

Sustainable Forest Management – Forest Policies Change in Pakistan to Increase Carbon Sequestration and Mitigate Climate Change

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Abstract. Currently, the forestry sector in Pakistan is confronted with many challenges, including deforestation, massive degradation of forests, a decline in their productivity, loss of biodiversity, soil erosion, desertification, and a reduction in environmental and recreational values, making the country one of the most vulnerable to climate change effects. The Global Climate Risk Index has placed Pakistan as the 8th most vulnerable country to climate change impacts, in spite of the fact that Pakistan's contribution to global greenhouse gas (GHG) emissions is less than 1%. The underlying causes for this situation include population pressure, dependence of local communities on forests and a lack of economic incentives for them, lack of modern & SFM approach, weak enforcement or non-compliance with laws and policies, ambiguous land tenure systems, prolonged droughts, forest fires, and floods; transfer of forest lands for non-forestry purposes; forest land encroachment; lack of intra- and inter-sectoral coordination; a lack of technologies and alternatives for wood; and lack of awareness of the benefits of forests beyond wood and non-wood products. Currently, efforts are being made for the revival of forestry through mega tree plantation programs and the strengthening of regulatory mechanisms. But still, future emissions of GHG are expected to increase due to rapid deforestation, land-use changes, and planned development in the infrastructure sector. Hence, to sustainably maintain the existing natural forests, increase carbon sequestration, and decrease GHG emissions, the adoption of modern forest management practices and various policy measures in the forestry sector are recommended. This includes strategies to increase green cover, i.e., afforestation; modern forest management practices in their true spirit; promoting ecotourism; strengthening and implementing relevant policies and laws; strengthening concerned institutions; paying incentives and providing ecosystem services to dependable communities; and encouraging energy from renewable sources.

Key Words: Forest, sustainable management, Carbon Sequestration, GHG Emissions, Policy Measures.

Introduction

Sustainable forestry development emphasizes on responsible management of forest resources to ensure long-term ecological, economic, and social benefits. Sustainable forestry practices help protect and restore biodiversity by preserving forest ecosystems, reducing habitat destruction, and promoting the connectivity of forest landscapes. Unsustainable management of forests, deforestation, and land-use changes have contributed to the degradation and loss of forest ecosystems. These activities release significant amounts of CO₂ into the atmosphere and lead to biodiversity loss, habitat destruction, and socio-economic challenges for local communities. CO₂ is one of the Green-House Gases (GHG) that trap heat in the Earth's atmosphere, creating the greenhouse effect resulting in global warming and climate change. Human activities, primarily the burning of fossil fuels, deforestation, and industrial processes, have significantly increased GHG concentrations in the atmosphere. Carbon dioxide (CO₂) is

the most prevalent greenhouse gas and has a significant impact on climate change.

Climate change has severe consequences, including rising temperatures, sea-level rise, extreme weather events, and disruptions to ecosystems and biodiversity. It is recognized as one of the most significant challenges facing humanity and the planet. Mitigating the climate change and reducing the carbon emissions has become global issue of pressing concern for human survival and sustainable development. Over the past few decades, the human has become cognizant of the adverse effects on climate change due to increased concentration of carbon, and has recognized the need to address the issue through transition towards a low carbon economy. This shift involves reducing reliance on fossil fuels and adopting an approach that combines two or more methods or initiatives to enhance carbon sequestration and reduce greenhouse gas emissions.

The quest for sustainable forestry and sustainable economic development has led to innovation and deployment of green technologies in many developed countries of the world. Investments and innovation in renewable energy, green infrastructure, energy-efficient technologies, and sustainable forestry practices have the potential of creating new industries, generate employment, and stimulate economic growth while reducing carbon emissions. The forests act as natural carbon sinks by absorbing and storing CO₂ in their biomass and soils as carbon stock. This carbon sequestration helps reduce the concentration of greenhouse gases, mitigating global warming and its impacts. Therefore, forestry sustainable development can contribute for sure, to carbon sequestration and addressing the climate change by conserving and expanding forest cover.

Objectives and scope of the Study

The primary purpose of this article is to briefly review the current situation of forest management in Pakistan, implementation of the prevailing forest and climate change policies, identify issues and propose a comprehensive dual carbon strategy specifically tailored for Pakistan to enhance carbon sequestration and reduce GHG emissions in Forestry Sector.

Methodology /Approach

Various research papers, journals, and articles related to the topic, including those on forests and climate change policies, were reviewed. Moreover, online meeting and informal phone interviews of the officers working in the Federal Ministry of Climate Change, provincial forest departments, and the REDD+ Program were conducted to assess the current status of forest management across the country, the implementation status of the relevant policies, identify gaps and recommend policy improvement measures for sustainable forest management and enhancing carbon sequestration.

Literature Review

Globally, seven main features of Sustainable Forest Management (SFM) are used as a reference framework for checking one's forest for its sustainability, which include the extent of forest resources, forest health and vitality, forest biological diversity, forest productive and protective functions, socio-economic functions, and the legal, policy, and institutional framework (Siry et al., 2005; Sarre & Sabogal, 2013). According to Li, N. (2014), the objective of SFM is to make sure that the goods and services derived from the forest fulfil people's needs while also maintaining their continued availability and contribution to long-term development.

According to the FAO, as of 2000, the world had 3.9 billion hectares of forests, of which 87% were under public ownership. Nearly 1.7 billion ha of forests (43%) were stated to be covered by forest management plans, and 477 million ha (12%) were under formal forest protection laws. Forest certification includes 121 million ha (3%) of forests, with 93% of the certification occurring in the Northern Hemisphere but most of the deforestation occurring

in the Southern Hemisphere. Many countries in the world are trying to achieve sustainable forest management (Siry et al., 2005).

According to the IPCC's Fifth Assessment Report (2007), global deforestation and forest degradation contribute about 11% to global GHG emissions. At the same time, the forestry sector has the potential to sequester 31% of CO₂ emissions, transforming it into a major carbon sink for the country. Therefore, halting deforestation is one of the most important activities to mitigate the impacts of climate change.

The increasing emissions of GHG such as carbon dioxide (CO₂), nitrous oxide (N₂O) and methane (CH₄) cause global warming. The current greenhouse gas concentrations have reached levels that endanger the earth's climate and ecosystem balance (Jagger et al., 2011). Climate change has become a serious issue due to the increasing accumulation of GHG dominated by carbon dioxide (Tangang et al., 2012). Forest ecosystems can play a significant role in reducing CO₂ from the atmosphere via photosynthesis and storing carbon in tree biomass and in the soil. Fossil fuel combustion processes in industries cause around 80% of GHG emissions, whereas the forestry and agriculture sectors only account for 20% of emissions. Nonetheless, the forestry sector has a significant role in controlling GHG emissions.

Forest management activities in developing countries can be used to sequester carbon to achieve emission reductions under the Clean Development Mechanism of the Kyoto Protocol. Forestry sector management options for mitigation, should consider the trade-offs between increasing forest ecosystem carbon stocks and other forest functions and increasing the sustainable rate of harvest and transfer of carbon to meet human needs (Seidl et al., 2007). The greatest source of GHGs emission is human activities such as fossil fuel consumption for heat and electricity production, industrial processes, and transportation which are sources of GHG. Deforestation is the second leading cause of anthropogenic atmospheric CO₂ emissions worldwide. Forest policies help in defining the retention, use, and protection of forests. Hence, policy tools must adapt to realize the goals of multi-functional forestry. The evolving nature of modern sustainable forestry goals need development in forest policy instruments, for multi-function (Cubbage et al., 2007).

CO₂ emissions changes are associated with changes in production level, processes and subsequent energy consumption. Various solutions have been proposed by researchers e.g. emission trading and imposing CO₂ taxes by government may serve the purpose of energy savings and emission reductions by mills (Lipiäinen and Vakkilainen, 2021). In addition to the aforementioned political means, technological development, especially biomass-based carbon capture and storage (BECCS, BECCU) technologies, may speed up reductions in emissions in the future forest industry (Kuparinen et al. 2019).

The Global Climate Risk Index developed by Germanwatch for 2021 has placed Pakistan as the 8th most vulnerable country to climate change impacts in spite of the fact that Pakistan's contribution to global greenhouse gas (GHG) emissions is less than 1%. Pakistan is a party to the United Nations Framework Convention on Climate Change (UNFCCC) which has recognized deforestation as one of the main sources of emissions of carbon resulting in global warming. The FREL report has scientifically assessed the average annual rate of deforestation up to about 11,442 hectares whereas, an increasing trend of more than 17,000 ha was observed from 2008-2012.

According to REDD+ Report of Ministry of Climate Change Pakistan, most of the area affected by deforestation during 2004-2012 consisted of riverine (34%), scrub (20%), dry temperate forests (19%), pine (13%) and thorn forests (9%). The highest rate of deforestation is observable in the riverine forest of Sindh Province owing

to the introduction of Forest Land Lease Policy in 2004 which lead to substantial clearance of riverine forests for agricultural use. The mean annual emissions from the deforestation were up to 1.0 million tons of carbon equivalent (CO₂e) between 2004 and 2012 with the projected increasing emission trend from further deforestation. The largest share of CO₂ emissions originated from dry temperate forests (34%), riverine (27%) and Chir pine forests (16%) followed by moist temperate (11%), scrub (9%) and thorn (3 %) forests in 2004-2012. Based on above, the National Forest Reference Emissions Level (FREL) has been set as approximately 946,653 tons of CO₂e emissions per annum. Forestry and land use change contribute approximately 3% to Pakistan's total greenhouse gas (GHG) emissions, i.e., around 9 MtCO₂e in 2008 (Khan et al., 2011). By 2050, this figure is expected to fall to 0.36% (Khan et al., 2011). Reforestation programs normally serve as a low cost solution to reduce GHG and increase carbon sequestration through photosynthesis.

Results and Discussions

Framework for Integrating Sustainability and Carbon Sequestration in Forestry

Sustainable development of forests incorporates a range of tools and approaches to achieve its objectives. These include forest certification systems (e.g., Forest Stewardship Council, Program for the Endorsement of Forest Certification), participatory management approaches, ecosystem-based management, and adaptive management strategies. These tools provide frameworks for planning, implementing, and monitoring sustainable forest practices, ensuring the long-term integrity of forest ecosystems. Unfortunately, the first two of the aforementioned tools are lacking in Pakistan's Forestry Sector. Forest Policy of a country sets the direction and main priority of a country. To understand the Pakistan's forestry sector priorities over the past and extent of success achieved in sustainably managing the forests, a brief review of its forest policy evolution is given below.

Evolution of Sustainable Forest Management Policy in Pakistan – A Historical Perspective

The history of forest management and conservation in Indian Sub-continent is divided into British Period (19th to 20th Century) and Post British Period that begun in 1947 when Sub-continent was divided into two independent countries i.e. India and Pakistan. The new country Pakistan adopted its laws manuals from the British with certain amendments. Forest Act 1927 was enacted in the country for the management of forest lands. Later on, various forest policies were formulated from time to time for forest management. The first forest policy of Pakistan was announced in 1955, followed by those of 1962, 1975 and 1980 as part of the National Agricultural Policy, 1991, 2001, 2010 and the latest in 2015. Forestry operations of Khyber Pakhtunkhwa (KP), Punjab and Gilgit Baltistan (BG) are governed under their own provincial policies.

Stages of Pakistan's Forest Policy Evolution

To understand the analysis of the policies and the changing perspectives in it over time, the evolution history of the Pakistan Forest Policy is divided in to following three stages:

1st Stage- Forest Policy in Colonial Period (1894-1955)

Forest Policy 1894

2nd Stage- Forest Policy Dominated by Timber Production (1955-1992)

National Forest Policy 1955

National Forest Policy 1962

National Forest Policy 1975

Policy on Forestry and Wildlife 1980 (as a part of National Agricultural Policy)

National Forest Policy 1991

3rd Stage- Forest Policy Shifted to Conservation (1992 to today)

Forestry Sector Master Plan (1992)

National Conservation Strategy (1992)

1993 Policy Banning the Commercial Felling of Trees in Timber Forests

Forest Policy 2001

National Forest Policy 2010

National Forest Policy 2015

Overall Analysis of Pakistan Forest Policies

After getting independence in 1947, Pakistan continued with the British Forest Policy of 1894 /of colonial period till formulation of its own forest policy in 1955. The main objective behind British' forest management was production of sleepers for railway track and fuel for engines through forests to ease the communication of British Army to fulfill their strategic objectives in Indian-subcontinent. It had a tightfisted control over forest resources.

As stated earlier, Pakistan's first national forest policy after independence was announced in 1955, guided by the Central Board of Forestry (established in 1952), and aimed at increasing the area under forests. This was then replaced by the National Forest Policy of 1962, with a primary objective of revenue generation and maximization of yield from forests. It was followed by the National Forest Policy 1975, which is considered a relatively people-friendly policy as it recognizes owners' rights to manage guzara forests. This was again replaced by the 1980 National Policy on Forestry and Wildlife, which emphasized the planting of fast-growing species and fuel wood and the involvement of people in tree plantations and nature conservation.

The Pakistan Forest Policy of 1991 was primarily influenced by donors' interest in promoting forestry programs at the grassroots level. Although it had good intentions, it also could not achieve the objectives of sustainable forest management. It set a very ambitious target of increasing the afforested area from 5.4% to 10%, which even today is a dream. This policy was again targeted at increasing revenue at the expense of people's rights to natural resources. So, until 1991, forest policies aimed primarily at timber harvesting from timber forests (both natural and man-made modern timber forests), with the concurrent goal of increasing forest cover.

In short, until 1991, forest policies were formulated on the recommendations of experts drawn from different fields. These policies, though strong on technical considerations, lacked the imaginative flexibility to make them work in the real situation. The cornerstone of these forest policies was the principle of conservation and traditional management of forests to fulfil the demand for timber and fuelwood. Since Pakistan has a narrow resource base, the forest policies have focused on maximizing the production of wood through intensive forest management, i.e., short rotations, artificial regeneration, and the use of fast-growing tree species. Communities reliant on forests for a living were viewed as a barrier to sustainable forest management and were never involved in the formulation, planning, or management of forestry policies. However, it is still to the credit of these forest policies that tree planting campaigns were organized at the national level in order to expand the forest resource base in the private sector.

The National Conservation Strategy (NCS), 1992 seeks to approach the entire set of economic concerns through the sustainable development paradigm. The document is not limited to forestry. In fact, it is considered the landmark document on incorporating environmental concerns into all national policies. The twenty-five-year Forestry Sector Master Plan (FSMP) prepared in 1992, is an overarching document that provides the general vision for the forestry sector. The broad goals identified in the plan are to protect, manage and rehabilitate forests, increase

fuel wood production in upland watersheds and lowland farms, as well as improve land use and productivity in order to address rising poverty.

In response to disastrous floods in 1992-93, the government of Pakistan initiated some major reforms for the conservation and management of forests (Yusuf, 2009; Fischer and project, 2010; Ahmad et al, 2022). This included a Forestry Sector Master Plan (1992) mentioned earlier, and ban on logging in timber forests throughout the country. This policy (Ban) came in the form of an executive order by the caretaker government in 1993. Initially it ordered a complete ban on commercial forest exploitation for two years. The ban was successively extended by following governments until 2001. While the ban was supposed to ensure preservation of forests against commercial exploitation and thus decrease pressure on the already degraded resources, at the same time devising a plan for regeneration, in retrospect its imposition proved to be counterproductive. The ban adversely impacted forest owners who depended on income from commercial timber proceeds for their livelihood. This coupled with the weak management of forest resources prompted interest groups to conduct illegal felling and smuggle timber to the markets. Throughout the ban period, owners colluded with the timber contractors and as a result substantial amount of timber was harvested illegally from timber forests.

Moreover, given the ban, timber prices skyrocketed, thus increasing the profit margins from illegal harvesting. Interestingly however, given that the owners were forced to sell timber in the black market they did not manage to capture market prices. It was the mafia (smugglers) that ended up receiving bulk of the timber profits. Also, since marking for legal cutting ceased, communities did not receive royalties from timber proceeds, which further removed any incentive for forest protection. The government also lost billions of rupees in revenue from commercial sales of forest products.

The new policies, from 2001 onward, have conservation approach including element of climate change and reduction of GHG emissions. Currently, the Forest Policy 2015 is in vogue in Pakistan as a National Forest Policy. The current National Forest Policy, promulgated in 2015, directly affects the forest sector. It has two main policy objectives: (a) to increase forest cover and (b) to reduce deforestation and promote forest conservation. Forest policy envisages the integration of REDD+ as a tool to improve forest cover, conserve forest carbon stocks and combat deforestation. The goal of this document is the expansion of national coverage of forests, protected areas, natural habitats and green areas for restoration of ecological functions and maximizing economic benefits while meeting Pakistan's obligations to international agreements related to forests.

The specific objectives are: (i) enhancing public awareness on economic, social, ecological and cultural values of forests, (ii) implementing a national level mass afforestation program to expand and maintain forest coverage to meet international standards, (iii) controlling deforestation through regulating movement of timber and inter-provincial trade of timber, (iv) establishing and managing protected areas and networking through ecological corridors, (v) reducing carbon footprints of energy and economic sector programs, (vi) facilitating the implementation of international conventions and agreements related to forestry, biodiversity and climate change, (viii) promoting standardized and harmonized scientific planning of forests, research and education.

The current Forest Policy of 2015, based on previous learnings, have integrated all components of the forestry sector and have an ecosystem-based and participatory forestry approach. It was formulated in consultation with all relevant stakeholders and is relatively balanced and acceptable to all concerned. Massive afforestation programs have been launched in Pakistan, like the 10 billion tree tsunami program and the Green Pakistan program. Besides, work on establishing modern urban forests on the pattern of Miyawaki plantations or growing trees in patches in urban areas, particularly in big cities like Islamabad and Karachi, has been started a few years ago. Furthermore, speedy work on peri-urban plantations in small cities and farm forestry is also in progress. The logic behind the transition from commercial forestry in timber forests towards modern urban and peri-urban forests is to reinforce the ecological role of forests to improve urban ecosystems, by reducing carbon concentration and subsequent climate

change effects through enhancing forest cover, and let the timber forest protect watersheds and provide environmental services.

Conclusion - Challenges in Sustainable Development of Forestry and Dual Carbon Strategy in Pakistan

From above analysis of policies and the online meetings with the forest and other relevant department officials, it is concluded that Implementing Sustainable Forest Management (SFM) faces several challenges, including inadequate financial resources, weak governance and enforcement mechanisms, and conflicting interests among stakeholders. Currently, the forestry sector in Pakistan is confronted with many challenges, including deforestation, massive degradation of forests, a decline in their productivity, loss of biodiversity, soil erosion, desertification, and a reduction in environmental and recreational values, making the country one of the most vulnerable to climate change effects. The Global Climate Risk Index has placed Pakistan as the 8th most vulnerable country to climate change impacts, in spite of the fact that Pakistan's contribution to global greenhouse gas (GHG) emissions is less than 1%. The underlying causes for this situation include population pressure, dependence of local communities on forests and a lack of economic incentives for them, lack of modern & SFM approach, weak enforcement or non-compliance with laws and policies, ambiguous land tenure systems, prolonged droughts, forest fires, and floods; transfer of forest lands for non-forestry purposes; forest land encroachment; lack of intra- and inter-sectoral coordination; a lack of technologies and alternatives for wood; and lack of awareness of the benefits of forests beyond wood and non-wood products.

Other key issues of forestry sector at national level include lack of uniform standards for forest monitoring in forests and coordination among federation and provincial forest departments in this respect. The forestry sector is not given priority due to financial constraints, which explains why the recommended strategies are often not implemented. Provincial Forest Departments frequently confront issues of transfer of forestlands for non-forestry uses, encroachments on forest lands, shortage of irrigation water, inter-sectoral conflicts, natural calamities, and governance. All these need to be given proper attention to be solved for sustainable development of forests and enhancing carbon sequestration.

In Pakistan, the great majority of the productive forests have been managed under working plans. There are working plans for the forests that have been used in the past. Unfortunately, due to various constraints, the prescriptions of the forest working plans could not really be implemented, resulting in overexploitation of forest resources. At present, natural forests in particular are managed without planning. Officially, only dead and dry trees are removed to cover the minimal local need for wood or to generate income.

Compared to other sectors like agriculture and industry, the adoption and application of technologies in forestry in Pakistan are negligible. Forest management is still based on ancient principles and practices. However, there have been some improvements in forest inventory using satellite imagery, GIS and GPS. There is still no innovation in nursery raising, planting, efficient irrigation methods, or forest conservation measures (pest and disease control). Although limited research on the technical problems of forestry involving technologies continues, forest departments are unwilling to use the research results. Even the techniques that have been successfully developed on pilot scale in donor-funded projects have not been replicated or scaled up.

Recommendations for Integrating Sustainability and enhanced Carbon Sequestration in Forestry Sector of Pakistan:

The initial forest policies were focused on commercial forestry and primarily concerned with timber production. However, over the last few decades, forest management has become broader, and today the focus of all recent forest policies and climate change policies is on the forest's ecological function, which now includes providing services

such as biodiversity conservation, recreation, groundwater protection, visual buffering, carbon sequestration and environmental monitoring. The Kyoto Protocol (1997) justifies the integration of carbon sequestration aspects into the forest policies of its signatory countries, including Pakistan, which already has made provisions in its prevailing forestry and environmental policies.

Pakistan is already making efforts to reduce carbon emission and has successfully launched several mega plantation initiatives. However, from the gaps identified in the above analysis of the forest policies, there is still a lot to do to achieve the goal of sustainable management and double carbon strategy. The following SFM approaches aimed at enhancement of carbon sequestration as a double carbon strategy are recommended as policy' implementation improvement suggestions for the integration of into management practices:

Afforestation and Reforestation

A forest's ability to sequester and store carbon depends on its health and lifespan. Healthier forests and more forested areas will help increase forest carbon stocks. Restoring degraded forest areas and creating new forest areas are actions that improve forests' ability to sequester and store carbon. This can be applied to any type of forest in Pakistan, from temperate forests to mangroves, as per existing level of the degradation. Transformative approach of using fallow land in different parts of the country may be adopted. Implementing massive afforestation programs and promoting social forestry/agroforestry on farm/communal lands are important to improve tree cover and reduce pressure on natural forests. This increase in tree cover will lead to an increase in carbon stocks due to carbon sequestration.

The International Institute for Sustainable Development (IISD) has recently identified five high priority options for GHG mitigation in Pakistan, including community forest management, coniferous forest conservation, and the implementation of agroforestry practices, commercial plantations, and reforestation of degraded lands. Conservation and regeneration of existing forests is one of the most cost-effective options for reducing greenhouse gases, with coniferous forests being the most important sites for conservation due to their high carbon storage, presence of peatland, and longer age of maturity (Bukari et al., 2012). Little or no harvest of carbon sinks results in the best CO₂ sequestration and thus the highest incentives in a carbon market. Costs would include fencing and monitoring protected areas, monitoring carbon stocks, and compensating forest-dependent communities.

One-third of Pakistan's forests are managed by communities, and they suffer from the highest rates of deforestation (GoP, 2015). A financial incentive for the communities to ensure a net increase in carbon storage could reverse this trend. Community forestry increases carbon sequestration while allowing for the continued use of productive land. Given the population and land use pressures in Pakistan, multiple land uses are a viable option. Commercial plantations offer a quick way to meet Pakistan's growing demand for timber, as well as sequestration benefits. Riparian forest plantations have been successful in regions such as Sindh and Punjab provinces. Rangeland reforestation and irrigated plantations are unrealistic due to water scarcity and may not be successful on a large scale in the future.

Agroforestry / Silvopastoral Practices

The current practice of overgrazing has several environmental impacts, including deforestation and degradation of forests and subsequently reduces the forests capacity to sequester carbon. There could also be adverse effects on soil and biodiversity loss. Uncontrolled grazing by livestock and lack of management practices often results in low productivity. Productive practices that combine trees (or other woody perennials) with agricultural crops on the same land are known as agroforestry. It is a proven system for increasing land use because it can provide equal or higher yields than conventional practices, with additional environmental and economic benefits, including carbon capture and storage in areas where agroforestry is practiced and reduced pressure on forests. Areas.

As, silvopastoral and agroforestry systems integrate multiple dimensions (environment, production, economy, and culture), it is important to design them according to local conditions and to involve experts from different disciplines. These include agroforestry systems such as multi-layered tree gardens, ally cropping, multi-purpose trees on arable land and windbreaks, green hedges, and firewood production. The agroforestry systems may be successfully adopted as mitigation option for the agricultural sector.

Sustainable Forest Management (SFM) in True Spirit

SFM is a proven mechanism for obtaining particular products and services from forests though ensuring their ecological integrity and sustainability, thereby reducing their long-term loss and maintaining the forest's ability to store carbon through carbon sequestration and reducing the greenhouse effect. Although experience and mechanisms for promoting SFM already exists, there is a need to practically manage the forests under forest working plans by further updating them to ensure the forests' sustainability in true sense for various purposes.

SFM will require actions such as developing a planning framework for participatory management (forestry, range management, grazing) and management plans for forests and protected areas; preparing participatory plans for forest restoration in degraded and deforested sites; ensuring the full functioning of the National Forest Monitoring System (NFMS); identifying hotspots to promote nature-based ecotourism to provide positive incentives for the livelihoods of forest-dependent communities; designing and implementing payment systems for ecosystem services; establishing a fair and benefit-sharing mechanism at the provincial and local levels; and identifying and promoting alternative energy options and energy-saving technologies for forest-dependent communities. It should be mentioned here that Pakistan's Ministry of Climate Change has developed a national forest monitoring system to scientifically monitor greenhouse gas emissions from the forestry sector against established baselines. Coordination with provincial forest departments is still required for full operation of the NFMS. Forest management should be improved through modern techniques such as the use of fertilizers, irrigation, weed control, tissue culture, etc. The element of participatory forestry should be incorporated as an essential one in the forest management for sustainability.

Incentive in the form of Payment for Ecosystem Services

To ensure participatory forestry, a system of payment for ecosystem services (PES) need to be used to compensate forest owners or users for ensuring a certain level of health in specific ecosystems to maintain the environmental services provided by the forests, e.g. increasing forest carbon stocks and reducing deforestation. This would produce a positive motivation to maintain or enhance forest in quality or extent by avoid other activities that destroy or degrade the forest.

Use of Renewable Energy Sources and Reducing Use of Fossil Fuels

Reducing dependence on fuelwood and fossil fuels and taking policy measures to increase access to modern renewable energy sources can surely reduce pressure on forest biomass, increase carbon stocks, and reduce greenhouse gas emissions. This can lead to reduced pressure on forest ecosystems by preventing deforestation. Alternative energy sources may be used to develop off-grid or small-grid systems by generating electricity using micro-hydel, photovoltaic, solar, wind, biogas, biofuels, or other available green technologies. The use of electricity from sustainable sources for domestic use may reduce pressure on forests by reducing the extraction of firewood and decreasing dependence on fossil fuels, ultimately reducing greenhouse gas emissions.

Pakistan has the potential and can already draw on good experiences, such as the project Productive Uses of Renewable Energy in Chitral District in Pakistan (PURE-Chitral) completed in 2012, the Promotion of Sustainable Biomass Energy Production and Use in Pakistan completed in 2016, and others. The lessons learned from these can be capitalized upon when implementing this strategic option. However, LPG had a low uptake in forest communities

due to its higher cost. Some success in improving forest quality has been reported for micro-hydropower, but the evidence is subjective. Forest-dependent communities would depend on the provision of alternative resources.

Strengthening Institutional Capacities and Awareness

It includes law enforcement and forest monitoring, as well as investments in training, system development, and technology introduction at the provincial and national levels. A comprehensive skills gap analysis, training needs assessment, and institutional analysis focused on operational and HR capacity issues can be conducted. HR may be trained in two main categories, one that includes the ranks of forest officers at the division level and below to develop capacity related to forest implementation and management, while senior managers may be trained in strategic and policy areas. For system-level aspects, the performance and efficiency of the system can be improved using the latest technologies, such as GIS, RS, drones for monitoring and collecting digitized data, and digitized management. In addition, it is important to create greater awareness and understanding among policymakers of the value of ecosystem services and key forest biodiversity resources. In addition, research needs to be promoted for more information on the values of ecosystem services and the ability to credit the natural capital of key forest biodiversity resources for informed decision-making and for a better understanding of the importance of the forest sector.

Sustainable Tourism and Eco-tourism

Many parts of the country have spectacular views. Ecotourism could provide an attractive alternative livelihood for local communities in many parts of the country. This would lead to a reduction in pressure on the ecosystem and have an indirect impact on carbon sequestration by the forest, as well as a subsequent reduction in greenhouse gas emissions. However, their consent to participate in any projects must be ensured. Special attention needs to be paid to ecotourism, as it is almost nonexistent in practice in Pakistan.

Strengthening Policies, Laws and Regulations

Includes strengthening of current forestry laws and policies at provincial and national level to ensure that they do not lead to or encourage deforestation, forest degradation e.g., Forest Act, Mines Act, Climate Change Policy, water, energy, industrial and other relevant policies. Besides, make sure inter-sectoral synchronization (e.g., Mines Act and Forest Act).

Development of National and Provincial Land-Use Policies:

To regulate land conversion, it is critical to reduce pressure on forests and other types of land. It is essential that a centralized forum can undertake such an initiative, e.g. Planning Commission of Pakistan, so that future policies are representative of all federating units and based on international best practices. This can be achieved by engaging specialized government bodies such as Survey of Pakistan and SUPARCO etc.

Strengthening Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Implementation:

This is done by working with the respective Environmental Protection Agencies (EPAs) to strengthen and update EIA and SEA regulations in accordance with international forestry and biodiversity guidelines. Although policies are in place, EIAs are rarely taken seriously. Therefore, it is important to ensure that all projects affecting forests are adequately assessed for their environmental impacts and mitigated.

Strengthening the Judiciary with Regards to Forestry:

There is a need to work with and strengthen the forestry judiciary, e.g., by providing (additional) special forestry magistrates for speedy trials, by launching awareness campaigns targeting judicial academies; and also by supporting speedy trials and speedy enforcement. A database of legal cases can be maintained for easy reference.

Legal Considerations

None of the strategic actions proposed above are hindered by the existing legal and policy framework to the extent that they are applied to government forests in Pakistan, such as reserved or protected forests. Very few regulatory actions may need to be taken by the government to facilitate the implementation of the strategic options.

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