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Article

Strategic pathways to scale up forest and landscape restoration: Insights from Nepal's Terai

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Abstract: Deforestation and forest degradation mostly caused by human interventions affects the capacity of forest ecosystem to provide ecosystem services and livelihood benefits. Forest Land Restoration (FLR) is an emerging concept which focuses on the improvement of ecosystem as well as livelihood of the people at the landscape level. Nepal has successfully recovered degraded forest land mainly from the hilly region through forest restoration initiatives especially community based forestry. However, the Terai region is still experiencing deforestation and forest degradation. This study navigated the gaps related to forest restoration in the existing policies and practices and revealed that the persistence of deforestation and forest degradation in Terai is a result of a complex socio-economic structure, limitation of government to implement appropriate management modality, unplanned infrastructure, and urban development. We suggest that forest restoration should focus on ecological and social wellbeing pathways at the landscape level, to reverse the trend of deforestation and forest degradation in the Terai regions of Nepal. The study provides a critical insight to the policy makers and practitioners of Nepal and other countries (with similar context) who are engaged in forest/ecosystem restoration enterprise.

Keywords: Deforestation, Forest Degradation, Forest restoration, Livelihood, Bonn challenge

1. Introduction

Deforestation and forest degradation (hereafter referred to as D & FD) is one of the major sources of terrestrial carbon emission [1]. The incidence of increasing D & FD is the result of over exploitation of forest resources, agriculture expansion, urbanization, infrastructure development, and other climate induced factors [2,3]. D & FD compromises the ability of forests to maintain the supply of ecosystem services. Forests provides various ecosystem services including provisioning services like fuelwood, fodder, timber, food, NTFPs for local livelihood and social wellbeing [4]. A decline in the supply of these products threatens the livelihoods of millions of forest-dependent

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populations [5]. Due to increase D & FD, forest landscape restoration has become both global need and concern [6].

Forest restoration not only contributes to improving biomass, carbon stock and biodiversity conservation, but it also helps to support the livelihoods of forest-dependent people [7,8]. Several countries, including Nepal, have made various global commitments for forest restoration, and have become the part of global conventions such as Aichi Biodiversity Targets 15 of the United Nations Convention on Biological Diversity [9], and the United Nations Sustainable Development Goal 15 which elucidates "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" [10–13]. The latest United Nations Decade of Ecosystem Restoration 2021-2030, also highlighted the need for greatly increased global cooperation to restore degraded and destroyed ecosystems, including forests [14]. These conventions and commitments have prioritized forest restoration as a key measure to fight against climate change, avoid species loss, and support rural livelihood [15,16]. In addition, a myriad of private and public restoration enterprises have emerged at multiple levels and scales [17].

Nepal as such has not formally committed to participate in forest restoration commitments such as the Bonn challenge [18]. However, the country has initiated forest restoration through several community based forest management modalities since 1970s [19]. As a result, there is a reverse trend in D & FD in Nepal, mid-hill in particular and the forest cover has increased from 39.6% in 1994 to 44.74% in 2014 [20]. However, D & FD is still a prominent issue in Terai and Siwalik regions [21].

The government has attempted to restore the Terai area through the maximum use of available lands including national forest, public lands and private lands. The handing over of government managed forest to the local community is considered as one of the strategies to reverse the trend of D & FD in Terai [22,23]. Similarly, the government has targeted to restore 50,000 ha in Terai, out of which 30,000 is private land and 20,000 ha is public land, through plantation by 2024 [24]. Despite the initiatives and policy provisions regarding forest landscape restoration, the annual rate of deforestation is still noteworthy with the rate of 0.44% between 2001 to 2010 [25]. If this rate remains constant until 2025, the current forest area of 314,600 ha (outside protected areas) will reduce to 301,086 ha, with a net loss of 13,574 ha of forest area (between 2015 and 2025). In addition, there are many national priority projects in Terai areas such as Nijgadh International Airport, the construction of national electricity grids, widening and construction of east-west highways, the establishment of the capital of Sudur Paschim Province, Lumbini Province, and development of special economic zones as per country's new federal structure, which claims removal of huge part of natural forests. Apart from this, the population growth in the Terai region is at a rate of 1.75% per year which has created heavy pressure on forest resources [25,26]. Also, the forest areas are being encroached to incorporate the rapidly increasing population. About 87,201 ha forest area was encroached in the 26 districts of this region within the year 2005 to 2009. The government has targeted to relieve 14,000 ha of the encroached forest area and revitalize during the first five years of the master plan implementation [27].

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The Terai region has 322 local governments out of 753 in Nepal. Among them, 36% (115) do not have forests and 49% (159) municipalities have less than 10% area under forest cover [28]. To cater to the growing population, it is imperative to focus on appropriate forest restoration mechanism by assessing the existing forest management modalities and programs in the Terai. In this perspective, this study has reviewed the history of forest management in Terai, assessed the existing policies and programs; and proposed a pathway of change that could provide policy implication for forest restoration in the Terai region of Nepal and other countries that have similar context and condition.

2. Analytical framework

This paper discusses the possibility of restoring the Terai forest landscapes in the context of the Bonn Challenge and United Nations Decade of Ecosystem Restoration. Given the context of the increasing D and FD in Terai Landscapes, it is imperative to act immediately by joining hands with the global initiatives. The decade on ecosystem restoration provides unique opportunity to combat the desertification in the Terai region of Nepal and also support in achieving the global forest landscape restoration targets.

This paper adopted the two stage approach. At stage one, it assess the drivers of D and FD in the Terai, and their consequences. In addition, it also analyzes the policy and practice response made to halt these D and FD. For this, we reviewed published literatures and consulted policy makers and practitioners who worked in the forest restoration initiatives. Total thirty (N=30) informants were consulted on the restoration initiatives in the country and underlying causes of D and FD in the Terai. We also analyzed the policy provisions made by the government, and assessed different practices done as part of the practice response with reference to the Terai. The information of the stage one provided the important grounds to pave the stage two to design the pathways to restore the forest landscapes. In stage two, we proposed pathways for achieving forest landscape restoration outcomes in the Terai using framework suggested by Erbaugh and Oldekop, (2018) . Though the pathways principally aim to restore forest ecosystem function and improve local livelihood and social wellbeing, they differ in their focus (**Fig. 1**).

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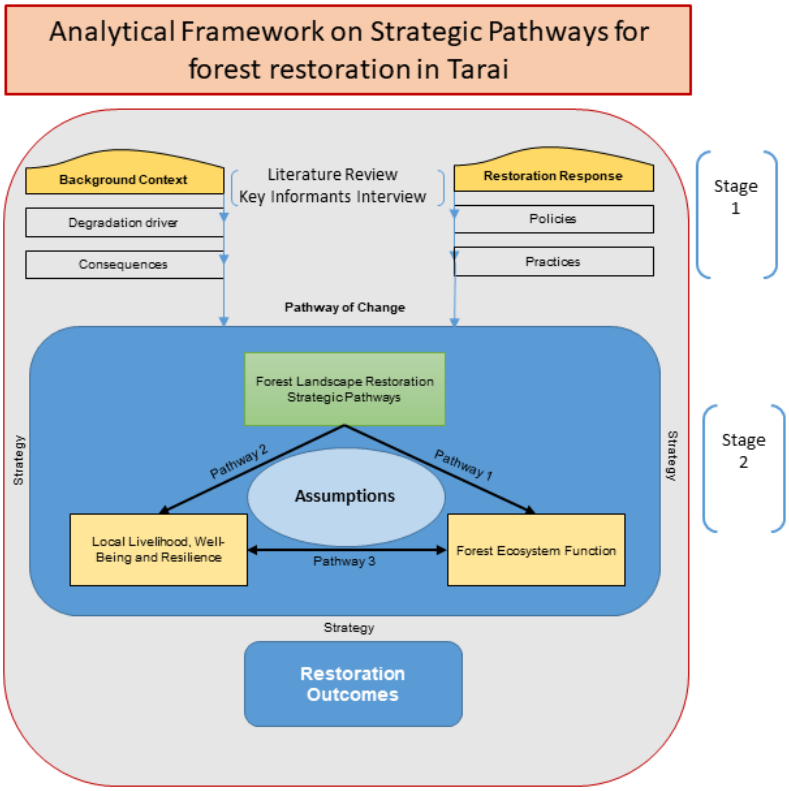

Figure. 1. Analytical Framework on Strategic Pathways for forest restoration in Terai (adapted from Erbaugh and Oldekop, 2018)

The first pathway (Pathway 1) focuses on the ecosystem recovery as its direct outcomes which can be achieved through site preparation, plantation, agroforestry, waste land management, and flood control measures. While recovering ecosystem also contributes to local livelihood and social well-being. The second pathway (Pathway 2) emphasizes on improving local livelihood and enhancing social well-being as a primary outcome. This can also contribute to the recovery of an ecosystem. We adapted this framework to deep dive and narrate the past and current FLR practices in Terai, and also draw where the gap is.

3. Context of Nepal's Terai

Spreading in the 26-32 km wide transect through east to west, the Terai physiographic region is a plain and fertile land, supporting 6.9% of the total forest area of the country [20]. Though Terai covers only 13.7% of the total land of Nepal (**Fig. 2**), it supports more than half of the total population of the country [26]. This region is well known for dense and high valued *Sal* (*Shorea robusta*) forest which harbor diverse flora and fauna [29]. The Terai region was inhabited by indigenous Tharu and Dhanuwar communities since the region was infested with malaria until 1960s. With the eradication of malaria, the region observed migration of communities mainly from the hilly region as part of the settlement program from the Government of Nepal and some migrants from India [30]. The increasing population pressure, urban growth, and infrastructure development negatively affected the quantity and quality of the forests over the years [31,32].

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Due to the availability of high-value tree species, flat terrain and productive soil, the government had exploited the land of Terai for revenue generation (Adhikari and Dhungana, 2010). The Terai forest has undergone rapid change over the years. From 1954 to 2015, nearly 70% of the forest has been lost in Terai (**Table 1**). To reduce deforestation and manage high value forest, government had piloted and implemented different forest management modalities, such as Operational Forest Management Plans (OFMPs), Community forest (CF), Collaborative Forest Management (CFM), Block forest management, President Chure Terai Madhesh Conservation and Development program and Protected Areas (PAs) system. However, as attempts are not sufficient to curb D and FD and support local livelihood [33], the Terai is facing both deforestation and forest degradation issues [25,31].

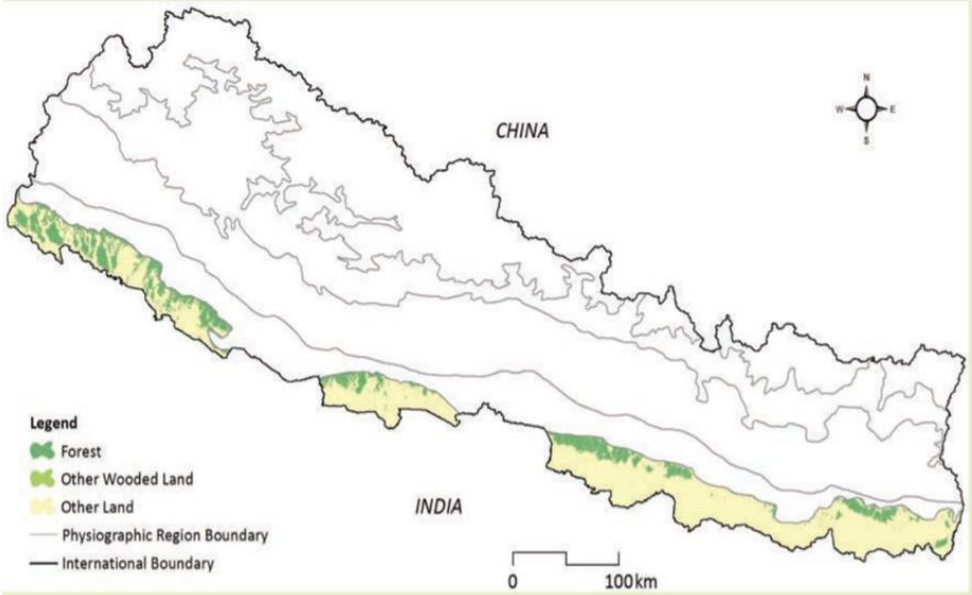

Figure 2. Location of the Terai region in Nepal (Source: FRA, 2014)

Table 1. *Forest area in different time period in Terai. (Source: Ghimire, 2017).*

Period	Forest area (ha)	Shrub/grass	River bed	Source
1954	476,081		50,908	Topographic map, Survey of India 1965
1979	240,850	44,010	72,529	LRMP
1994	166,623	46.211	84,511	Aerial photographs (1990-94)
2015	151,292	71,845	78,330	Google Earth Engine 2015, Landsat 8 and topographic map 1994

4. Policy discourse and their interaction with forest degradation and restoration outcomes: A decadal analysis

Nepal has gone through different evolutionary phases of policy development that have at times resulted in both negative and positive consequences. The institutional structures and their functions have also significant impact on forest restoration over the

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years in the country. This section navigates the historical development of forestry policies of Nepal since 1950s and their impact on the Terai forests (**Table 2**).

1950s: The Private Forest Nationalization Act 1957 has always been regarded as a major policy instrument for fueling deforestation in many parts of Nepal [34]. The act transformed the forest management under customary practices into open access resources. As a consequences, rapid deterioration of forest resulted through conversion of forested areas into farmlands through the random felling of trees across the country [35]. In addition, the government initiated resettlement program in Terai by inviting hilly migrants to convert forest land into agriculture and settlement [30] .

1960s: During this decade, the D and FD continued and even speeded up due to the resettlement program and because of forest area controlled by the government. The government introduced Forest Act 1961 and Forest Protection Act 1967 to curb deforestation, but emphasized the felling of Sal timber, mainly to export to India [36]. The government initiated some plantation projects in some areas mostly to supply raw materials [37].

1970s: Paradigm shift in forest management approach from state-centric to local government-centric as Panchayat Forest (PF) and Panchayat Protected Forest (PPF) was observed during this decade but it was limited only to mid-hill region. The Terai received more hill migrants as a result of malaria eradication, which fueled deforestation and forest degradation. The establishment of protected area (PA) started during this decade. Large-scale plantation of tree species such as *Dalbergia sissoo* and Eucalyptus *spps* started in communal and private lands to meet fuelwood and timber demand.

1980s: Policies devised during this decade primarily focused to conserve forests of mid-hill totally ignoring the deforestation in Terai [37] and initiatives were more focused to increase state control over the Terai forests. This resulted in loss of trust among the indigenous people who were guarding the Terai forest, therefore triggered deforestation [32,38]. Migration from the hills continued during this decade as well. Political movements too resulted in rapid destruction of forest and encroachment of forest area continued during this decade as well.

1990s: The expansion of CF was prevalent during this decade but in hills only and very few CFs were handed over in Terai as compared to Hills [39]. With the aim to replicate CF model of the hill, Community Forestry Project and Churia Hills Community forestry project were initiated in Terai and Chure[1] region. But the replication of the CF model from the hills did not get successful in Terai due to the issue of distant users and benefit-sharing accrued from high value timber [23,39,40]. Production oriented forest management was piloted in 19 districts in central Terai through the development of the Operational Forest Management Plan (OFMP) [19]. This decade showed exponential growth of population [26] thus experienced encroachment and forest degradation to meet shelter and food requirement for growing population. Political movements such as Maoist insurgency and beginning of a multi-party system intensified encroachment in forest land and exploitation of natural resources of Terai [30].

[1] Chure region is a foothill of Himalaya and considered as youngest mountain making it vulnerable to environmental degradation.

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2000s: Collaborative Forest Management modality was introduced in Terai which mainstreamed distant users who were largely ignored by the CF program [39,41]. Public land forestry was also introduced during this period with the formation of multi-stakeholder district level platform known as District Forest Sector Coordination Committee (DFSCC). At the same time, corridor approach initiated to connect PAs in the Terai region. These initiatives, to some extent, helped restore landscape of Nepal's Terai.

2010s to till date: The Government has introduced scientific forest management to increase the production and productivity of Terai forests in CFM in 2014 and expanded gradually in CF too. Similarly, 16% of the total encroached forest land was reclaimed [42]. Recently, Emissions Reduction Program has been implemented for 14 Terai districts to achieve 34.2 $MtCO_2$ carbon benefits (combined emission reductions and removals) over 10 years period [31]. Forest investment plan is going to be implemented in Terai, while integrated landscape management is under implemented.

Table 2. *An overview of policies, degradation factors and restoration initiatives in Terai region between 1950s and 2010s.*

Decade	National Policy/Legislation	Degradation Drivers	Impact	Restoration response
1950s	Private Forest Nationalization Act 1957	Migration and Resettlement Existing land tenure system (Birta) and Raikar.	Conversion of Private forest into farm land in Terai.	Strict protection of forest from people by forming sanctuaries and using force [32].
1960s	Forest Act 1961 Forest Protection Act 1967 with special provision	Encroachment and extension of settlement [30]	Forest categorization. Forestry officials empowered, judicial power to forestry officials. Law enforcement power reinforced	Protection and conservation of forests in Hills but less importance to Terai [37].
1970s	National Forestry Plan 1976, Amendment in Forest Act 1977, Panchayat Forest and Panchayat Protected Forest Rules 1978	Resettlement Land use change Encroachments Unsustainable harvesting	Clearance of massive forest area in Terai	Establishment of national parks in Terai.
1980s	Decentralization Act 1982 Revision of PF and PPF Rules1987 Master Plan for the Forestry Sector1989	Encroachments Unsustainable harvesting Grazing	Theory of Himalayan proposed environmental crisis as a result of forest degradation in the hills which caused flooding in the Terai [43]. Priority given to community forestry in the hills ignoring forest loss in Terai. Government	Forest handed over to local communities as community forest.

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			took control of Terai forest.	
1990s	Forest Act 1993 Forest Rules1995 Revision of Forest Act 1999	Illegal tree felling in national forest, CF being under protection in the hills Forest clearing for settlement and agriculture continued.	Degradation of Terai forest continued. Government piloted and tested new forest management approach [34].	Replication of hill model of CF but majority of CF handed over were degraded forest. OFMP were prepared and implemented in Terai
2000s	Revised Forest Policy 2000 Terai Arc Landscape Program started in 12 Terai districts covering 20% of Nepal's forest (2001) National Agriculture Policy 2004 National NTFP Policy 2004 Nepal endorsed REDD+2008	Economic and infrastructure development Grazing [30]	Established Collaborative Forest in Terai [39]. Increased productivity, production and environmental services of the forest. It identifies community, collaborative, leasehold, protection, buffer zone, religious and private forests as key tools of forest restoration. National Agriculture Policy: Marginal lands, pastures, degraded forests and waste public lands shall be handed over to target communities to support their livelihood and upgrade forests and other lands. Biodiversity conserved, promoted and utilized and the agro-forestry system developed in such a way as to improve the condition of degraded forests and natural reservoirs.	Replication of CF model of hills to Terai forests failed to show good results and criticized for elite capture, failure to address distant users and difficulty to control D AND FD. Piloting of CFM in 3 districts which later extended to other districts [39,41]. Forestry promotion outside the forests, e.g. public land forestry, agroforestry initiated in some districts.

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2010s	Nepal started working on Aichi Targets	Grazing Unsustainable tree cutting	By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems.	Extension of CFM. Plantation and forestry development outside the forest.
	National Biodiversity Strategy and Action Plan (NBSAP) 2014		The NPSAP contributes to Aichi target 5 concerning loss of natural habitats, and Aichi target 7, concerning sustainable use of forest to ensure conservation of biodiversity	
	Readiness Preparation Proposal 2010 Nepal submitted ERPD 2018		ERPD: The Terai ER Program sets an ambitious but achievable agenda to achieve 34.2 MtCO2e in carbon benefits (combined emissions reductions and removals) over a 10-year period.	
	Land Use Policy 2015		Land Use Policy: If forest area is to be used for national priority projects, afforestation equivalent to those areas-not less than that should be mandatorily done.	
	Forest Sector Strategy 2016-2025		Invited private sector for forest restoration	
	President Chure-Terai Madhesh Conservation and Management Master Plan 2017		Aim to reduce deforestation rate by 0.05%- from 0.44% to 0.18% in the Terai and Chure respectively. 500,000 ha of forest will be managed in 20 years period. By 2030, 300,000 ha of land will be managed as forest area	
	National REDD+ Strategy 2018		Reduce carbon emissions, enhance carbon stocks and ecosystem resilience through mitigation and adaptation approaches by minimizing the	

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Forest Policy 2019 June 27, ratified Kyoto protocol, Doha amendment	causes and effects of the drivers of D & FD, and promoting sustainable forest management across ecological regions.

4. Pathways for achieving forest and landscape restoration outcomes.

The decadal analysis and review of policy and practice reveal that the forest land of Nepal's Terai region is in jeopardy because of inadequate policy and institutional interventions from the government. The forest land is still under threats from a myriad of drivers, including unsustainable and illegal harvesting, overgrazing, forest fires, encroachment (from immigration and settlement in government-managed forests), resettlement (from the relocation of communities displaced by flooding along river corridors) and infrastructure development [31]. As D & FD is associated with complex direct and indirect drivers and processes in a mosaic of socio-ecological system, in-depth understanding of underlying causes of these drivers, complex structures and processes associated with ecosystem function as well as socio-economic issues is deemed important not only for combating D & FD problem in the Terai but also for stimulating restoration practices [30]. While addressing socio-ecological issues related to D & FD demands systematic and context specific pathways that provides a clear road map to achieve anticipated outcomes. In this context, we propose a Theory of Change that provides a pathway to deal with existing problems, identify and suggest pathways of change that address the existing problem along with the assumptions related to those pathways; strategies to move along those pathways; expected changes resulted from those strategies; and restoration outcomes resulted from those changes (**Fig. 3**).

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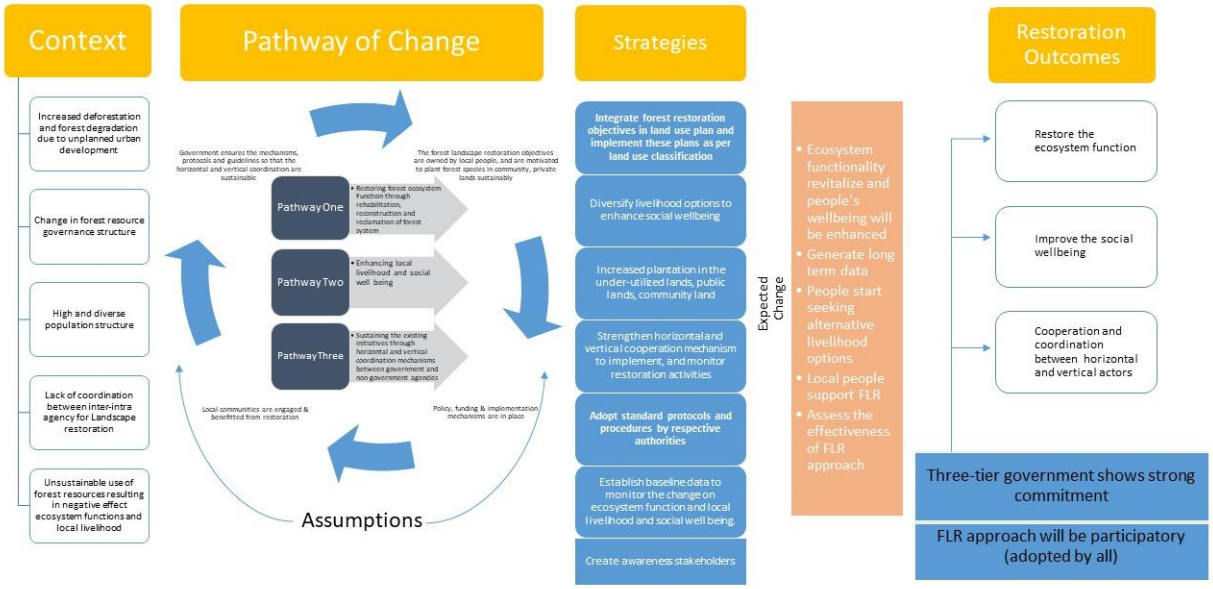

Fig. 3. *Schematic representation of Forest landscape Restoration (FLR) Theory of Change and impact pathways (modified after Erbaugh and Oldekop, 2018).*

4.1 Pathways of change

4.1.1 Restoring forest ecosystem functions through rehabilitation, reconstruction, and reclamation of forest systems

This pathway intends to rehabilitate, reconstruct and reclaim forest ecosystem function. The government of Nepal has been adopting this pathway since 1960s and has made budgetary provisions to restore the forests through carrying out several restoration activities like nursery establishment, seedlings development, and plantation programs annually in public and private lands. Furthermore, large-scale planation such as *Dalbergia sissoo*, *Eucalyptus* spp. were promoted, however such large monoculture plantation faced various problems including dying and diseases. The establishment of PAs like, national parks, wildlife reserves also contributed directly to restoration outcomes. The government investments are also made through deployment of security forces (Nepal army and armed forest guards) in forests and protected areas. In some cases, people have been displaced from the core areas with or without providing compensation [44].The pathway is successful in the rehabilitation of degraded areas, reconstruction of lands used in different purposes (for example agriculture), and reclamation of naturally degraded areas, mainly due to landslides, river bank erosions and flash floods. However, scholars have argued that escaping peoples' participation has negatively affected the livelihood of affected people as well as brought detrimental effects to forest restoration outcomes [19,45]. This pathway thus has to be linked with other pathways for effective restoration results [14].

4.1.2 Enhancing local livelihood and social wellbeing

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One of the criteria to be considered for successful restoration is enhancing local livelihood and social well-being [5]. However, local livelihood and social wellbeing are often ignored in Terai by the government. The management of Terai forest mainly are state controlled with very low participation of local communities. Therefore, forest management approaches such as OFMP which was considered as technically sound failed to generate the intended outcome in Terai because of not integrating livelihood concerns of local people. Community Forestry too did not succeed to cater the demand of indigenous and distant forest users and failed eventually [21]. For achieving restoration goals, the livelihood of the forest-dependent population has to be supported through activities like forest-based enterprise and green economic activities such *Sal* leaf plate making, bamboo furniture, essential oil production etc. Nevertheless, infrastructure has to be developed to ensure the smooth functioning of such enterprises through linkage with market, insurance mechanism and value addition activities. Researches have suggested that interventions integrated with livelihood improvement activities reduce pressure on the forest and side by side help achieve other objectives, including forest and ecosystem restoration [45,46].

4.1.3 Sustaining the existing initiatives through horizontal and vertical coordination mechanism between government and non-governmental agencies

Landscape level restoration requires an integrated approach involving engagement of multiple actors (both state and non-state actors), including government bodies, non-governmental organizations, private sectors and civil society organizations [47]. Majority of the restoration activities that were implemented in the Terai so far undertaken in an isolated approach that often lacks coordination between and among the national and sub-national actors. Few initiatives such as President Chure Terai Conservation Program and Terai Arc Landscape program showed successful results. Recently, Nepal has undergone massive changes in its governance structure as per the federal system. In this perspective, the local government can take lead and bring on board government and non-government bodies in forest restoration activities. Historically, massive structural and policy changes took place on land use, urban development, and structural buildings. The primary indicators of these developments have resulted negative impact on the forest areas [35]. The then Department of Forests solely taking the responsibility of forest conservation on its shoulder, is facing huge challenges to halt D & FD. Restoration not only involves planting and growing trees and developing it into forest, but it also consists of maintaining the function of ecosystem and making it in line with global normative change and discourse [48] . Therefore, an integrated land use plan has to be made keeping in view the impact of development at a landscape level. Similarly, the urban planning needs to be made in a way that the net effect on forest ecosystem is null or minimum. This demands horizontal coordination among the different line agencies at all levels right from policy formulations to implementation and monitoring and evaluation. Also, there is a need to have vertical coordination within the thematic ministries, departments and grassroots level institutions to maintain uniform understanding while translating the restoration policies and priorities into practice [47]. In a nutshell, enabling environment should be made in a

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way that all stakeholders can actively participate in designing, planning, implementing and monitoring forest landscape restoration interventions.

4.2 Strategies for development

To guide the aforementioned pathways for forest landscape restoration in Nepal's Terai, we have suggested the following seven strategies.

4.2.1 Integrate forest restoration objectives in land use plan and implement these plans as per land use classification

Forest restoration practices may institutionalize only if the restoration objectives are embedded in country's policy instruments and development plans, particularly in the land use plan. As the country has recently gone federal system, most of the newly restructured local level governments lack proper land use plan. Even if they have, they lack skills and knowledge in integrating restoration strategies and implementing actions as per land use classification. Capacity development with regards to land use plan preparation, training and orientation to forest restoration practices and continued support (financial and technical) for restoration activities could be some of the working strategies where the governments (local and provincial governments) can channelize their investment.

4.2.2 Diversify livelihood options to enhance social wellbeing

Local people of the developing countries effectively participate in the forest restoration activities only if the proposed program/initiative addresses their livelihood issues. Researches have shown that the involvement of local people encourage participation, improves accountability and overall effectiveness of the program [46,49]. Investment in the diversification of income sources of local people and awareness raising programs (on ecosystem goods and services) may help to achieve the goal. Diversification of livelihood option of forest-dependent through the investment in forest-based enterprise and income generating activities help to reduce direct pressure on existing forest resources and contribute in the green economy [50]. On the other hand, awareness raising program inform local people on ecological integrity, functionality and goods and services of forest and other ecosystems. The provincial and local governments can invests in generating off- farm employments to the forest and agriculture dependent poor communities.

4.2.3 Increase plantation in the under-utilized, public, and community lands

In Terai, the forest is located in the northern area and mostly managed by the migrated population. The indigenous populations who are living in the south are devoid of access to forest resources. Plantation should be targeted to private and communal lands in these forest deficient areas. Study shows that Nepal's Terai region have large area of underutilized public and community lands that can be converted into the forest land with local's participation [46]. Implementation of restoration activities in these lands not only helps to increase forest cover, but also provides ecosystem goods and services that help to address the subsistence needs of local people and improve local

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livelihood [46]. The restoration activities reduce pressures to the natural forest lying in the northern part of Terai and ensure the continued flow of ecosystem goods and services to the south. Apart from public and communal land, private forestry and agroforestry should be promoted. However, the restoration of a large chunk of Terai's land demands huge investment from the government (local and provincial) [51]. As forest landscape restoration is not a one-time event, the provincial and local governments can take a lead to gradually advance the process. At first, they may undertake an inventory of the underutilized and private lands (under their jurisdiction and rights). Secondly, they can prioritize these lands for undertaking restoration activities based on the inventory and assessment. And finally, governments can implement restoration activities through intensive coordination with related stakeholders. Subsequent follow-up and monitoring is also required to ensure the success of the restored ecosystem after undertaking restoration activities.

4.2.4 Strengthen horizontal and vertical cooperation mechanism to implement and monitor restoration activities

Forest restoration initiatives implemented at various scales (national and subnational) lack horizontal and vertical coordination among the governments and with stakeholders. Strengthening horizontal and vertical cooperation and coordination mechanism (horizontal and vertical) among three-tier governments is of utmost importance to make the stakeholders aware of shared but differentiated responsibilities [34] on forest and ecosystem restoration processes and practices [47]. At the provincial and local level, coordination and cooperation mechanisms can be set up by involving relevant stakeholders including local people and the private sector. This coordination mechanism may not only augments the coordination environment between the stakeholders while undertaking forest restoration activities, but it also enhances uniform understanding and concerted efforts to resolve restoration jurisdiction related issues, thereby enhance shared ownership [14].

4.2.5 Adopt standard protocols and procedures by respective authorities

Nepal has initiated forest landscape restoration activities since 1960s both in hills and Terai. Although the country is making a huge investment in forest restoration activities, anticipated result, at least for the Terai region, has not been achieved so far. It is partly because of the lack of standard protocols and procedures for forest landscape restoration processes and practices. It's high time that the government develops site specific (considering site specific forest and ecosystems) protocols and procedures for undertaking forest restoration activities. The federal government, in this regards, can develop guiding protocol in line with global restoration policy and practices. While the local and provincial governments may develop site-specific protocols and procedure within the overarching framework of the federal-level guidelines. These kinds of protocols and procedures may work as a guiding framework for all governments to facilitate restoration related activities. On the other, it makes them flexible enough to choose appropriate activities that suit their local environment and context.

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4.2.6 Establish baseline data to monitor the change on ecosystem function and local livelihood and social wellbeing

Nepal has set an example in participatory forest landscape restoration in mid-hills. However, there is limited evidence on how the restoration related activities are being implemented in the Terai region. In this perspective, the establishment of baseline data is essential to gauge the efficacy and effectiveness of implemented restoration activities and to take inference/lesson for forest restoration related decision-making and evidence-based planning. To mainstream and institutionalize restoration discourse at sub-national, local and provincial-level government can start establishing baseline data and link with the national-level database. This will bridge not only the national and transnational data gaps in forest landscape restoration but it also makes ecosystem restoration planning scientific and well-grounded.

4.2.7 Create awareness among stakeholders

Awareness raising is a powerful tool to change people's behavior [52]. As restoration activities are directly related to rehabilitating and restoring degraded ecosystem at least at a functional level, making the stakeholders aware of the need for ecological restoration is helpful in both enhancing people's participation and stimulating mass movement for the restoration initiatives. For this, champions and role models including actors and political leaders can be selected and mobilized for awareness and capacity building activities.

5. Conclusions

Despite the long history and legacy of forest and ecosystem restoration practices in Nepal, the anticipated outcome hasn't been achieved in Nepal's Terai region. Moreover, the forests and communal land are still under threats from a myriad of drivers, including population growth, unsustainable harvesting of forest products, and unsystematic development activities. This study assessed the historical forest restoration practice of Nepal, mainly in Terai; and have suggested range of context specific working strategies and pathways both to minimize deforestation and forest degradation and institutionalize and localize FLR discourse at the sub-national level. As the ecological pathway alone cannot guarantee the success of the restoration program, particularly in the developing world, we argue that programs addressing socio-economic issues of the locals also need to be integrated into the policy and planning framework of FLR. The study provides a critical insights to the policy makers and practitioners of Nepal and other countries who are engaged in forest/ecosystem restoration enterprise

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