DOES AGRO FORESTRY HELP PROTECT NATURAL FORESTS IN SEMI ARID ENVIRONS

(A Case Study of the Bunji Community Managed Conservation Area Astore, Pakistan)

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ABSTRACT

Agro forestry has been a viable option to substitute the scarce forest resources in fulfilling the needs of fuelwood and timber of rural communities in the arid and semi arid mountainous areas. We have evaluated the extent of agro forestry and its impacts on protection of natural forests in Bunji, a small village in Gilgit-Baltistan, Pakistan. On average, land fragmentation has resulted into a loss of 1.3 ha per capita during the past fifteen years. However, compared to farm land (46%) only 7% loss in land under farm forestry was observed. A remarkable change had occurred in land use patterns. Land under crop production has decreased on an average rate of 2.3% year^{-1} while the land under agro forestry has increased at the rate of 1.4% year^{-1}. Total number of trees in the village increased at the rate 7.3% year$^{-1,}$ except Poplar (*Poplus spp*), which has decreased at the rate of 1% year^{-1} probably due to its excessive harvest for timber in construction of new houses, diverting community's reliance on farm trees for timber needs. Moreover, the annual domestic energy consumption in Bunji was about 5234 Kg year^{-1} from different sources including fuelwood, LPG (cylinders) and Kerosene oil. However, fuel wood from agro forestry was the main source of domestic fuel (98%) with an annual consumption of 5116 Kg household^{-1} year^{-1}. The rest of 2% was met from other sources i.e., Kerosene oil and LPG. Each household was self sufficient in fulfilling its fuel wood requirements from the trees grown on their farmlands, and so the firewood pressure on natural forests has completely been alleviated by avoiding extraction of fuel wood and timber from natural forests.

Key words: Firewood, forest conservation, Bunji, WWF, Gilgit-Baltistan

INTRODUCTION

The barren arid environs of western Himalayas in Gilgit-Baltistan (Pakistan) dry temperate conifer forests are scattered, patchy and scarce, but play an important role in the livelihood of the rural people by providing fuel wood, fodder, timber and habitation to a variety of non-timber forest products. Total forest cover is about 4.5% of the total land area of Pakistan; 72, 96096 km^2 (Sheikh & Aleem, 1975). Most of the people draw their livings from subsistence agriculture with average land holding of 1.2 hectares per household. Approximately 36.4% of the total land in Gilgit-Baltistan is occupied by mountains, 4.1% by forests, 5.4% by plantations, 22% by rangelands, 24% by glaciers, and 6.2% by rivers, lakes and streams. Only 2% of the total land is under agriculture, primarily mountainous and least productive (SoE, 2003).

The harsh environment coupled with its inhabitants' growing needs leaves with only 4% of the land area under forest (AKRSP, 1994). Majority of the local populace depends on forests (4.1% of the total area: 72,694 km^2) for fuel wood, fodder, timber and medicines. Rapidly growing human and livestock populations exerts increasing pressures

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on these forests and associated shrub lands for free grazing of domestic animals and fire wood collection. Scattered forests had been gradually moving away from human settlements due to illicit cutting for timber and firewood mostly by locals for use and sale.

Being at higher altitudes under harsh winters and limited growing season, vegetation here has a considerably slow growth and meager natural regeneration, consequently pushing the natural forests towards depletion (Rafi, 1996; Saeed, 1992) except a few patches left in the most difficult and inaccessible places in some areas of the region (Gloeklar, 1995). Under such pressures, there was a dire need for economically viable, socially acceptable and ecologically feasible alternatives options to meet timber, firewood and fodder needs. Following examples of the Asian rainforest plantation (> 82 mha) mostly from China, Indonesia and India, one of such options was to plant more trees (Athar, 1999). It was obvious that plantations grew faster (about 15 $m^3 year^{-1}$) than natural forests, particularly Pines and Eucalyptus were more successful in plantations than native forests (Dsilva *et al*., 1994).

Since ages, agro forestry has been a major traditional land use in Gilgit-Baltistan. People had been growing non-fruit wood trees for timber, fire wood and fodder on their uncultivable lands. However, due to conventional planting practices with not or less post plantation care, normally yielded insufficient biomass to meet daily life needs of fuel, timber and fodder. Depleting natural forests and increasing access to local timbers market through road networks attracted farmers to grow multi-purpose fast growing tree species in the area (Gohar, 1994). However, with the rapid increase in population over the last few decades, the land holding is decreasing and the traditional agro-pastoral system is becoming less sufficient in the area (Warrington, 1996).

During early 1990s communities of Bunji, a barren water scarce village was supported by the local NGOs to promote agro forestry involving communities. People from the village were trained in nursery raising, contour planting, water & soil conservation, tree planting, protection and monitoring and given saplings of Robinia, Poplar, Ailanthus, Russian olive and Mulberry for plantation on their wastelands. The community with support from local government and non government organizations kept on growing forest trees on marginal lands with the aim to be self sufficient in timber, firewood and fodder, so that timber, firewood and fodder pressures could be diverted from natural forest in the longer run (AKRSP, 2004).

Since agro forestry has been practiced in Bunji valley sine long but was has never been evaluated so far. The present study was therefore conducted to appraise the extent of agro foresty as a substitute for natural forests to meet people's need for firewood and timber in the Bunji village, indirectly diverting presure from natural forests on the area.

METHODS AND MATERIALS

Study Area

The Bunji valley spreading over 350 km^2 area in Astore district of Gilgit-Baltistan is situated on the left bank of Indus River, exactly at the point where three world mightiest

mountain ranges *i.e.,* Karakoram, Himalayas and Hindu Kush meet (Bunji Valley Conservation Plan, 1997). It lies at an altitude of 1372 m at sea level. It is home to a human population of about 4,781individuals living in 450 households.

The area falls under the transitional belt between the Mediterranean and the dry temperate zone. The summer temperature rises up to 47°C, while during winters the mercury level drops down below freezing point (-5°C). The higher elevation receives heavy snowfall in winter, whereas, the valley bottom revives sporadic rain showers. Annual rainfall ranges between 100-200mm.

Mountains surrounding the village harbor a variety of wild flora and fauna, including natural forests mainly of scattered patches of junipers (*Juniperous marcopoda, J. communis*), blue pine (*Pinus wallichiana*), Fir (*Abies pindrow*), Spruce (*Picea smithiana*) and Birch (*Betula utilis*). Wild fauna include critically endangered Snow leopard (*Uncia uncia*), Astore Markhor (*Capra falconeri falconeri*) and Ladakh Urial (*Ovis orientalis vignei*).

Alpine pastures at higher reaches are known to have medicinal and aromatic herbs of high economic value. Farms as well as wastelands are grown with Poplar (*Poplus nigra, P. alba, P.ciliata*), Russian Olive, (*Eleaegnus* spp.) Black locust (*Robinia pseudoacacia*), Willow (*Salix* spp.*)*, Mulberry (*Morus alba*) and Ailanthus (*Ailanthus altissima*), mostly grown by local community as part of the agro forestry initiative (Bunji Valley Conservation Plan, 1997).

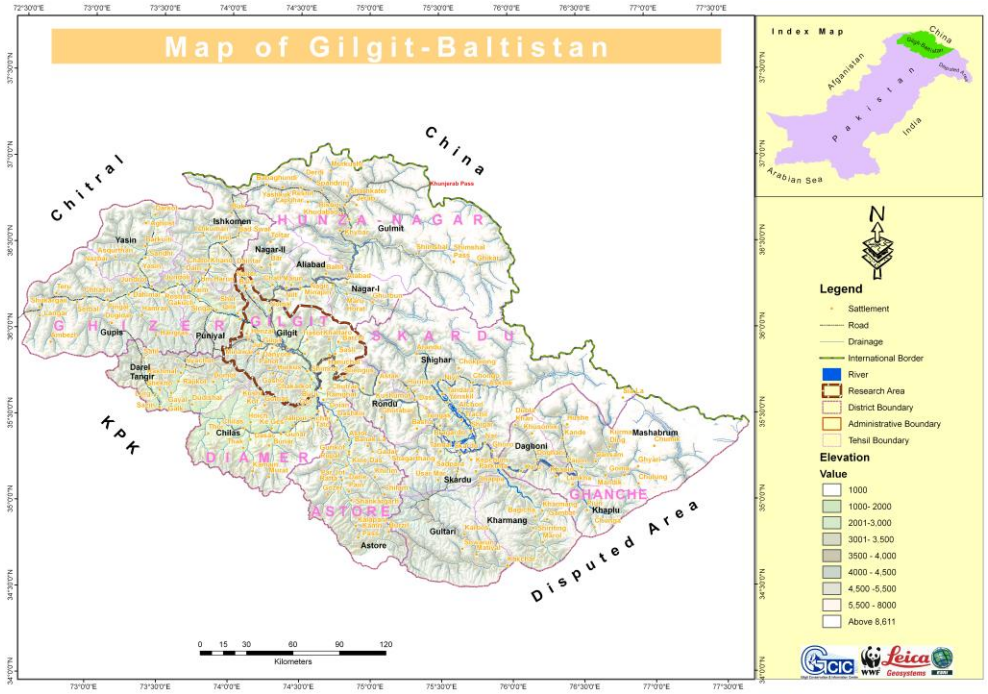

Fig. 1. Map of study area

Data Collection

Semi structured interviews and focus group discussions, using pre designed questionnaires was carried out to conduct the study in 2008-09. Questionnaires were mainly comprised of three parts. The first part contained questions about land use patterns such as size of land holding, land under crop production and agro forestry, barren land and miscellaneous (constructions and kitchen gardens). The second part inquired about the number of trees, tree species and the historic trend of planting. While, the third part dealt with the domestic fuel consumption and assessment of pressure on natural forests. A total of 180 respondents, randomly selected from 50% of the total households were interviewed and six focused group discussions with a total of 133 people. Only the family heads (> 40 years of age) who had been making independent decisions on farming and other household affairs were considered for the interview. Care was taken to avoid exaggeration in landholding and productivity, and the figures provided by farmers were cross checked with the record of local forest and agricultural department in Gilgit.

Analysis

The data collected from each household was compiled, compared and analyzed through simple analysis including calculation of different variables, their mean and standard deviation with minimum and maximum averages, and percentages etc. The data was then presented through tables, graphs, pie charts, bar diagrams and histograms using MS Excel 2007 (McCullough & Heiser, 2008).

RESULTS AND DISCUSSIONS

Change in Land Use Pattern

The land use pattern in Bunji has changed with changing preferences of the local communities towards natural resource utilization, attributed to an eventual change in life styles and an increase in daily life needs in the face of ever increasing human population and availability of resources. Fourteen years earlier (1995), the average land holding in Bunji was 7.0 ha per household compared to 6.66 ha later in the year 2009. The average land holding has decreased by almost 0.34 ha, probably due to and fragmentation, when a joint family divided into more than one families and the land was divided in nuclear households accordingly. As a whole, around 58.13% of the land uses got the change at the rate of 4.15% year^{-1}. Agricultural land uses reduced by 50% during the past fourteen years, followed by reduction in waste lands (25%) and others i.e., construction and kitchen gardening (14.29%) at the rate of 3.57%, 1.79% and 1.02% per year, respectively. It is obvious from the Table 1, unlike agricultural, wasteland and miscellaneous land uses, Agro forestry had increased by almost 31.16 percent during same period at the rate of 2.23 % increase year^{-1}, which make the agro forestry practices preferred and more rewarding for the villagers. In addition, 38.5% reduction in the wastelands over the past fourteen years shows an escalating land development intervention in the area. Percent reduction in land under construction and kitchen gardening accounts to a marked indifference, mainly because of more constructions for increased human population.

Table 1. A comparison of pattern of land use under various categories during 1995

and 2009

Land Use	Land use 1995 (ha)	Land use 2009 (ha)	Land use change in 14 years (%)	Rate of Land use change (Year-1)
Crop Production	1.8	1.2	-50	-3.57
Agro-forestry	1.9	2.76	31.16	2.23
Barren Land	2.5	2	-25.00	-1.79
Miscellaneous	0.8	0.7	-14.29	-1.02
Total	7	6.66	-58.13	-4.15

The land under agro forestry in Bunji had considerably increased in the last fifteen years. Land under crop production was decreasing at the rate of 2.3% year^{-1}, while the land under agro forestry had increasing at the rate of 1.4% per year. A decade earlier, 26% of the land holding was covered with agricultural crops, 27% with agro forestry, 36% was barren and 11% was under other uses i.e., construction and kitchen gardening. During 2009, average land holding was comprised of 18% agriculture crops, 41% agro forestry, 30% barren land and 11% under other uses like construction and kitchen gardens, as shown in the Fig.2 and 3 below:

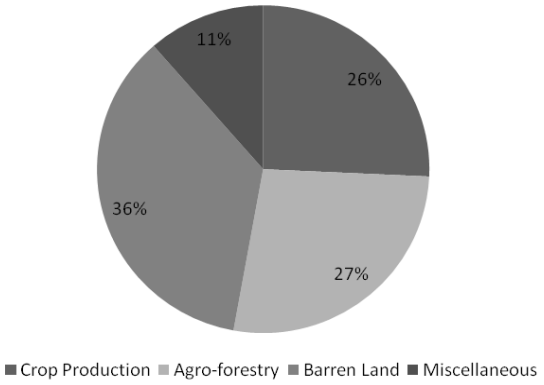

Fig. 2. Per capita land use (ha) 1995

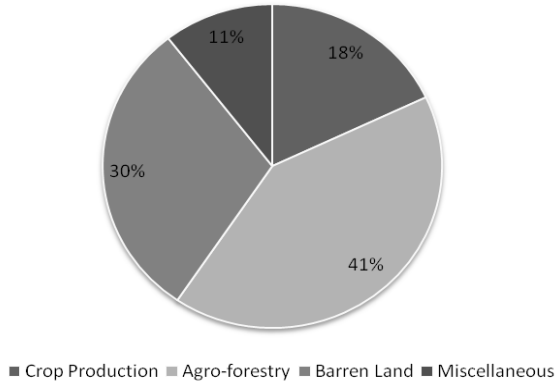

Fig. 3. Per capita land use (ha) 2009

Number of Trees per household

The number of trees per household in Bunji had increased by almost 42.3% over the last fourteen years. Before the Mountain Areas Conservancy Project (MACP) interventions in the area during mid nineties, each household in Bunji had an average of 667 trees of different species i.e., popular, willow, rubinia, olive and apricots that increased except for popular to an average of 1156 trees per household by the year 2009. This increase was at the rate of 3.02% year^{-1}. Except Poplars, rest of the tree species had got an increasing trend. The poplar trees had decreased at the rate of 0.68% year^{-1}, probably due to their excessive use as timber wood for construction of new houses and for sale in local market.

As shown in the below table 2, *Robinia pseudoacacia* had been planted fast and so has increased by almost 4.54 % year^{-1} followed by willow (4.15% year^{-1}), Apricots (3.09% year^{-1}), Russian olive (2.56% year^{-1}) and other (Apples, Cherries, Mulberry, Walnuts) by around 2.80% year^{-1}. There was an overall trend of planting multipurpose fast growing tree species i.e., Willow, Robinia and Russian olive compared to Poplar, Walnut and other slow growing fruit trees were least preferred.

Table 2. Average number of trees of different of species per household (1995-2009)

Type of plants	Average number of trees per house hold		Number Increase/ decrease	% Increase/decr ease	Rate of increase/decrease year-1
	1995	2009			
Poplar	46	42	-4	-9.52	-0.68
Willows	26	62	36	58.06	4.15
Rubinia	79	217	138	63.59	4.54
Russian Olive	292	464	172	37.07	2.65
Apricots	21	37	16	43.24	3.09
Others	203	334	131	39.22	2.80
Total	667	1156	489	42.30	3.02

Natural forests and domestic energy requirement

Firewood has been the main source of domestic energy for cooking, heating, warming. Results on energy sources revealed that almost all of the respondents used firewood as source of fuel for domestic purposes. Per capita firewood consumption was 755 kg per month during summer whereas, 1,172 kg per month during winter. Among the other sources was kerosene oil with a mean consumption of about 24 liters for cooking and 16 liters for heating per house hold per month. Contribution of electricity was 30 kWh while the share of other sources like Batteries, LPG Cylinders, candles and cow dung cake was almost negligible. Firewood is also used for heating during winter in commercial establishments i.e., hotels and small industrial enterprises (Water and Power Development Authority, 1997). Since the supply of firewood from local forests and plantations is not sufficient to meet the local demand for firewood (5234 Kg per annum) so most of time, firewood is transported from low land areas of Pakistan (IUCN, 2003).

Table 3. Per Capita Energy Consumption in Bunji valley, Astore

Source of domestic energy	Annual Consumption (Kg)	Contribution (%)
Firewood from Agro forestry	5116	98
Fire wood from natural forest	0	0
Fire wood purchased from local market	0	0
Liquid petroleum gas (LPG)	100.4	1.9
Others i.e., Kerosene oil etc	17.52	0.1
Total	5234	100

The annual domestic energy consumption in Bunji is 5234 Kg, met from different sources including fire wood, Liquid Petroleum Gas (LPG) and Kerosene oil (Table 3). Fire wood extracted from agro forestry has been the major source of domestic energy with an annual consumption of 5116 kg per household *i.e.*, 98% of the firewood need. Other sources like LPG and kerosene oil are least preferred energy sources with 1.9% and 0.1% contribution, respectively.

Interestingly, the study showed that nobody from the local community purchased firewood from outside the valley, except non-local government servants and armed force personnel, which shows that the local population was self sufficient in fuel wood owing to the large-scale agro forestry practice in the area.

CONCLUSION

The community has become fully sensitized about the value of natural forests; hence they opted for sustainable alternatives of fuelwood and timber by growing trees on their farm lands. This approach has not only helped them reduce pressure on natural forests, but fulfilled their fodder and forage requirements as well. A considerable change in pattern of land use with increasing status of land under Agro forestry and decreasing under agricultural crops has determined that community prefers agro forestry as a more rewarding livelihood option. The community has now become self sufficient in fuelwood available on their farmlands. They are not cutting natural forest to meet their domestic need for fuel and fire wood. Therefore, the pressure on natural forest has automatically reduced to minimum and it is also setting a trend of self-sufficiency through Agro forestry. Due to the ban on natural forest, Poplar trees are being used for constructions. The rate of planting Poplars is less than the rate of consumption. The situation may lead to a shortage of Poplar trees in the village and eventually reverse pressure on natural forests for timber. Therefore, community may consider planting more poplar trees in the longer run.

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