AGA KHAN RURAL SUPPORT PROGRAMME
BALTISTAN

NLH
AGRICULTURAL
UNIVERSITY OF NORWAY

HIGH ALTITUDE INTEGRATED NATURAL RESOURCE MANAGEMENT

REPORT NO. 4

NATURAL FOREST INVENTORY

KNUT VELLE

AKRSP - NLH, DECEMBER 1998

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HIGH ALTITUDE INTEGRATED NATURAL RESOURCE MANAGEMENT: This is Report No 4 of seven progress reports presenting the activities and preliminary findings of joint research under an institutional cooperation programme between the Aga Khan Rural Support Programme, Pakistan, and the Agricultural University of Norway. The report addresses the sub-theme, *Natural forest inventory.*

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VILLAGERS OF BASHO

PROJECT REPORTS 1998

Report No. 1: Summary report
Report No. 2: Institutions and organisations in pasture and forestry management
Report No. 3: Pasture, livestock and biodiversity
Report No. 4: Natural forest inventory
Report No. 5: Gender, resource management and livelihood security
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Report No. 7: Socio-economic survey of Basho (project site)

More copies of the reports may be obtained from AKRSP, Regional Programme Office, Skardu or Noragric's Library.

Preface

The Aga Khan Rural Support Programme (AKRSP) and the Agricultural University of Norway (NLH) have initiated a cooperation programme on alpine resource management. The programme was planned during mutual visits in 1997, and implementation started in March 1998. The programme is funded by the Norwegian Agency for Development Cooperation (NORAD) as an integrated part of Norwegian support to AKRSP's natural resource management programme in Baltistan. In 1998 the main activity was an integrated study of alpine resource management systems (pasture and natural forest) in the Basho watershed of Skardu district.Appendix 1 lists the main components and AKRSP - NLH counterparts. The project was initiated in the spring of 1998, primarily though joint field research by visiting NLH staff and AKRSP counterparts.

This field report briefly presents the findings of a natural forest inventory carried out in Basho during August 21 to September 4, 1998. The inventory was carried out in teams involving villagers from Basho, staff of the Forest Department under the leadership of Mr Sharif, Divisional Forest Officer, Skardu. Appendix 2 (brief travel report by Dr Knut Velle) gives an overview of the main activities.

Acknowledgements

During the first year of implementation participants have enjoyed the opportunity of carrying out field research in the Basho watershed of Skardu District. We thank the people of Basho, including their representative, the Basho Development Organisation (BDO), for a warm reception and permission to work in the area. Men and women of the eight villages of the watershed have contributed of their valuable time and knowledge to joint activities, such as participatory learning exercises, field trips, village meetings and interviews. Local people also made their school available for a researcher and her family. The village organisations and the Basho Development Organisation have shown exceptional hospitality and support. It has been agreed that all maps, reports and other documentation shall be made available to the BDO, when appropriate for display in local schools.

We thank the District Commissioner, Skardu, Haji Sanaullah, and other government official for their interest in the collaborative programme and for offering useful recommendations and advice, and in some cases active participation in the programme. The practical implementation of the field programme was made a lot easier by the generous offer from the Divisional Forest Officer, Skardu, Mr Sharif, that AKRSP and visiting researchers could use the Forest Department Guest House in Basho. With respect to this project component in particular, we are grateful for the permission to carry out a study of the natural forest in Basho.

We thank NORAD and the Royal Norwegian Embassy, Islamabad, for the continued support and the consistent good-will towards the cooperating institutions, as well as active interest in the challenges and development potential of Baltistan.

AKRSP made excellent arrangements for field research. All Norwegian participants sincerely appreciate the many efforts without which they would not have been able to carry out research in Baltistan.

Support by local people, government institutions and the donor agency will remain a condition for the project to achieve its goals. The partners appreciate with humility the good relations and many contributions they have enjoyed so far. We hope that the linkage programme may continue and grow to the benefit of local people, the co-operating institutions and relevant government authorities.

Ås/Skardu,

Executive Summary

An inventory of the natural forest was carried out as a systematic sampling survey with a grid of 100m by 100m (1 ha). In the field, the lines and plots were identified by means of compass bearing and measuring tape. Circular plots with a radius of 15m were selected which produces a plot size of 707 m^2. As each plot represents one ha, the surveyed area thus covers 7.1% of the total area. Within the plot all the trees were measured/assessed for the following parameters:

- dbh (diameter at breast height) in cm
- height; total tree height from the root to the tip of the tree in m
- timber quality
- age at breast height; intentionally the age of every 10^{th} tree should be enumerated. As one of the borers got broken only half, approximately every 20^{th} tree was measured.

In addition, the plot area was assessed for the following parameters: area category, bush cover percentage and regeneration

The main findings are given in the table below:

Forest area	Area ha	Total volume m^3	Mean per ha m^3	Standard deviation m^3	Coeff. of variation	Max per ha m^3
Sharimond	27	880	32.6	35.9	110.1	166.4
Sari	55	1601	29.1	30.2	103.7	147.4
Ranga	31	350	11.3	14.1	124.8	48.1
Durom	274	10088	36.8	49.4	134.1	294.9
Chat	47	3007	64.0	39.6	61.8	183.7
Zigerkun *)	45	2250	50.0			
Total	**497**	**18176**	**36.7**	**45.2**	**123.2**	**294.9**

*) Estimate without measurements

Standard Error of the Mean = 2.2 m3.   Sampling Error = 5.9%

As regards distribution in size the results show clearly lack of trees in the small size classes, the proportion of old trees is to big in comparison to younger.

Regeneration, categories in percent of total area

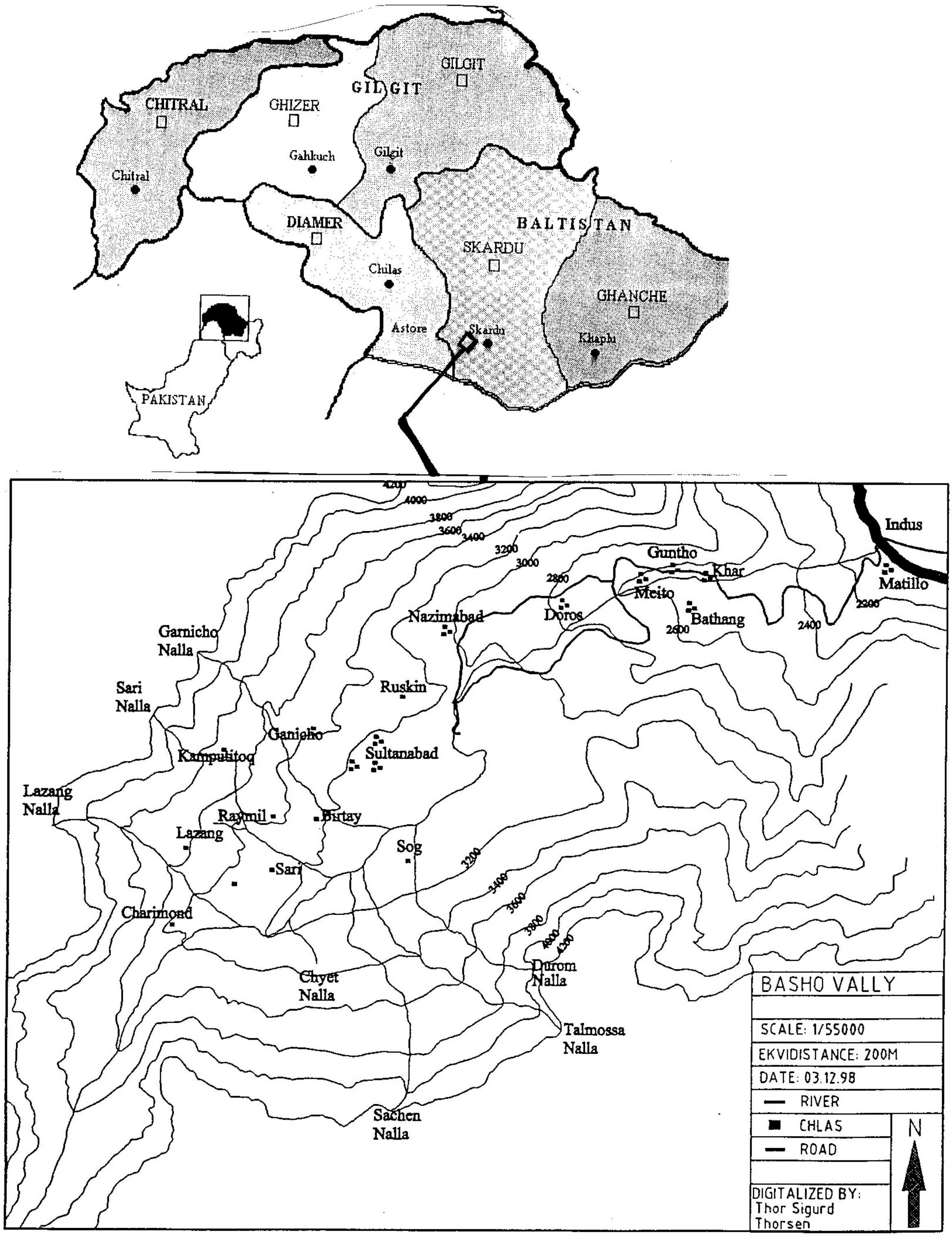
Adequate regeneration	5.5%
Some regeneration, but not sufficient	24.0%
No or very little regeneration	70.5%

The table shows that the status of the regeneration is far from satisfactory. Regeneration is the overwhelming problem in the Basho forests. It is particularly poor on steep slopes.

The annual increment was found to be 1.2% or 218m^3.

List of figures and tables

Map of the Basho Watershed and its location within Pakistan



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1. INTRODUCTION

The context of this report is the agreement between AKRSP and NLH to cooperate on a combined programme of competence building and applied research on High Altitude Integrated Natural resource Management (Project document: NLH - AKRSP, 1997). It is stated here that:

> *The aim of the institutional cooperation programme is to gain further insights into pasture and forest resources and their role in farmers' livelihood systems. Participatory, applied research shall enhance the capacity of AKRSP to work with village organisations and partner institutions for sustainable management of pasture and forestry resources, through providing knowledge which may be used in developing management and conservation strategies, initially at project sites.*

The specific objectives relating to AKRSP are:

- to expand the knowledge of the resource systems of Baltistan through a joint research project in order to enhance the capabilities of project staff to respond to the challenges of integrated resource management in high-altitude areas.
- to improve AKRSP documentation and extension systems with respect to forestry and pasture
- to improve AKRSP's links with national and international research institutions

The specific objectives relating to NLH are:

- to strengthen its knowledge-base for development-oriented research in the region and within fields where NLH are already working
- to gain the opportunity for carrying out applied, participatory research together with an implementing NGO and farmer-based organisations
- to provide an opportunity for staff, students and ex-students to gain field level working experience in Baltistan, Pakistan

The main **activities** in the programme will be:

- planning and conducting joint, participatory field research/documentation
- training and capacity building for AKRSP staff, primarily through joint research/documentation
- disseminating and sharing knowledge gained through workshops, training sessions, networking and publications
- exchanging information, references and literature through a library link for improved networking and information management
- technical advice for field-level application of the knowledge generated through research

2. METHODOLOGY

2.1 ***Study area***

2.1.1 Selection of study area

As a part of the NRM programme of AKRSP-Baltistan, the cooperation project focuses on Baltistan, the eastern-most region of the Northern Areas, covering the districts of Ghanche (District centre: Khaplu) and Skardu (District centre: Skardu Town). During the NLH-AKRSP Field Planning Workshop in Baltistan in September 1997, the Basho watershed was suggested by AKRSP as the site for a joint case study. After visiting both Hoshe (Ghanche District) and Basho (Skardu District), Basho was chosen as the main study area in 1998. Some of the criteria were:

- The presence and importance of alpine resources, including natural forest assumed to be among the largest patches left in Baltistan
- Local people's active interest in the alpine commons, partly expressed through the recent formation of a cluster organisation (the BDO)
- Accessibility (less than two hours driving distance from Skardu)

Basho was selected, therefore, as an interesting and illustrative case for both AKRSP and NLH, given the interest in the high alpine zone. Alpine natural resource management in Basho is probably similar to that of many other watersheds in Northern Areas or Baltistan, but in a strict scientific sense it was not selected to be representative of a certain larger area.

2.1.2 Location

The Basho watershed (75°15' E, 35°25' N) on the Khar Nullah is located about 45 km west of Skardu Town in the District of Skardu, Baltistan, and is surrounded by the Deosai Plains to the south, Kachura valley to the east and Skoyo-Karabathang-Basingo Catchment to the west. The watershed is a side-valley to the Indus valley, and the river Indus outlines the northern boundary of Basho. The total area of the Basho watershed system is about 120 km^2 It ascends from the southern side of river Indus at an altitude of approx. 2,150 m elevation. to the Banak La mountain at 5,520 m elevation. The uppermost village of Sultanabad is situated at approx. 3,200 m. elevation. A jeep road runs from the Indus river all the way up to and across the last end moraine step at 3,100 m , almost reaching the village of Sultanabad.

2.1.3 Climate, geology and physical characteristics

Situated in the western-most arm of the Himalayan range, Basho is found within a semi-arid and rugged mountain landscape "mountain desert"). It falls within the "rain shadow" of the Himalayas, and average rainfall in the valley bottoms is estimated to be between 100 and 200 mm, but rising with elevation to create a moist environment at the extensive, high-altitude rangelands. Because of the altitude, the area has a marked seasonal climate comparable to that of the temperate zone. The mean maximum temperature during summer revolves between +30 - 35° C, while the mercury drops to -15° C in winter.

The bedrock in Basho Valley is mainly igneous (plutonic) and metamorphic with a granittic composition. This bedrock can only be seen as shear cliffs and peaks high above the valley floor. The valley sides and bottom are covered by sediments, in places with a thickness of several hundred meters.

Big and small end moraines cut across the valley and mark the terminal point of several periods of glaciation. The biggest one, located between Nazimabad and Sultanabad, marks a dramatic change in the landscape. The moraine has functioned as a sediment trap, which has resulted in the formation of a wide river plain with meandering stream channels.

The valley sides are covered with thick layers of glacial deposits that have been reworked by the action of water and gravity to form steep slopes, gullies and fans. A thin layer of wind blown silt (loess) covers large areas on the valley sides and gives the surface a smooth appearance.

As in the rest of the Northern Areas, all human cultivation in agriculture and plantation forestry is based on irrigation. A major geographical distinction is therefore between areas *above the channel* and *below the channel*. The distinction here is primarily a functional one: between the areas that receive irrigation and those that do not (i.e. an area may be below one or several channels in terms of altitude, but *above the channel* because it is still out of reach by irrigation due to other constraints of landscape or infrastructure. Past and on-going channel construction and cultivation projects are changing the mountain sides and cultivated lands. Channels bringing snow melt from the glaciers to the fields are the blood veins of agriculture in Basho. Channels create a distinct line between the deserted grey colours above and the fresh greenness of afforestation sites (dominated by alfalfa and poplar) and cultivated fields beneath.

2.1.4 Vegetation

The area falls under three major vegetation types (Schweinfurth, 1957). The lower north-eastern part from the river Indus to about 2,500 m elevation is described as ***Sub-tropical semi-desert.*** This area is dominated by dry, steep slopes with outcrop of rocks. The average annual rainfall ranges between 130 - 160 mm, lacking a defined rainy season. People practice double-cropping agriculture and sub-tropic horticulture depending on irrigation channels leading the glacial water from higher up the valley. The area above the sub-tropical semi-desert is classified as ***Steppe of Artemisia***, dominated by scrubs such as *Artemisia maritima*, *Eurotia ceratoides* and *Kochia*. The average rainfall may approach 400 - 500 mm, depending on location, and most of the precipitation is received as snow during winter.

This upper-most part of Basho is shaped as a cup with alluvial plain, cultivated areas, houses and patches of trees covering the valley bottom. High snow-covered mountain peaks surround the valley and slides into moraine slopes form the valley sides. Vegetation varies greatly from the drier south-eastern facing slopes to the moister north -western slopes. Natural blue pine forest covers the north-western facing moraine slopes above Sultanabad. The forested moraine slopes are led by deep gulches and glacifluvial gravel fans sparsely vegetated by pine trees, willow (*Salix sp*.) and shrubs. Grassy slopes and juniper (*Juniper macropoda*) cover areas where the forest has been cut down. Above the pine forest patches of birch (*Betula utilis*) delineates the upper forest line at about 3,800 m. Steep slopes with artemisia (*Artemisia maretima*) covers the south-eastern facing parts of the valley up to 3,600 m. Patches of blue pine (*Pinus wallichiana*) and juniper are found around the lower broqs at about 3,300 m. Average rainfall is 400 - 500 mm, depending on location and precipitation is received primarily as snow during winter. The altitude limits cultivation to single cropping favouring alpine species such as barley.

The vegetation described as moist alpine scrub and meadows borders the ***Steppe of artemisia*** at about 3,600m. This type is dominated by glacifluvial gravel fans and deposits along streams, scree slopes and precipitous cliffs. Signs of avalanches and landslides are frequent on higher slopes.

2.1.5 Wildlife

No complete inventory has been done in the area. Wildlife known to be found in Basho is Asiatic ibex (*Capra ibex sibirica*), snow leopard (*Panthera uncia*), wolf (*Canis lupus*), red fox (*Vulpus vulpus*), marmot (*Marmota caudata*) and mouse hare (*Ochotona sp*.). Musk deer (*Mochus mochiferus*) is known to be found in the area, but has been highly priced and hunted for its musk. Common birds include chukor patridge (*Alectoris chukar*), jungle crow (*Corvus machrohynchos*) and Himalayan snowcock or ram chukor *(Tetraogallus himalayensis*). Asiatic ibex is probably the most abundant Caprinidae in Pakistan, in terms of relative numbers (Schaller 1977). Distribution of Asiatic ibex is restricted to the relatively dry mountains of Northern Pakistan that includes the inner Himalayas, Hindukush and Karakoram. Population numbers for the Northern Areas (District Gilgit, Diamer and Baltistan) were estimated to be between 9,000 and 10,000 ibex in 1993 (Hess et al. 1997). Other mammals known to be found in the study area are listed in appendix 12 of Report No. 3, *Pasture, livestock and biodiversity*.

2.1.6 Socio-economic characteristics

People in Basho live in eight different villages distributed from top to bottom of the zone of permanent habitation along the Khar Nullah: Sultanabad, Nazimabad, Doros, Meito, Guntho, Khar, Bathang and Matillo (ref. map on page vii). Agriculture and livestock production are the major sources of livelihood; the pastoralist system involves a seasonal transhumance between villages and temporary settlement in the high alpine zone. Off-farm employment play an increasing role. Most visitors would find the natural scenery of Basho unusually attractive, but so far trekking or other forms of tourism are not developed in the watershed.

The majority of people are *Balti* speakers, while a minority are *Shina* speakers (immigrants from the Astore Valley) (AKRSP 1997, PRA at Village Basho). *Shina*-speakers are also termed *Broqba* (mountain people, sometimes used derogatorily) and make up the majority of inhabitants in Sultanabad.

The total number of households in Basho is estimated at 297 and approximate number of inhabitants at 2,400, based on an average household size of eight (Socio-economic survey by Aurang Zeb Zia, AKRSP, 1998).

AKRSP has worked in Basho since 1987. Today, seven of the villages have a Village Organisation (VO) and 4/5 have a Women's Organisation (WO). A cluster organisation, Basho Development Organisation (BDO) was established in January 1997, but as with the VOs, it grew out of a long-standing tradition of cooperating within the watershed. Villagers refer to a tradition of shared ownership and use of alpine resources.

Already during field visits in September 1997, the Basho watershed was found to represent a dynamic social situation with respect to institutions and organisations in management of forest and pastures. People depend on scarce natural resources and on creativity in reshaping natural conditions through terracing, irrigation etc. Their capacity for physical reshaping of nature is crucial for their survival and heavily dependent on institutional arrangements. While it is true that villagers claim that the sharing and distribution of rights in forest and pasture are based on generations old traditions, dynamic processes of change may also be observed. There are examples of institutional changes in response to changes in pasture and forest conditions (for instance limiting access to a certain pasture, when land degradation is observed).

2.2 Implementation of the forest inventory

2.2.1 Inventory design

The inventory was carried out as a systematic sampling survey with a grid of 100m by 100m i.e. the survey lines compose a grid where the lines are located 100m apart and the plots 100m apart along the lines. Every plot thus represents an area of one hectare (ha). Normally, rectangular grids with longer line spacing are more efficient for such inventories. The lack of proper maps and aerial photographs, however, lead to this square, dense grid through which the plots can compose a rough structure for a map.

In the field, the lines and plots were identified by means of compass bearing and measuring tape. From a fixed starting point the first survey line was established, selecting a “convenient” compass bearing. Keeping track of the direction and distances enables a firm orientation of the grid. A numbering system for the plots was created similar to the numbers of a co-ordinate system. The number comprises four digits where the first two give the line number and the last two the plot number. Thus, every plot has a unique identification number giving the relative position in the grid.

The electric pole outside the school constituted the basic point from where the grid was established. This point was given the identification number 1010 (line number 10, plot number 10). The reason why

0101 was not selected as the first number was to avoid negative numbers. The first plot can take the number 0101 only when it is located in the extreme corner point of the survey area. In this case we gave a tolerance for possibly 9 plots to occur “behind our back”. Compass bearing for the lines was selected to 200 degrees (180 degrees according to old system). Moving 100m from the basic point in the selected line direction thus brought us to plot number 1011. When moving to new plots the number so forth will be given by its orientation to the lines and plots in the grid. Keeping track of these numbers is crucial for the spatial orientation and mapping potentials appearing from classifying each plot and its grid location.

All distances are supposedly horizontal, thus slope has to be taken into consideration when stretching the measuring tape from one plot to the next. Sources of error increase with steepness. To avoid too much climbing up-hills and also reduce sources of erroneous distance measurements, the terrain was considered when determining the compass bearings. Survey lines parallel with the contour lines are favourable both for practical reasons and to reduce sources of error.

2.2.2 Plot measurements

For practical reasons the plot shape was determined to be circular. Plot size is important from a statistical point of view, whereby optimal size is dependent on a number of factors i.e. the structure of the variation within the forest, the number of plots, the terrain and the cost structure. As no verified knowledge of this kind was available, the decision had to be based on an “eyeball estimation” of these conditions. Circular plot with a radius of 15m was selected which produces a plot size of 707 m^2. As each plot represents one ha, the surveyed area thus covers 7.1% of the total area. Conversion to per hectare based data, with the factor 10,000/707, thus simultaneously gives figures for the total area.

Coming to the plot, the centre was first demarcated. Subsequently 15m of the measuring tape was pulled out and rotated while one end anchored to the centre. Within the plot all the trees were measured/assessed for the following parameters:

- dbh (diameter at breast height) in cm
- height; total tree height from the root to the tip of the tree in m
- timber quality
- age at breast height; intentionally the age of every 10^{th} tree should be enumerated. As one of the borers got broken only half, approximately every 20^{th} tree was measured.

In addition, the plot area was assessed for the following parameters:

- area category
- bush cover percentage
- regeneration

2.2.3 Stratification

Two perspectives are important when designing a classification system for a forest area. Firstly, diversion into significant different categories will give more precise information of the land resources. Secondly, dividing the land into homogeneous units based on standing stock will yield higher precision on subsequent stratified volume calculations. As for the relevant area it was difficult to identify visible forest criteria on which distinct stratification could be done. Neither on site quality class nor on age of the forest, important for forest management planning, this was possible. Stratified calculation is thus not statistically beneficial here. A classification related to the location and geological formation of the different parts of the forest was thus used. Several forest attributes such as bush cover, hydrology and regeneration are likely to be derived from those criteria. The categories are also likely to coincide roughly with botanical composition, pasture conditions and grazing patterns. Proper maps in this process would considerably have facilitated ease and accuracy in stratifying the area.

2.2.4 Measurements

In implementing the inventory work the valley was divided into six parts, listed under:

1. **Sharimond,** the innermost forest area in the valley.
2. **Sari,** forest downstream for Sharimond
3. **Ranga**, the plain fluvial deposit area from the school southwards covering the area between the main river and the village Sultanabad.
4. **Durom**, the Blue pine hillside on the Eastern side of the valley between Khardenlogma and Alfapigaryinglogma including Forikcho (the artificial Lake area) and Maisik to Snopo Chomic (end of Jeep road), up to Chat forest.
5. **Chat**, forest from the upper timberline of Birch downwards to the river.
6. **Zigerkun**, hillside upstream Chat, not measured, estimated from photographs to be approximately the same size as Chat forest.

Table 1: Distribution and number of plots measured in different areas of the valley

Forest area	**Plot numbers**	**Number of plots**	**Compass bearing**
Sharimond	0101 - 0213	27	50 degrees
Sari	0301 - 0416	55	50 and 400 degrees
Ranga	0910 - 1413	31	200/400 degrees
Durom	3918 - 5636	274	250/50 degrees
Chat	6210 - 7012	47	300/100 degrees
Zigerkun	Not field measured		

Table 2: Measurement/assessment keys recorded:

Plot. No.	Identification number for the plot relating to a co-ordinate system with lines and plots.
Area category	**1**: Plain area built up of fluvial deposits and boulders representing most of the valley bottom, stocked by Blue pine, Juniper and substantial cover of bushy vegetation, especially Sea buckthorne. **2**: Gently sloppy fluvial deposits, representing the areas surrounding the plain area under the steep slopes. **3**: Blue pine slope, representing the big and steep slopes on the eastern hill sides. **4**: Birch forest, representing the upper elevation of the forest belt - the timberline - above the Blue pine forest. **5**: Sharimond forest, the innermost forest down to Sari. **6**: Sari forest, gently sloppy areas close to the river **7**: Sari slope forest, higher up in the hillside.
Bush %	Estimate of the percentage cover of bush in the plot.
Regeneration	A score for the regeneration i.e. trees with dbh less than 4cm: **1**: Adequate regeneration. **2**: Some regeneration, but not sufficient. **3**: No or very little regeneration.
Tree no.	Subsequent number of the trees measured in each plot.
Dbh	Diameter at breast height of the tree in cm, minimum 4cm
Height	Total height of the tree in m.
Timber quality	A score for the tree considered for timber: **1**: A good, straight stem where a big proportion can be used for timber (a small bend at the basis of the tree may occur). **2**: Parts of the stem can be used for timber. **3**: Not applicable for timber.
Age	Age at breast height, counted from a boring sample
Tree species	**1**: Blue pine **2**: Juniper **3**: Birch **4**: Willow and Salix **5**: Others

2.3 Processing

Two software packages have been used for entering, calculating and analysing the data; Microsoft Excel and SPSS (Statistical Package for Social Science).

2.3.1 Volume calculations

Due to lack of adequate volume tables for the relevant tree species, functions for apparent morphologically similar Norwegian tree species were used.

For Pinus Wallichiana (Blue Pine) and Juniperus excelsa the following functions, developed for Pinus sylvestris were used. The functions give volume of the stem including bark:

- For dbh > 10 cm: $V = -9.9793 + 0.204787*dbh^2 + 0.029966*dbh^2*h + 0.003539*dbh^2*k - 0.002918*dbh^2*b$
- For dbh < 12 cm: $V = 2.0044 + 0.029886*dbh^2 + 0.036972*dbh^2*h$

where dbh = diameter at breast height

where h = tree height in m

where k = height from the ground to the crown

where b = double bark thickness at breast height in mm

$k = 4.1203 - 0.2817*dbh^2/100 + 2.6234*h^2/100 - 0.3184*(d/h)^2$

$b = 2.9571 + 1.1499*dbh - 0.7304*dbh/h$

For Betula utilis, Willow, Salix and others the following function developed for birch in Norway was used. The function gives volume including bark.

- $V = -1.25409 + 0.12739*dbh^2 + 0.03166*dbh^2*h + 0.0009752*dbh*h^2 - 0.01226h^2 - 0.004214*dbh^2*b$ $(b = 1.046*dbh)$

Measurements of the total biomass of trees were not carried out in Basho. Biomass is given in units of weight. From other research projects one has experience that for pine 30 – 40 % should be added on to stem mass to compute the total tree biomass.

3. FINDINGS

3.1 Resulting volumes and tree figures

Table 3: Stem volumes of the forest in Basho, all species

Forest area	Area ha	Total volume m^3	Mean per ha m^3	Standard deviation m^3	Coeff. of variation	Max per ha m^3
Sharimond	27	880	32.6	35.9	110.1	166.4
Sari	55	1601	29.1	30.2	103.7	147.4
Ranga	31	350	11.3	14.1	124.8	48.1
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Chat	47	3007	64.0	39.6	61.8	183.7
Zigerkun *)	45	2250	50.0			
Total	**497**	**18176**	**36.7**	**45.2**	**123.2**	**294.9**

Standard Error of the mean = 2.2 m^3 per ha. Sampling Error for the inventory is 5.9%

*) Estimate without measurements

Comment: The figures are obtained through conversion from the results of the plots to per ha. Chat is the most densely stocked forest and also has less variation than the other areas. Ranga is the area having least stocked volume.

Table 4: Number and average size of trees measured in the different areas

Forest area	**Number of trees measured**	**Average size dm^3**
Sharimond	192	324
Sari	504	225
Ranga	232	107
Durom	1972	362
Chat	689	308
Total	**3589**	**314**

Comment: While Durom has the biggest trees, the average tree size in Ranga is only one third of the rest of the areas.

Table 5: Volume and number of trees distributed on species

Tree species	**Number of trees %**	**Volume %**
Blue pine	55.8	87.6
Juniperus	25.1	8.5
Birch	15.2	3.2
Willow	3.6	0.4
Others	0.3	0.3
Total	100.0	100

Blue pine is the dominant species. The volume of broad leaved trees accounts for only about 4% of the total volume.

3.2 Bush cover

Table 6: Bush cover structure in % of area

Bush %	0%	5-10%	15-20%	25-30%	35-40%	45-50%	55-60%	65-70%	75-80%	85-90%
No. of plots	260 59.9%	92 21.2%	31 7.1%	17 3.9%	11 2.5%	12 2.8%	4 0.9%	5 1.2%	1 0.2%	1 0.2

Apart from Ranga area, bush cover is sparse in Basho. Table 6 shows that 260 plots or 60% of the plots have no bush cover.

3.3 Regeneration

Table 7: Regeneration, categories in percent of total area

Adequate regeneration	5.5%
Some regeneration, but not sufficient	24.0%
No or very little regeneration	70.5%

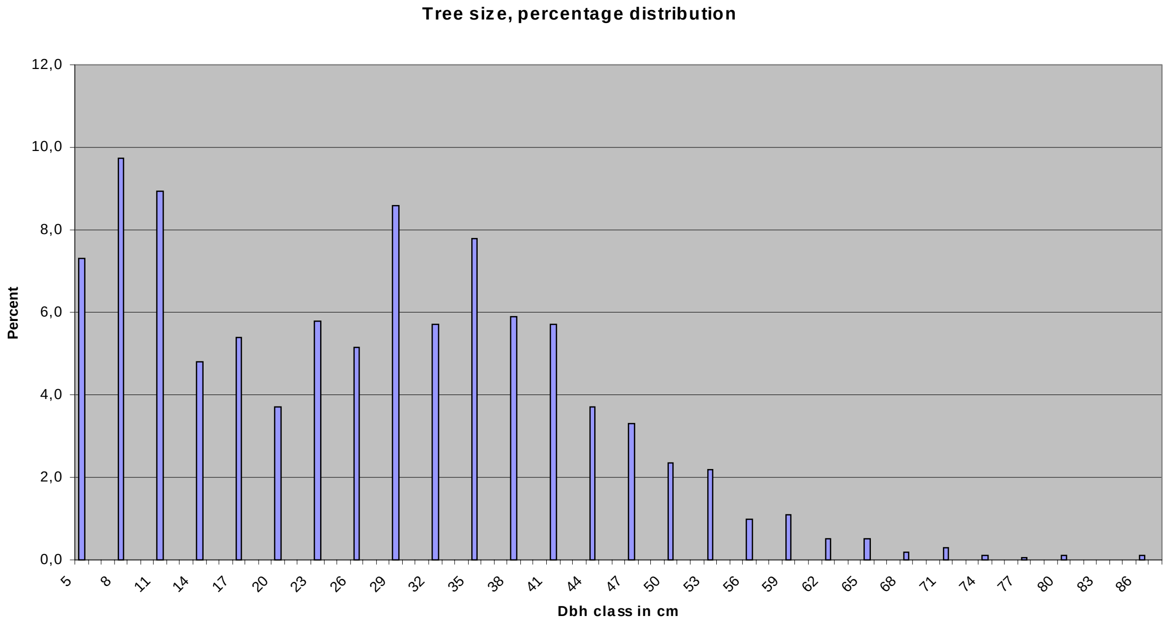
Table 7 shows that the status of the regeneration is far from satisfactory. Regeneration is the overwhelming problem in the Basho forests. It is poor, especially in the steep slopes. Potential causes for the inadequate regeneration are:

- **Climate**; dry climate, insufficient water for the seed to germinate and establish the root system.
- **A top layer of pine needles** abundantly covers the surface. This layer is likely to hamper the regeneration; both preventing the seeds from getting soil contact and hindering the germination.
- **Acid soil condition**; the layer of needles also is likely to have created an acid environment, adverse for germination of the seeds.
- **Freezing**; seedlings are possibly exposed to freezing under certain climate conditions winter, spring or autumn.
- **Grazing** by domestic animals
- **Logging**; physical damage of seedlings under logging operations
- **Avalanches** on certain steep locations

3.4 Frequency on size

The frequency distribution on size of Blue pine trees is shown in the diagram below. Dbh is used as the expression for size. The bars display the percentage number of trees in three cm diameter classes; e.g. class 8 has included the trees with dbh from 7 to 9, class 11 has included the trees with dbh from 10 to 12 and so forth. For sustainable forests the ideal situation is where the number of relatively small trees is considerably higher than the number of big trees. From the diagram it can be read that this is not the case for the Basho forest. The diagram shows clearly lack of trees in the small size classes, and the proportion of old trees is to big in comparison to younger. Following the shape of the diagram from the big sizes downwards the frequency distribution looks good down to about 30 cm. Further downward the frequency is inadequate.

Figure 1: Tree size (percentage distribution)



3.5 Annual increment

All together 143 trees of Blue pine and Juniperus were bored at breast height for age determination. Ten years has been added to get total age of the trees. By means of the calculated total volume and total age, mean annual increment was found for each tree. The sum of this increment in percent of the total volume for the same trees thus give the average figure for the increment. 114.708 m^3 was found as the total volume and 1.387 m^3 as the increment respectively. This gives an annual increment of 1.2%.

In terms of volume, the current annual increment of Coniferous trees in Basho is 210 m^3.

3.6 Timber quality

All the Blue pine trees measured have been considered for timber quality and a score recorded according to the system outlined above. The results were as follows:

Score 1	Score 2	Score 3
48.1%	29.7%	22.2%

A large proportion of the trees has a bend at the basis due to the steep terrain, snow pressure and sliding soil. In spite of this general defect almost half of the pine trees have adequate quality to be sawn, including most of the bent trees. Almost a quarter of the trees has improper quality for sawing.

3.7 Tree health

The general impression is that the pine trees and forest look healthy in that the needles have a sound greenish colour. The surprisingly few observations of sick trees, attacked by insects or fungi must be seen in view of the regulations; rights and habits of wood collection. Although Forest Department has sole jurisdiction of the timber, local people can harvest dead or damaged trees. This has obviously been done.

Systematic recording of damaged trees has not been carried out. However, one could not avoid observing the relatively many man-caused damaged trees in some areas. The explanation for this is allegedly that the trees in various ways for specific purposes are pre-treated when still green to assume certain properties or qualities (ref. Report No 2, chapter 4.2.4). In fact this was sometimes done in a rather sophisticated manner and seemed to have developed into a craft. In some areas a substantial number of fresh trees also have been cut leaving stumps of about one meter height.

3.8 Site quality and soil conditions

Site quality is to a great extent dependent on the soil conditions and edaphic factors. (Site quality reflects the soil conditions, and soil conditions affect the site quality.) Through the age determination exercise it was observed that site quality varies considerably within small areas. One suspects that soil conditions represent the main cause for this variation.

3.9 Main constraints

- Lack of maps. Proper maps would have facilitated ease in implementing the inventory.
- Inaccuracies connected to the use of the compass.
- Inaccuracies related to the use of the measuring tape.
- The volume functions used are not tested for the relevant tree species.

4. RECOMMENDATIONS

- Legal rights for different stakeholder groups should be clarified.
- Regeneration opportunities; reasons for the poor situation should be further studied.
- A management plan should be designed – involving groups of the stakeholders on how to regenerate the different parts of the forest. Regulations on cutting should be imposed by systematically taking out the biggest and oldest trees, and subsequently re-planting the areas
- Obligations in facilitating forest regeneration should be suggested for all groups having legal rights in the area.
- Intermixing with broad-leaved tree species should be tried to improve the top soil conditions and also reduce fire risk.

- Pit-sawing, i.e. splitting the logs at the stump by manual saws, should be introduced. (This is done by erecting a simple scaffolding on which the logs are rolled, marked and subsequently sawn.)

5. SOME FINAL WORDS

There are definite signals of depletion of the forests of Upper Basho. The causes of the deforestation are not necessarily signs of too much cutting, rather the way the cutting is implemented and the absence of sufficient regeneration. The different groups of stakeholders seem to be blaming each other for the current situation. Allegations on who is responsible for the alarming situation should come to an end - eaten is eaten and cut is cut - now plans for the future must to be put forward to initiate work on whatever means that are found beneficial for regeneration of the forest.

APPENDIX I: : OVERVIEW OF PROJECT COMPONENTS AND COUNTERPARTS

High Altitude Integrated Natural Resource Management

Project	NLH	AKRSP
Institutions and organisations in pasture and forestry management (property rights and other formal and informal institutions interpreted as the rules for behaviour; organisations/actors within the institutional framework)	**Hans Sevatdal**, Håvard Steinsholt, Poul Wisborg	**M. Akbar Raza**, Dr Abbas; Wazir Ghulam Haider
Pasture, livestock and biodiversity (the dynamics of high pasture management, fodder demand and fodder production, quality assessment for land use planning and conservation of soil and vegetation	**Øystein Holand, Per Wegge**, Kathrin C. Hofmann, Åge Nyborg, Veronika Seim, Thor Sigurd Thorsen	**Iqbal Hussain**, Dr Abbas, Jawad Ali, Ulrik Motzfeldt
Farm forestry and natural forest assessment (forest and tree resources assessment, regeneration evaluation, and analysis of the supply and demand of forest products and linkages between farm-forestry practices and natural forest)	**Knut Velle**	**Jawad Ali**,
Gender in natural resource management (dynamics of changes in women's and men's use, access to and control over resources, and the effects of changes on household food security)	**Ingrid Nyborg**	**Nazir Ahmed**, Gulcheen Aquil
Information and documentation (creating a common information resource base relevant to all project sub-themes, facilitating exchange of information between project counterparts in Baltistan and Norway and supporting AKRSP Baltistan's efforts in networking for information access)	**Liv Ellingsen**	**M. Masood Khan/Nazir Ahmed**
Coordination	**Poul Wisborg**	**Khaleel Tetlay**

APPENDIX II: : TRAVEL REPORT. SKARDU AND BASHO 18.08 – 14.09. 98 (KNUT VELLE)

1. Background

Cooperation programme between Noragric/NLH and Aga Khan Rural Support Programme (AKRSP); concerning the project High Altitude Integrated Natural Resource Management, funded by NORAD.

2. Purpose

2.1 The main purpose was initially to be technically responsible for the inventory of the Natural Forest in Upper Basho Valley to obtain estimates of:
- Standing stock/biomass
- Yield/potential yield
- Morphology and structure of forest
- Regeneration opportunities

2.2 After coming to Basho the following additional purposes emerged:
- Transfer of competence through strengthening the skills and understanding of forest inventory techniques to AKRSP-, DFO- and local staff.
- In co-operation with AKRSP-, DFO- and local staff implement an inventory of the natural forestry resources in Upper Basho valley.
- Collect baseline data in order to suggest recommendations for a management plan for the Upper Basho valley forest area

3. Activities

Together with my fiancée I travelled via Islamabad to Skardu. The first day we had a meeting with the AKRSP leadership and some of the staff to clarify the components of the assignment in Basho and organise the necessary practical arrangements. The second day we travelled up to Basho, met the inventory staff at the forest hut and continued to the school where we should put up. Discussions on the inventory design started immediately and also demonstration and training on the actual field work. The following13 days the forest area was systematically covered by two inventory teams, and trees measured through a systematic plot sampling design. The 14th day we went back to Skardu, and the following day a workshop for presentation of the preliminary results was launched, where AKRSP-, DFO- and local staff were present. Individual certificates were issued and handed over to all the inventory staff.

4. Preliminary achievements

4.1 Training in use of forest inventory equipment.
4.2 Implementation of a complete forest inventory.
4.3 Mensuration of about 450 sample plots, circular with a diameter of 30m, assessing forestry parameters.
4.4 Measurement of approximately 3600 trees, mostly Blue pine.

5. Follow-up

5.1 Outline the inventory design and work procedures.

5.2 Compute the inventory results.

5.3 Draw a draft map of the forest area.

5.4 Identify criteria and suggest recommendations for sustainable management of the forest.

5.5 Integrate the results with the other components of the High Altitude Integrated Natural Resource Management project.

Actual travel route:

August 18th: Travel Drammen - Oslo – London – Islamabad

August 20th: Travel Islamabad – Skardu

Meeting at AKRSP in the morning

Meeting at AKRSP in the afternoon

August 21st: Travel to Basho

Meeting in Basho

Design of inventory

Establishment of two inventory teams, briefing of inventory procedures

Upstart of inventory

August 22nd to September 4th: Forest inventory in Basho and entering of the measurement data into computer.

September 4th: Travel Basho – Skardu

September 5th: Presentation of preliminary results at AKRSP

September 7th: Travel Skardu – Islamabad

Meeting at the Norwegian Embassy including briefing of Mr. Ramslien and local personnel at the Embassy.

September 11th: Travel Islamabad – London – Fornebu – Drammen.

Drammen 30.09.98

Knut Velle