Greenhouse Gas Mitigation Options for Pakistan: Forestry Sector

This factsheet provides a summary of the mitigation option analysis in the forestry sector, for more details please refer to the corresponding technical report.

Key Facts

The Food and Agriculture Organization of the United Nations (FAO) estimates that Pakistan's forests account for 1.9 per cent of the total land area with other wooded areas covering another 1.9 per cent (FAO, 2014). Together these cover 3 million ha. However, there is considerable uncertainty associated with estimates of national forest cover given differences in definition, survey methods and time of assessment. The official estimate is 5 per cent of the total land area (GOP, 2015). Approximately 45 per cent is conifer forest and the remainder is scrub (30-40 per cent), plantations, riverine forest, trees on farmland or mangroves. Good quality (>50 per cent cover) 'tall tree' forest in Pakistan covers less than 400,000 ha or <0.5 per cent of the total land area (GOP, 1998).

Mass afforestation and tree planting campaigns have been undertaken. Despite this, between 1990 and 2015, Pakistan saw a net loss of over one million hectares of forest (FAO, 2014). This represents a reduction in carbon stock of over 100 mega tonnes CO2 (World Bank, 2015). Estimates of deforestation also vary but all sources agree that forests are declining. An average rate of 2 per cent per year is widely used (GOP, 2015).

The key drivers for deforestation are demand for forest products outstripping supply (mostly fuel wood), population expansion, grazing, illegal harvesting and land use change.

Forestry and land use change contribute approximately 3 per cent to Pakistan's total greenhouse gas (GHG) emissions (around 9 $MtCO_2$ e in 2008) (Khan et al., 2011). This is expected to decline to 0.36 per cent by 2050 (Khan et al., 2011). Reforestation and plantation programs offer relatively low cost abatement opportunities with considerable sustainable development co-benefits.

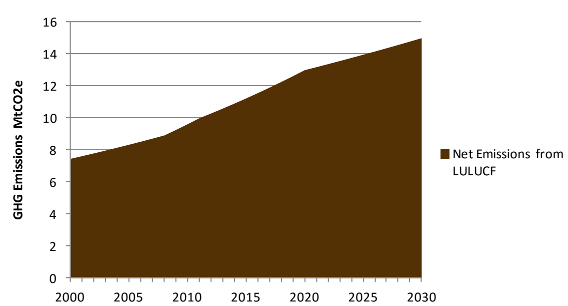
The challenge for the sector is to reverse deforestation while meeting the needs of a growing population for wood products. These are elaborated at the end of this factsheet.

GHG Baseline

Projected emissions from the forestry sector by source, to the year 2030 are indicated below in Figure 1 and Table 1. The baseline assumes continued loss of natural forests at the current rate of 2 per cent but an increase in the standing volume of planted trees of 3.9 per cent in line with recent trends (Forest Carbon Partnership Facility, 2013). Policy settings in place to protect forests are likely to be counteracted, under a BAU scenario, by on-going population pressures and the impacts of climate change on forest regeneration.

Emissions are projected to rise by 150 per cent between 2012 and 2030, or approximately 2.23 per cent per year. Emissions are forecast to grow from approximately 10 $MtCO_2e$ in 2012 to approximately 15 $MtCO_2e$ in 2030.

FIGURE 1: PROJECTED GREENHOUSE GAS EMISSIONS IN FORESTRY SECTOR (MT CO_2E)



Mitigation Options

Eight options were identified based on: GHG abatement potential, sustainable development co-benefits, cost effectiveness, evidence of existing action and barriers to implementation. The methodology for calculating emissions reductions, as well as more detail on assumptions and figures, can be found in the corresponding technical report for the forestry sector.

Five high priority GHG mitigation options (in bold) were identified that offer abatement potential, can be implemented immediately without significant barriers and which are cost-effective.

- **Community-based forest management**
- **Preservation of conifer forest land**
- **Implement agroforestry practices**
- **Commercial plantations**
- **Reforestation of degraded land**
- Riverine forestry plantations
- Rangeland afforestation
- Irrigated plantations
- Reduce dependency on firewood

Rationale for prioritization

Preservation and regeneration of existing forests is one of the cheapest GHG abatement options, with considerable sustainable development co-benefits. In Pakistan, coniferous forests are the most important sites for preservation due to their high carbon stock, presence of peatlands, and longer maturity age (Bukari, 2012). Commercial plantations are a low-cost option for governments, as private investors would be expected to meet the majority of funding requirements.

Community forestry provides carbon sequestration while allowing continued productive use of land. Multiple land use is a realistic option for Pakistan given population and land-use pressures. Commercial plantations offer a rapid way to meet Pakistan's growing demand for wood as well as sequestration benefits. Reforestation of degraded lands does not convert farmland to tree cover as well as benefits for land rehabilitation.

Riverine, rangeland and irrigated plantations are unrealistic given water shortages. Policies to increase access to modern energy sources would reduce pressure on forest biomass. However, LPG and kerosene have had poor penetration in forest communities due to their higher cost. Some success has been noted for micro-hydroelectric generation in improving forest quality, but the evidence is anecdotal (Kamal, Amir and Montadullah, 2012).

TABLE 1 EMISSION MITIGATION MEASURES AND IMPACTS

Emissions Mitigation Measure	GHG Emission Reductions in 2030 ($MtCO_2e$)	GHG Emission Reductions from Sector BAU in 2030 (%)	Marginal Abatement Cost (US$/Tonne CO_2e Reduced)
Community-based forest management	3.2	21.3%	Low (<$25)
Preservation of conifer forest land	4	26.6%	Low (<$25)
Implement Agroforestry Practices*	8.4	56.0%	Very low (<$10)
Commercial plantations	3.2	21.3%	Low (<$25)
Reforestation of degraded land	2.9	19.3%	Low (<$25)
TOTAL FORESTRY SECTOR	**21.7**		Very Low-to-Low

* Note this option is also included in the agriculture sector report and should not be double counted in determining total mitigation impact.

Community-based forest management

This scenario envisages community management of conifer forests to increase carbon storage (remunerated by government grants, REDD+ or CDM mechanisms) and subsistence harvesting. It is based on studies in Nepal (Karky and Skutsch, 2010 and Skutsch and Karky, 2012). One-third of Pakistan's forests are community managed and these are suffering the highest rates of deforestation (GOP, 2015). A financial incentive to ensure net increase in carbon storage could reverse this trend. Forest management to increase above ground biomass and litter has been shown to dramatically increase carbon storage in degraded Indian forests (Joshi and Singh, 2003). The 2015

National Forest Policy allows selective harvesting in native forests (GOP, 2015).

Scenario Definition

The total carbon stock of conifer forest was approximately 187 $MtCO_2$ over a total of 1,473 ha in 2010.[i] The option conservatively estimates that community-based forestry for carbon sequestration could be implemented over 20 per cent of this area by 2030 (294,600 ha). Existing carbon stock would be protected from *commercial* harvesting but some harvesting would be allowed for local use only. Community members would actively regenerate forests.

Emissions reductions were calculated as follows:
tCO_2e = Cumulative Area Protected * Annual Abatement potential

Emissions Reductions in 2030 (tCO_2e) = 294,600 ha * 11 tCO_2e/ha*yr
= 3,240,600 tCO_2e

The mitigation potential of 11 tCO_2 e ha^{-1} yr^{-1} is derived from the most conservative results of a community-based forest management project in Nepal (Karky and Skutsch, 2010).

Benefits and Impacts

Benefits include the sustainable use of forests and carbon sequestration. Environmental and social co-benefits are expected. Costs would include compensating communities for carbon storage, provision of afforestation training and material, policing of illegal commercial harvesting and auditing community monitoring.

Preservation of conifer forest

This mitigation option differs from community-based forest management in that it involves complete protection from all harvesting in a proportion of conifer forests.

A commercial harvesting ban in place in the 1990s halted the legal timber trade but did not stop illegal logging. Conifer forests in all land tenures (state-owned, communal and private) continue to decline at a rate of around 40,000 ha per year (Ahmed et al, 2012). The quality of these forests is also in decline, as over 50 per cent of the coniferous forests have tree cover less than 25 per cent (MoE 2004 in FCPF, 2013). Halting this decline would preserve a carbon sink and allow additional sequestration through natural regeneration. Low harvest or no harvesting of carbon sinks lead to the best CO_2 sequestration and therefore the highest incentives in a carbon market.

Scenario Definition

The scenario assumes that 50 per cent of the total 1,473 m ha of conifer forest in Pakistan would be prioritised for protection by 2025

Emissions reductions were calculated as follows:
tCO_2e = Cumulative Area of Conifer Forest Protected * Annual abatement potential

Emissions Reductions in 2030 (tCO_2e) = 736,500 ha * 5.45 tCO_2e/ha*yr
= 4,012,171 tCO_2e

Benefits and Impacts

Benefits would accrue to biodiversity, threatened species, water quality and flood mitigation. Costs would include fencing and policing of protected areas, as well as monitoring of carbon stocks. Communities dependent on the forest would require compensation or the provision of alternative resources.

Implement Agroforestry Practices

The Government of Pakistan has already expressed its will to increase the forest cover to 6 per cent in the country, which would offer strong and significant mitigation potential through carbon sinks. Each province in the country has already begun to run programs fostering agroforestry practices, most commonly promoting planting eucalyptus, as well as trees such as shishum and kikar.

More than 80 per cent of all farms in Pakistan are less than five hectares and small farmers are concerned of the opportunity cost of planting seeds other than what is required for optimal crop production on such small lands. Yet, studies have shown that it is possible to plant as much as 12 trees per hectare of cropland without having any negative impact on crops.

Scenario Definition

Desk-based research suggested minimal uptake to date because of the number of small farms and the need to prioritise the land for crop production. There is significant potential if a program can be developed to illustrate the many co-benefits. Here, modelled agroforestry practices on an additional 3 per cent of agricultural land, through plantation of multipurpose and fast growing tree species.

Emissions reductions were calculated as follows:
tCO_2e = Reduction potential * Total Agricultural Land * % of Hectare Targeted

Emissions Reductions in 2030 (tCO_2e) = 8.06 tCO_2e/ha * 34,890,000 ha * 0.03
= 8,436,402 tCO_2e

Commercial plantations

Demand for wood products in Pakistan outstrips supply by at least 30 m m^3 per year (FAO 2007). This gap is expected to grow as demand reaches 58 m m^3 by 2020 while the sustainable yield of 14 m m^3 diminishes with deforestation (FAO, 2007). Pakistan needs to increase productive forest to meet this demand as well as to provide carbon storage. Intensive plantations offer a high-yield option that has been demonstrated in Pakistan (Gera, 2006) and India (Bala et al. 2010; Kaul et al. 2010).

Sustainably managed plantations can reduce emissions in four ways:

1. Sequestration of carbon in well managed plantations compensates for the CO_2 emitted by combustion of fuel wood;
2. Timber products such as construction materials act as a longer term carbon sink post-harvest;
3. By providing an alternative source of wood, pressure on native forests is reduced; and
4. With good management, below ground carbon can accumulate despite regular harvesting of above ground timber (FAO, n.d.).

Scenario Definition

The mitigation option assumes that plantations are grown on 2 per cent of arable land, an area of 400,000 ha. This seems plausible given the government's target of planting 70 m tree saplings per year (GOP, 2015). With a planting rate of 1000 saplings per ha, the scenario envisages planting 22 m per year for the first four years, increasing to 88 m per year by 2029.

The mitigation potential of 15.4 $tCO^2e\ ha^{-1}\ yr^{-1}$ is based on results for fast growth short rotation crops of eucalyptus and poplar in Pakistan. These are the most popular plantation trees in Pakistan.

Emissions reductions were calculated as follows:
tCO_2e = Cumulative Plantation Area * Annual Abatement potential

Emissions Reductions in 2030 (tCO_2e) = 440,000 ha * 7.26 tCO_2e/ha*yr
= 3,194,400 tCO_2e

Benefits and Impacts

High-yield plantations would help meet Pakistan's demand for wood products while diversifying rural incomes. Commercial plantations can generate employment in nursery operations, harvesting and tending operations (FAO, n.d.). However, if farmland were converted it would take land out of food production. It is also at odds with the government's target of increasing agricultural production by 5 per cent per year. An alternative would be to afforest degraded land or watershed areas, but yields may be lower if soil quality or rainfall is lower.

Fast growth, high yield plantations can deplete soil nutrients leading to lower yields after multiple rotations (Montagnini and Porras, 1998). Mixed plots with a range of species that mature at different ages can reduce this effect and stagger harvesting times. Longer rotation species provide a longer-term carbon sink (Montagnini and Porras, 1998).

Reforestation of marginal and degraded land

Deforestation has caused approximately 11 m ha of land to become degraded in Pakistan (Khan et al. 2012). It is the cause of the most widespread degradation in river basins leading to erosion, siltation of dams and irrigation channels and higher flood risk. Waterlogging and salinity affect a further 14 m ha, and 24 m ha by overgrazing.

Scenario Definition

As a conservative estimate, this mitigation option assumes that 10 per cent of the 11 m ha of land degraded by deforestation would be suitable for reforestation (1.1 m ha). A mitigation potential of 2.62 $tCO_2\ e\ ha^{-1}\ yr^{-1}$ was derived from an estimate for rangeland reforestation in Pakistan given that a suitable estimate for reforestation on degraded land in the region could not be found. Rangeland reforestation is likely to be a reasonable proxy given similar growing conditions of poorer soil and exposed conditions.

Emissions reductions were calculated as follows:
tCO_2e = Surface of Land Restored * Annual Abatement potential

Emissions Reductions in 2030 (tCO_2e) = 1,100,000 ha * 2.62 tCO_2e/ha*yr
=2,882,000 tCO_2e

Benefits and Impacts

Rangeland degradation and deforestation have been estimated to cost the country seven billion rupees (US$ 67 million) per year (World Bank, 2006). Reforestation would reverse some of this degradation as well as provide a carbon sink. Reforestation work can provide employment to local communities. Growing trees on degraded land does not require the conversion of arable land.

CHALLENGES

There is no national inventory or monitoring system for forest carbon. Some provincial-level projects are in place and national level initiatives are in development as part of REDD+ preparedness (GOP, 2015).

Forests and environmental management is a provincial responsibility with the federal government having limited leverage. Governments also have little control over communal and private forests.

Poor communities depend on forests for subsistence. Enforcement of protected areas will have a negative impact on these communities if they are not compensated.

The illegal timber trade is entrenched. The lucrative trade promotes corruption, undermining sustainable management and conservation.

Disconnect between policy and implementation. The Government of Pakistan has overarching policies to halt deforestation. The translation into effective implementation has been a primary cause of on-going deforestation (Yusuf, 2009).

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[i] Author's calculation based on an area of 1,473 m ha of conifer forest (Ahmad, Abbasi, Jabeen and Shah 2012) and an average carbon density of 127 t C/ha (Khan and Qasim. 2012; Nizami, Syed Moazzam ,2012).