Meanwhile, local governments play a crucial role by implementing conservation measures, climate adaptation strategies, and sustainable land-use practices while also providing valuable feedback to provincial and federal authorities to refine policies and ensure effective watershed management.

Government of Nepal
Ministry of Forests and Environment
Department of Forests and Soil Conservation
Phone: +977-01-5320303/5327574
Email: info@dofsc.gov.np
Website: www.dofsc.gov.np