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Identifying local actors of deforestation and forest degradation in the Kalasha valleys of Pakistan

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ABSTRACT

Prevention of forest loss is a high priority in Pakistan, where catastrophic flooding in 1992 and 2010 has been linked to deforestation. Under the United Nation's REDD+ program, new incentive schemes are developed to encourage forest protection and reforestation, while implementing social safeguards for forest-dependent indigenous groups. The objective of this study is to support Pakistan's REDD+ readiness activities that affect the Kalasha, a unique indigenous people that are nominated for enhanced protection of the UNESCO Intangible Cultural Heritage list. We aim to identify actors and power structures that have caused deforestation in the past, and recommend policy improvements that protect forests as well as the Kalasha's culture and traditional livelihoods. A remote-sensing based historical analysis showed that government actors have significant power to influence land use practices in the region, although their policy instruments may not have had the intended effects. A logging ban in 1993 could not stop forest loss and instead caused a shift to illegal selective cutting of the same magnitude. Near human habitation, forest loss actually increased after the ban. In household surveys, self-reported clearing of forests conformed to remote sensing data, and fuel wood use was identified as the primary pressure on forest resources. Results from expert interviews, however, revealed contradictory perceptions regarding the actors responsible for forest loss. Both local residents and government officials hold the other side as primarily responsible, while rationalizing their own contribution. We recommend policy changes towards more balanced power structure in joint forest management committees. In addition, alternative heating methods would remove the currently largest pressure on forest extraction for fuelwood. Since fuelwood production for regional consumption constitutes one of the largest sources of income for the poorest households, REDD-based compensation schemes would have to support the most affected households of the indigenous Kalasha.

1. Introduction

Forest loss in Pakistan has been a concern for many decades due to deforestation rates that are among the highest in the South Asia at 2.2% per year (FAO, 2011). As a consequence of damage to regional watersheds, forest loss has been linked to catastrophic flooding in 1992 and 2010. In response to the 1992 floods, the Government of Pakistan instituted a ban on commercial felling of green trees, but this has not stopped the decline of forest areas in Pakistan. Deforestation rates as well as the total proportional loss of the forest area remain above the global average. According to Government of Pakistan, remaining forests cover about 4.8% of the total land area (FAO, 2011). FAO assessments are more pessimistic, estimating that only 2% of the total land area in Pakistan remains as forest. Of the remaining forest area, a high proportion represents degraded ecosystems. Forest with canopy cover of 50% or more comprises < 0.5% of the total land area of the country and could be depleted by the 2020s (Steimann, 2005).

While there is consensus among the general public as well as policy makers and resource managers that deforestation continues to pose a significant threat in Pakistan, opinions are divided over who is responsible for the causes of deforestation and forest degradation and how it is to be stopped or slowed. Previous studies in Pakistan have linked deforestation and forest degradation to local people (Ali and Benjaminsen, 2004; Ali et al., 2005; Shahbaz et al., 2007; Khan and Khan, 2009), to government policy of forest rights and access (Rome, 2005; Yusuf, 2009; Fischer et al., 2010), and to ineffective forest management and forest protection by government departments (Hasan, 2001; Pellegrini, 2011). The research indicates that causes of deforestation are not easily generalized and depend to varying degrees on actors, governance, and power structures that are interlinked and

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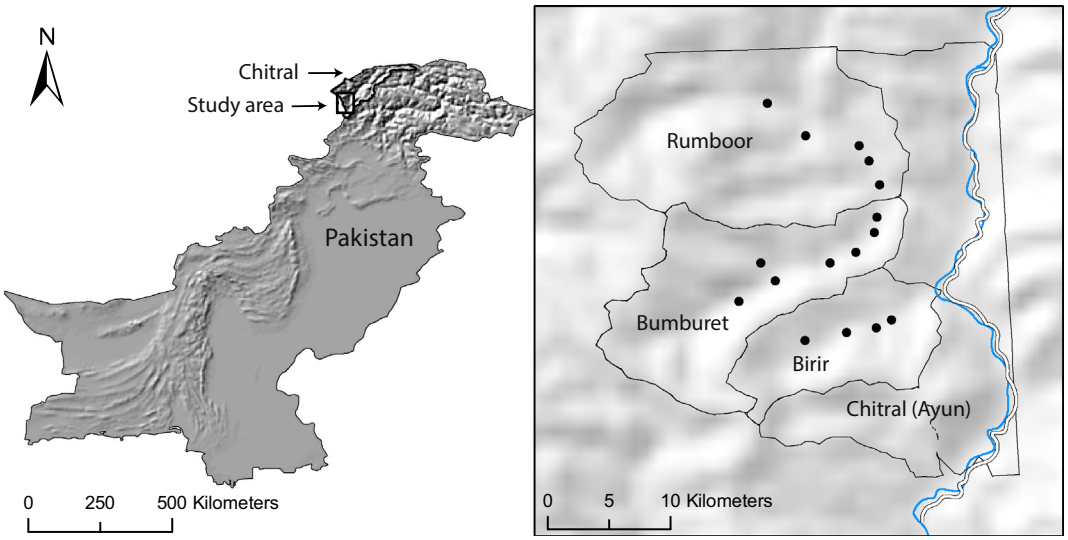

Fig. 1. The location of the study area in the Chitral district of Pakistan, and the location of the valleys and villages (•) of the indigenous Kalasha people that were subject of this study.

collectively determine deforestation and forest degradation. The factors vary regionally due to different socio-economic situations, cultural backgrounds and traditions as well as regional forest management histories (Aspinall, 2004).

A useful approach to study these relationships is the Actor-Centered Power (ACP) analytical framework proposed by Weber (1964), and applied to address power issues related to community forestry by Krott et al. (2014). The ACP framework systematically investigates aspects of coercion, incentives, and dominant information for use as power tools between superiors and subordinates (Weber, 1964; Krott, 2005; Maryudi et al., 2016). Power can be derived from coercion, financial incentives, or through information, where the empowered actor provides instructions and guidance that cannot easily be verified by the subordinate, thereby altering the subordinate's behavior without their informed consent (Krott, 2005; Devkota, 2010). Examples for the application of the ACP framework in a forestry context include studies by Devkota (2010), Maryudi et al. (2016), Yufanyi Movuh (2012) and Schusser (2013).

Identifying actors and their power and motivation at regional and local levels is of particular relevance in Pakistan. Most of the country's forests (40%) are in Khyber Pakhtunkhwa (KP) province and specifically in the Chitral, Dir, Swat and Hazara districts within the KP province (Steimann, 2005). The Chitral district is home to the Kalasha, an indigenous people nominated and tentatively accepted for enhanced protection on the Intangible Cultural Heritage list of the United Nations Educational, Scientific and Cultural Organization. As a signatory of the United Nations Framework Convention on Climate Change (UNFCCC) in 2005, Pakistan has committed to report on conserving carbon stock through sustainable use and management. In addition, Pakistan has also committed to the UN Reducing Emission from Deforestation and forest Degradation (REDD+), which outlines REDD readiness activities to ensure social safeguards for forest-dependent indigenous groups, protecting their livelihoods and cultural and spiritual identities.

In this paper, we contribute an analysis to support Pakistan's REDD + readiness activities that affect the Kalasha. We aim to identify actors and power structures that have caused deforestation in the past, and analyze the effect of past policies meant to improve the protection of forests. The analysis relies on 191 household surveys in 15 villages in three valleys. The sample represents 15% of all households and covers all areas inhabited by the Kalasha. For context, we quantify deforestation and forest degradation patterns before and after the Pakistani federal government instituted a logging ban in 1993 with remote sensing. To infer actors and power structures, we also conducted expert interviews of the district's government employees in the forest department, local community leaders involved in the management of forests, and regional NGOs that operate on livelihood and forest conservation and development. The central objective of this study is to understand the interests and motivations of the actors involved in forest depletion, infer the power structures among these actors, and investigate if their perceptions are consistent with the observed patterns of deforestation and forest degradation. We conclude with recommendations for improvements to policies that protect forests as well as the Kalasha's culture and traditional livelihoods.

2. Social and legal background

The Kalasha are an isolated and unique indigenous people of Indo-Aryan roots with a fusion of Indo-European culture and traditions (Ayub et al., 2015). A study by Rosenberg et al. (2006), employing genetic testing, concluded that they are a distinct population with only minor contributions from outside peoples. The Kalash formed a one major genetic cluster, the others being Africans, Europeans, Middle Easterners, South Asians, East Asians, Melanesians, and Native Americans. Starting in the 14th century, the Kalasha were largely displaced from their ancestral homes of Chitral by invaders from current Afghanistan who enforced Muslim religion in the area. With the Kalasha culture reduced to a few southern Chitral valleys subject to this study (Fig. 1), dominant Muslim rulers governed Chitral as an independent monarchy until 1885 (IUCN, 2004). After a period of colonial rule of the British Indian Empire, the Chitral District was fully absorbed into Pakistan in 1969 as part of the Northwest Frontier Province.

The Kalasha people's livelihood is based on a mixed mountain economy of small scale combined with livestock husbandry. Grain crops together with fruit and walnut trees are cultivated on a subsistence basis in the Kalasha valleys on tiny irrigated and terraced fields at an altitude around 1800 m. The Kalasha people practice an animistic religion that revolves around objects, places and creatures of the forests including mythical spirits and characters that live in the high mountains. They have traditionally relied on timber and non timber products from the species rich and productive mid-elevation oak forests as well as the higher elevation conifer forests.

Historic land management is influenced by the Muslim rulers between the 14th and 19th century, who introduced Islamic law to govern many aspects of the legal system. However, they also recognized many of the Kalasha's customary laws that had evolved in the prior centuries, particularly with respect to issues related to natural resource use and

sharing (IUCN, 2004). Under customary law, committees of notables (Jirga) settled resource disputes between individuals and communities or clans, and in most cases their decision was final and binding on all parties. Matters involving common pool resources, such as pasture, forests and water channels were decided by the Jirga, and violators were fined (IUCN, 2004).

After the absorption of Chitral state into Pakistan in 1969, the Government of Northwest Frontier Province (now KP) declared all forests, pastureland and hunting parks as state property in 1975. However, communities share property rights with the state based on the accepted customs at the time the forests were taken over by the state (Hasan, 2007; Shahbaz et al., 2008). Based on the statutory and customary laws, villagers in the vicinity of forest maintain some ownership rights. They can extract standing timber for domestic use upon payment of concessionary fee. They are entitled to free grazing in the forested land and pasture (Hasan, 2007). They have rights to collect dry, diseased and decayed trees for fuelwood use, and they are also entitled to a 60% share of timber sale royalties (Hasan, 2001, 2007).

After the 1993 ban, the 60% share of timber sale royalties to local residents was terminated, but locals were permitted to harvest some live trees for their own use for building and repairing structures. Use of the forest is now administered at the village-level through a Joint Forest Management Committee (JFMC), consisting of forest department officials, local forest resource users and other local representatives. Inhabitants of forest districts of KP can legally obtain some trees for their own use through timber permits issued by forest department on recommendations of the JFMCs, which entitles them to harvest and transport a specific volume of timber (Khan et al., 2006).

3. Data and methods

3.1. Study area

The Kalasha Valleys (Rumbur, Bumburet, and Birir) are situated in the southwest of the Chitral District of Pakistan (Fig. 1). The Chitral District also contains a high percentage of remaining forests and wildlife with a high biodiversity conservation value in Pakistan, and is home to the prominent Chitral Gol National Park. The district is diverse in topography, climate, and vegetation, with dry temperate coniferous forests found on the higher slopes of the valleys dominated by *Cedrus deodara*, *Pinus wallichiana*, *Abies pindrow*, *Juniperus excelsa*, while lower elevation forests are dominated by oak species, including the valuable timber species *Quercus incana* (Khan et al., 2013). The northern part of the Chitral District has very little forest cover due to high elevation. Due to rugged terrain, access to cultivable agriculture land in Chitral is constrained, and freezing temperatures prevent double cropping in higher elevation locations (Nusser and Dickore, 2002).

3.2. Remotely sensed land cover changes

The remote sensing data for quantifying deforestation and forest degradation in the Kalasha Valleys were Landsat imagery obtained from the United States Geological Survey (USGS, 2017). Scenes with < 10% cloud cover, and acquired during the summer months (June, July, August, and September) are listed in Table 1. The spatial resolution for the scene collected for 1973 is 60 m; the resolution for the others is 30 m. Before classification and analysis, the 30 m resolution images were re-sampled to a 60 m resolution.

The satellite images were classified using the Interactive Supervised Classification tool of the Spatial Analyst Extension of ArcGIS. The classification was based on the maximum likelihood method, with an equal a priori weight. Training samples were identified for the following classes: dense forest, sparse forest, crops, and other through visual inspection of the remote sensing scenes, aided by high-resolution imagery from Google Earth. Training data polygons were restricted to areas that did not show any changes in land cover over the course of the study period based on visual inspection of all remote sensing scenes, so that each scene was classified with the same training data for consistency. Initially, we had hoped to also identify pasture, bare rock, river bed, and ice but we were unable to adequately separate pasture and bare rock. These four other types were aggregated as “other”. A multiband image layer was used for the classification of each of the scenes. For the 1973 image, bands 1 (green; 0:5 μm- 0:6 μm), 2 (red; 0:6 μm- 0:7 μm)), 3 (near infrared; 0:7 μm −0:8 μm)), and 4 (near infrared; 0:8 μm-1:1 μm)) were used to create the multiband layer. For the rest of the images, bands 4 (blue; 0:45 μm- 0:52 μm), 5 (green; 0:52 μm- 0:60 μm), 6(red; 0:63 μm- 0:69 μm), and 7 (near infrared; 0:76 μm- 0:90 μm) were used.

Table 1
Remote sensing data scenes used for land use and land cover change analysis.

Year	Landsat sensor	Acquisition date	Path/row
1973	MSS	7/12/1973	163/35
1993	TM	6/19/1993	151/35
1996	TM	9/22/1996	151/35
1997	TM	7/7/1997	151/35
2003	ETM +	8/5/2003	152/35
2013	OLI TIRS-8	7/3/2013	151/35
2015	OLI TIRS-8	9/15/2015	151/35

The area of each of the four land classes was recorded for each of 7 years for which images were collected. Analysis focused on the periods 1973–1993, and 1993–2015. The earliest available image for the study area was captured in 1973. The year 1993 corresponds to the imposition of the commercial logging ban, and 2015 represents the most recent image available at the time of analysis. Annual change rates for the pre-ban period (1973–1993), the post-ban period (1993–2015), and the complete study period (1973–2015) was calculated as:

$$i = \sqrt[n]{\frac{V_n}{V_0}} - 1 \quad (1)$$

where i is the annual change rate, n is the number of years in the time period, V_0 is the area in the land cover class at the beginning of the time period, and V_n is the area at the end of the time period.

3.3. Resident surveys and expert interviews

We rely on both qualitative and quantitative research to identify actors and infer power structures, using 27 expert interviews and 191 household surveys of the Kalasha people at 15 villages. The selection of households was informed by the remote sensing analysis above. This survey covers all main villages of the three Kalasha valleys, however households were not chosen at random, but selected based on their location close to forest margins and areas of recent deforestation. The objective was to focus on households that are engaged in forest extraction or deforestation activities. Households on forest margins were dependent on forest for fuelwood, timber, and livestock grazing in open-canopy forests. We targeted around 15 households that met these criteria in each of five villages in each of the three valleys. In total, we surveyed 65 households in the Rumbur valley, 60 in Bumburet, and 66 in Birir.

We used structured village and household level surveys based on the Poverty Environment Network survey instrument, available on-line (www.cifor.org/pen). The survey is designed for a consistent, comprehensive analysis of tropical forests and poverty. The interview questionnaire focused on gathering household's information on patterns of forest use with a detailed section on demographic information, land use and agriculture production, firewood and timber collection and livestock grazing.

Household and village-level surveys were complemented with expert interviews that were primarily qualitative in nature, focusing on the causes and main actors of deforestation in the context of existing

policies. Participants were selected for suitability on the basis of widely used selection criteria first described by Tremblay (1957). Tremblay's "key informants" are characterized as participants who play a central role in the community, who are knowledgeable in the subject matter of the interviews, who have the required communication skills and are impartial regarding the interview topic as far as this is possible. For the purpose of this study we selected individuals from NGOs and the government sector with formal university training in the fields of forest management, agriculture or sociology, and who worked in managerial positions. We followed the principle of quota sampling to target 10 participants for each of the following groups government forest managers, NGO employees involved in forest conservation and development, and community leaders involved in local forest management. The final sample included 11 forest officers, 10 NGO workers as well as 6 village leaders.

Interview participants were selected by first compiling a comprehensive list of candidates, based on records of managerial employees of local government offices and NGOs. Then, candidates were selected to maximize representation, i.e. we avoided invitations of colleagues from the same government branch or NGO. Expert interviews were conducted face-to-face in private settings in the participant's offices. The interviews conducted between June 2016 and October 2016. Responses are reported in aggregate in order to protect confidentiality. The ethics approval for the questionnaires was obtained through the Human Research Ethics Review process at the University of Alberta Ethics Board (Approval ID Pro00063604, May 16, 2016).

3.4. Timber market analysis

To infer supply and shortages prior and after the logging ban, we analyzed price trends for conifer tree species in the study area. The data represents the timber market for the districts of Chitral, Swat and Dir. The data was provided by the Forest Development Corporation (FDC), reporting statistics between 1979 and 2013 for the timber market in Chakdara, Lower Dir, broken down by timber groups for the species Deodar (*Cedrus deodara*), Kail (*Pinus wallichiana*), and Fir/Spruce (largely *Abies pindrow*). Prices were adjusted for inflation and expressed in constant 2012 PKR values by using the annual consumer price index for Pakistan from the World Bank (World Bank, 2017).

4. Results

4.1. Remotely sensed deforestation and forest degradation

We observe a marked shift as to where deforestation takes place before and after the logging ban was implemented in 1993 (Fig. 2), although the overall deforestation trends are not drastically changed in response to the logging ban (Fig. 3). In the 1973–1993 period, most deforestation occurred at higher elevations in valuable confer forests, and that deforestation has shifted to the lower elevation oak forests in the 1993–2015 period (Fig. 2, red areas). There also appears to be an increase in forest degradation at the higher elevations in the 1993–2015 period (Fig. 2, right panel, yellow areas) as opposed to deforestation in the 1973–1993 period. For the total loss of forest cover, we do see inflection points around the time that the logging ban was implemented in 1993 (Fig. 3). This is most notable for the valleys of Bumburet and Rumbur, and was primarily driven by a slower overall decline of sparse forest due to the conversion of dense forest into sparse forest, i.e. yellow area in the right panel of Fig. 2. Overall, it appears that the logging ban has primarily contributed to a marked shift in the type of forest use and degradation, while overall declines have continued at a somewhat reduced rate of between 0.6% and 0.9% per year in the different valleys for overall forest cover decline between 1993 and 2015.

All of the valleys show an increase in the area of cropland over the period 1973–2015, which appears to slow after 1993 when the logging ban was implemented. Land conversion to agriculture was most pronounced in the main valley, and less prevalent for all three side valleys that are home to the Kalasha people. It is also apparent in all three Kalasha Valleys that the decrease in area of forest over time is much greater than the increase in cropland, indicating that small-scale timber logging, extraction of fuelwood, and use of sparse forests as pasture, preventing regeneration, appear to be the primary candidates for drivers of forest loss in the area, while conversion to agriculture is a minor factor.

4.2. Perceptions of responsibility from expert interviews

Our results from expert interviews reveal a binary perception regarding the actors responsible for forest degradation and forest loss. The first view, held by forest officers employed by the government, holds local people responsible. In their interview responses, they score timber extraction by locals, livestock grazing, agricultural expansion, and firewood extraction by locals as the most important factors (Fig. 4, dark gray bars). In contrast NGO workers and community leaders perceive government policies, government mismanagement, demographic and socioeconomic factors, and organized illegal logging as the main reasons for the forest decline (Fig. 4, medium and light gray bars).

Another notable result is that agricultural expansion was identified as an important cause of deforestation by government employees, which is contradicted by the remote sensing analysis with respect to the Kalasha valleys. Only in the main Chitral district does expansion of agricultural land play a role. In summary, the contrasting views point to a variety of potential causes of deforestation that appear to reflect stakeholder perceptions. Government employees point to local people as the primary actors, and local leaders and NGO employees point to government actors as those responsible for forest degradation and deforestation. Some of the perceptions are not supported by the remote sensing analysis for the Kalasha valleys, such as the importance of agricultural expansion.

4.3. Deforestation factors inferred from household surveys

Household surveys provide additional data to narrow down likely actors and mechanisms of deforestation. According to the survey, all households collect fuelwood and extract timber for domestic use and for sale. Compared to the global average of wood consumption of approximately 0.5 m^3/person/year for both developing and developed countries (FAO, 2003), wood use by the Kalasha people is high (Table 2). A substantial portion of their labor is dedicated to wood extraction (around 20 h/week/household), and the main driver of wood consumption is fuelwood, which is driven by fuelwood demand for heating in a region that has six month of snow cover. Most households reported that they only collect dry, diseased and dead trees branches, although Forest Department officers and NGO workers say that they frequently observe cutting of large living trees for fuelwood. Surplus fuelwood and timber are sold in the local and district markets. The average amount of fuelwood extracted for sale was about the same as the amount of fuelwood extracted for household use (Table 2).

Self-reported forest clearing for the purpose of agriculture collected through the household survey were small (Table 3), and approximately match results from the remote sensing analysis. Based on the survey respondents, the total area cleared for agriculture for the three valleys before the logging ban was approximately 800 ha, with an additional 200 ha after the logging ban was instituted (Table 3). Remote sensing data for the three villages detected a total agricultural expansion of 330 ha pre-ban and 153 ha post-ban. Given different methodological approaches and a positive sampling bias in the household surveys near the forest edge, the numbers appear reasonably close. Both estimates confirm that the overall area lost to agriculture is not a major factor in forest loss for the three valleys.

In the study area, livestock production provides food, and supplements the small-holders' income through sale of animals and animal-

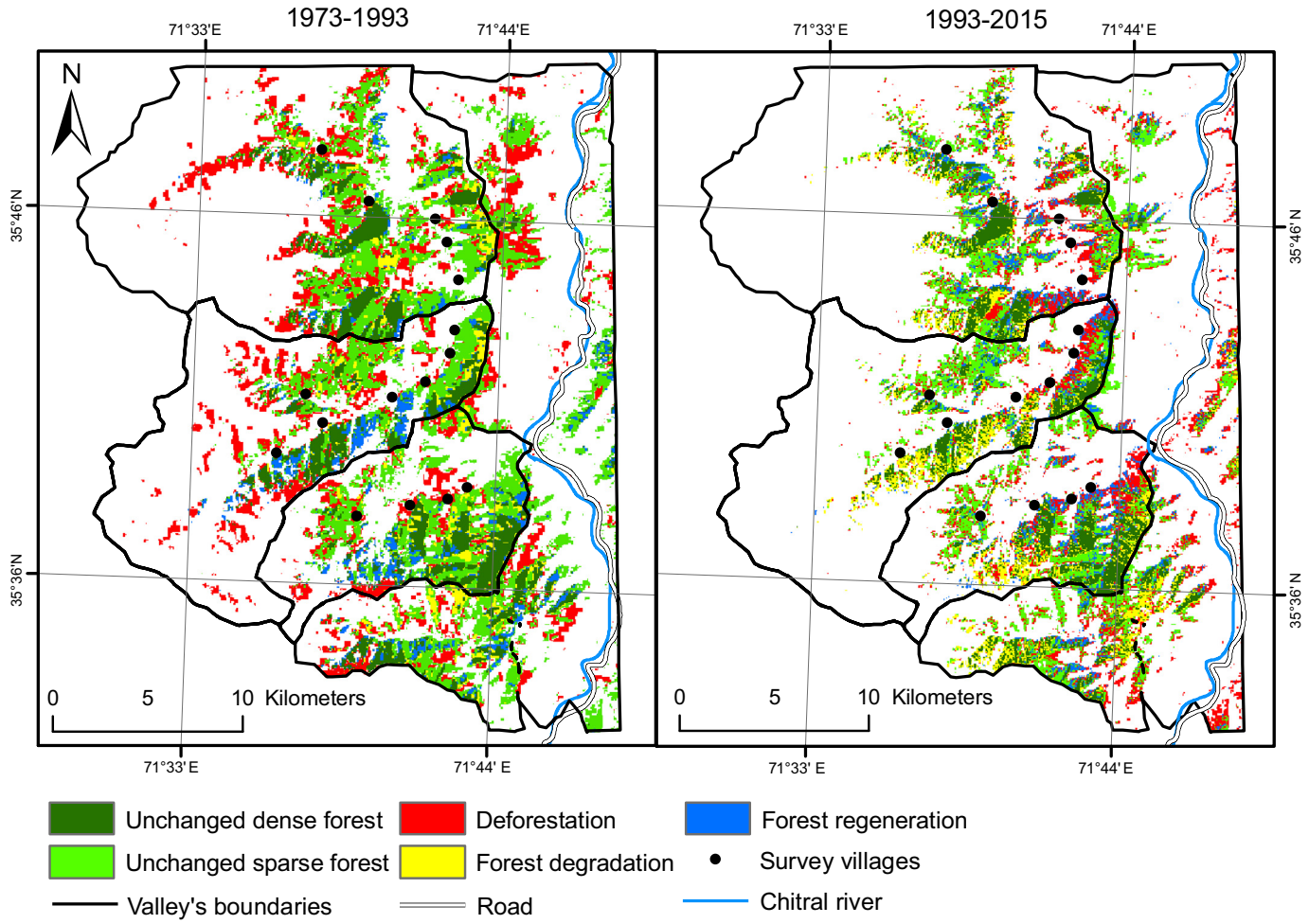

Fig. 2. Land cover change over a period of approximately two decades before (left panel) and after (right panel) a logging ban was implemented in 1993.

based products such as wool and hides. The livestock contributing most to the forest degradation are goat and sheep by grazing on regenerating oak forests. According to the household survey, the highest numbers of goat and sheep are found in the Bumburet valley (Table 4). The Bumburet valley also has the highest rates of forest decline for the 1993 to 2015 period (0.90% per year) compared to Birir (0.61% per year) and Rumbur (0.75% per year).

4.4. Role of illegal logging inferred from market prices

According to the remote sensing analysis, illegal logging appears to continue in the higher elevation conifer forests. However, instead of clear cutting prior to the logging ban (Fig. 2, left panel, red areas), the method of extraction appears to have shifted to selective logging (Fig. 2, right panel, yellow areas), which would make illegal harvesting less obvious to the forest authorities. An analysis of market values for local timber species also provides some indirect evidence that the logging ban had little or no influence in reducing supply of timber (Fig. 5). In the years following the logging ban, prices for the most common local timber species (fir, spruce, and pine) actually declined, suggesting an increase of timber supply, presumably from illegal logging activities that matched or exceeded previous harvest levels. The price development after the year 2000 does, however, show significant increases. According to the timber price development, the logging ban appears to have been initially counterproductive, leading to a short-term increase in deforestation. Price increases after the year 2000 imply a subsequent scarcity of timber supply.

5. Discussion

5.1. Government officials as actors in forest degradation

Our data suggests that following the 1993 logging ban, government employees appear to be the most likely actors of forest degradation as opposed to local residents who now appear primarily responsible for deforestation (the reverse situation compared to the period prior the logging ban). The data suggests that government actors certainly have significant power to influence land use practices in the region, although their policy instruments may not have had the intended effects. Remote sensing analysis indicates a major shift in practices following the logging ban, where large-scale commercial clear-cuts were replaced by selective cutting, leading to patterns of forest degradation rather than deforestation. A price analysis suggests that the overall rate of timber extraction may have initially increased, indicated by falling prices for seven years after the logging ban was implemented (Fig. 5). The subsequent increase in prices (after adjustment for inflation) could be due to better enforcement of the logging ban, but a plausible alternative explanation is that price increases may have been the result attributable to exhausting high-elevation conifer forest resources. The value of the most highly priced conifer in the region (the cedar species *Cedrus deodara*) is perhaps driven by high protection measures and high fines for cutting the species relative to the lower-value confer species (pines, spruce, and firs).

The government actors themselves acknowledge the role of illegal logging and activities of the so called “timber mafia”, although they deny their own role in the form of government mismanagement (Fig. 4).

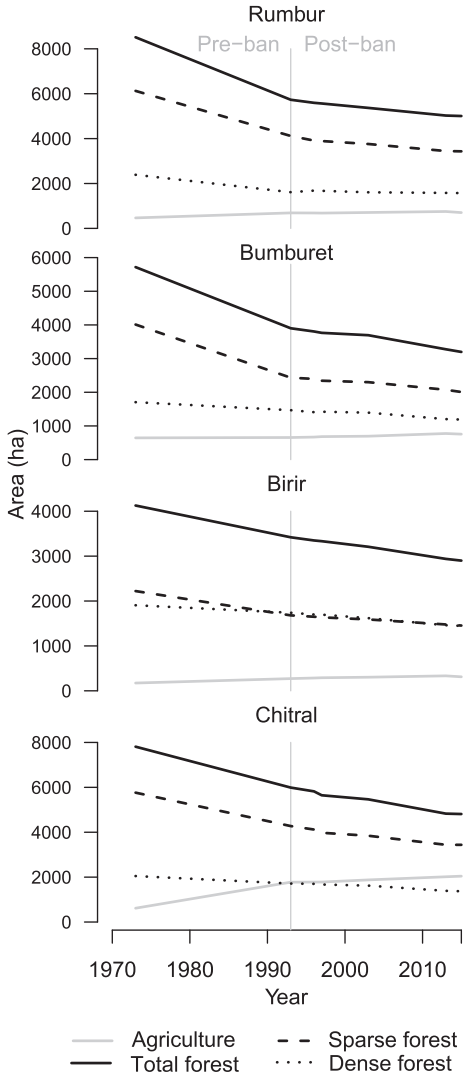

Fig. 3. Total are of land cover classes ("Total forest" being the sum of "Dense forest" and "Sparse forest" broken down by valleys shown in Fig. 1. A logging ban was implemented in 1993 and shown as a vertical gray line.

The timber mafia refers to corrupt politicians, bureaucrats, forest department officials and timber contractors who profit from illegal harvesting of timber. It seems unlikely that the initial increase in conifer wood, inferred from market price trends would be attributable to locals cutting high elevation forest. It appears that the logging ban simply shifted clear-cut operations to unregulated selective cutting, likely conducted by the same contractors and involving the same officials as the previous legal operations. The shift to selective cutting has led to the high levels of forest degradation visible in Fig. 2 (right panel, yellow).

Even after the logging ban, there were several ways to justify timber extraction. The Forest Department was allowed to issue legal permits for local use, but these permits may have been used to pass checkpoints and bring the timber to regional markets, even though the intention was to only allow local use (Knudsen, 1996). Another loophole, recently closed, allowed for legal harvest of old trees that were marked as unfit for further growth. This rule appears to have been exploited to extract the most valuable trees at an uncontrolled rate following the logging ban, a practice known as high-grading and widely recognized as one of the most destructive forest management approaches because all regeneration comes from the remaining low value trees, degrading the capability of forests to recover in the long term.

In summary, it appears that Government officials do have the power to act in their own interest rather than for the common good. Legal loopholes allowed them to maintain a narrative of proper forest management, despite their management practices not being scientifically sound. Nevertheless, the perception of government officials is that the responsibility for forest degradation and deforestation lies overwhelmingly with local people.

5.2. The Kalasha people as actors in deforestation

In contrast to the government actors, the local leader's perception is that of powerlessness as logging trucks with valuable resources come down from the mountains leaving them without benefit, noted in open-ended expert interview responses. Their conclusion is that government mismanagement is to blame (Fig. 4). At the same time they overlook their substantial contribution to the problem. The traditional wood consumption of the Kalasha people with access to forests as represented by our sample is one of the highest in the world per capita. While their needs for normal wood use is in line with the global average for both developing and developed countries (0.5 m^3/person/year), their consumption of fire wood for heating is an additional 1.5 m^3/year/person or more for domestic use, plus another 1.5 m^3/year/person for regional sale for the households surveyed.

This large pressure on forest resources has been amplified by rapid population growth over the last decades. Between 1981 and 2015, the population of the Chitral District increased at an annual rate of 2.5%. This equates to an 81% increase in the population over that 24 year period. It should be noted that reducing regional reliance on fuelwood could have problematic socioeconomic consequences for the Kalasha people. Satisfying regional demand for fuelwood is a major contributor to their livelihood, largely through the sale of fuelwood. The sale of fuelwood is particularly important for the poorest households in each of the Kalasha valleys, accounting for a quarter of their household income on average (Table 5).

In addition to fuelwood and timber extractions, our sample of forest dependent survey participants suggests that animal grazing is an important potential contributor to forest degradation and deforestation through inhibiting the natural regeneration of forests. The pasture areas are common areas with no local management plan. The lack of individual property rights causes the pasture areas suffering from the tragedy of the commons as described by Hardin (1968). The households share pasture land but livestock production is the responsibility of individuals, who raise as many livestock as possible. This leads to more animals than the carrying capacity of the land, which is an obstacle to forest regeneration in lower elevation open oak forests, where the livestock are kept.

Recent deforestation trends near human habitation are also evident in the remote sensing analysis, with at lower elevations particularly prevalent for the 1993–2015 time period (Fig. 2, red areas). This constitutes a large proportion of the recent deforestation and occurs in lower elevation oak forests. This is likely due to a combination of cutting of the oak for fuel and lack of regeneration due to overgrazing by livestock, particularly goat and sheep who feed on oak seedlings and saplings. One notable observation is that by far the highest numbers of goat and sheep are found in the Bumburet valley (Table 4). This may indicate that livestock numbers may play a significant role in forest decline, because no other factor from the household survey could explain the higher deforestation rate in Bumburet (0.9% per year) compared to the adjacent valleys (0.61% for Rumbur and 0.75% for Birir per year) for the 1993–2015 period.

5.3. Policies to mitigate deforestation and forest degradation

In recent years the national government has initiated the Green Pakistan Program, and the provincial Khyber Pakhtunkhwa government launched the Billion Tree Tsunami afforestation program that targets

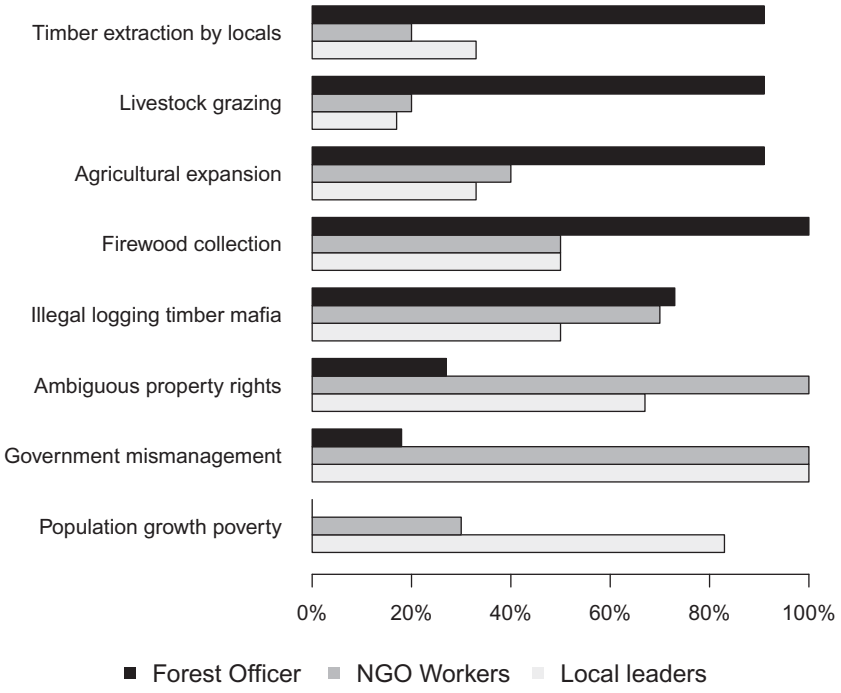

Fig. 4. Summary of the results from expert interviews, grouped by forest officers, NGO workers and community leaders, regarding the causes of deforestations listed on the left axis.

Table 2
Average household labour and the resulting timber and fuelwood extracted by valley. The data were reported by household, and converted to units per person based on an average household size of 7.2. Fuelwood was reported in original units of long tons (UK) with a conversion factor of 1.6 tons/m^3).

Valley	Labour (hours/week)	Green timber extracted (m^3/year/person)	Fuelwood extracted (m^3/year/person)	
			Own use	Sale
Rumbur	19.9	0.33	1.8	2.1
Bumburet	20.9	0.44	1.7	1.7
Birir	25.2	0.40	1.5	1.5

Table 3
Self-reported average area cleared by each household for agricultural use in the approximately two decades before and after the logging ban was implemented in 1993.

Valley	Number of households	Area cleared per household (ha)		Total area cleared per valley (ha)	
		1973–1993	1993–2015	1973–1993	1993–2015
Rumbur	348	0.49	0.14	171	49
Bumburet	725	0.71	0.14	515	102
Birir	225	0.58	0.21	131	47

Table 4
Average number of livestock per household and estimated total numbers of livestock by valley.

Livestock	Rumbur		Bumburet		Birir	
	Household	Valley	Household	Valley	Household	Valley
Cattle	2.5	368	2.2	1784	3	750
Goats	7.5	1119	7	5624	10	2500
Sheep	2.2	326	2	1600	3.6	900

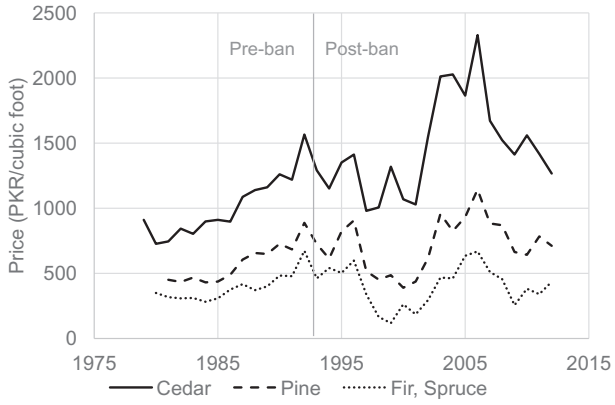

Fig. 5. Price trends for conifer tree species from higher elevation forest ecosystems in the study area. The data represents the timber market for the districts of Chitral and two adjacent districts, and prices are adjusted for inflation and expressed in constant 2012 PKR values).

our study area, with one billion trees established on 350,000 ha planted by the end of 2017 (Rehman et al., 2018). This represents one of the largest reforestation initiatives and the intention to expand the program to 10 billion trees over a 5-year period was announced in 2018 by the federal government to mitigate the effects of climate change. Protecting and expanding the countries existing forests has the potential to earn between $400 million and $4 billion each year under the REDD+ programs for carbon stored in the country's forests (Munawar et al., 2015). Our analysis suggests that the success of these initiatives and programs could be enhanced by a policy focus on actors of deforestation and forest degradation, which does not seem to specifically be addressed by the current afforestation initiatives. Local policies could create a more balanced power structure that empowers local Kalasha people in deciding how their forests should be managed. In addition, alternative livelihood options and investments in alternative technologies for fuelwood are needed to relieve the pressure on the remaining forest resource.

Table 5
Sources of income by valley and income class from 191 household surveys in the Kalasha valleys.

Valley	Annual income	Percentage of	Contribution to household income (%)			
	('000 PKR)	respondents	Crops	Livestock	Forest	Off-farm
Rambur	150–200	57	42.5	23.1	26.2	8.2
	200–250	17	40.7	24.2	22.1	13.0
	250–300	14	35.9	23.0	20.1	21.1
	> 300	12	31.7	21.3	19.1	28.0
Bumburet	150–200	75	41.3	25.3	23.1	10.3
	200–250	17	39.3	22.8	22.0	15.9
	250–300	11	33.2	21.2	19.1	26.4
	> 300	2	29.6	20.1	17.2	34.2
Birir	150–200	67	51.8	22.1	23.1	3.0
	200–250	19	44.8	21.1	22.0	12.1
	250–300	12	39.2	23.2	18.3	19.3
	> 300	2	37.6	21.1	16.2	25.2

Perhaps one of the most effective prescriptions would be offering alternatives to the reliance on fuelwood for heating and cooking. Less than 1% of households in the district use gas for cooking, so there are opportunities for reducing a portion of the required fuelwood demand through programs that invest in liquefied petroleum gas (LPG) equipment and distribution. LPG may also be used for rural heating systems, but the investments required would be much higher. A much cheaper way to provide relief on the remaining forest resources would be a switch to regionally abundant coal resources for heating. While this has negative environmental impacts both in terms of pollution and carbon emissions, this will likely be partially or fully compensated by preventing further deforestation and carbon sequestration by allowing regeneration of low-elevation forests.

A shift to LPG and coal to meet local and regional energy needs likely comes with severe negative socioeconomic impacts for the Kalasha people, especially for the poorest households where fuelwood accounts for 25% of household income. This is where REDD + incentive schemes may play a crucial role. REDD + could contribute to poverty alleviation by providing extra income from carbon credit payments, and other co-benefits such as improved tenure or carbon ownership. This is particular important in the context of indigenous communities of Kalasha where forest is not only a source of income but also deeply rooted in their cultural and religious practices. As Pakistan is in REDD + readiness phase, this study also highlighted the importance of additional social safeguards for the indigenous Kalasha. These include but are not limited to the acknowledgment of their customary rights over forest, and their traditional management systems.

Our analysis also suggests that better communication and joint management of natural resources between government agencies and local people may have benefits. The present situation appears to be that both groups maintain narratives that shifts responsibility to the others, and both sides overlook their own contributions to deforestation and forest degradation. Joint responsibility for forest management where both sides have equal power in decision making may introduces the needed checks and balances. Joint Forest Management Committees (JFMCs) do, in fact, already exist. They consist of forest department officials, representatives of the Kalasha people who collectively own forest land in their valleys, representative of non-forest land owners, village leaders and elders. The JFMCs primary role is to recommend permitting for timber cutting to meet local demand at the village level, e.g. for construction of new houses.

However, in open-ended interview questions, respondents reported that the JFMCs lack democratic legitimacy and true representation of local stakeholder interests, with members being appointed by the forest department, enabling misuse of permits for member's and department's benefits. Furthermore, the forest department still has the final say over all recommendations made by the JFMCs. To better represent local actors, members of the JFMCs should be elected by a democratic process, and representatives of stakeholders should have full voting rights over permitting decisions. JFMCs with democratic legitimacy would also be well positioned to administer REDD + programs and ensure that their benefits are shared with those that contribute to the protection and regeneration of forest areas.

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