Glacier Growing - A Local Response to Water Scarcity in Baltistan and Gilgit, Pakistan

Ingvar Nørstegård Tveiten

NORWEGIAN UNIVERSITY OF LIFE SCIENCES
DEPARTMENT OF INTERNATIONAL ENVIRONMENT AND DEVELOPMENT STUDIES
MASTER THESIS 30 CREDITS 2007

The Department of International Environment and Development Studies, Noragric, is the international gateway for the Norwegian University of Life Sciences (UMB). Eight departments, associated research institutions and the Norwegian College of Veterinary Medicine in Oslo. Established in 1986, Noragric's contribution to international development lies in the interface between research, education (Bachelor, Master and PhD programmes) and assignments.

The Noragric Master theses are the final theses submitted by students in order to fulfil the requirements under the Noragric Master programme "Management of Natural Resources and Sustainable Agriculture" (MNRSA), "Development Studies" and other Master programmes.

itveiten@yahoo.com

Noragric
Department of International Environment and Development Studies
Norwegian University of Life Science (UMB)
P.O. Box 5003
N-1432 Ås
Norway
Tel.: +47 64 96 52 00
Fax: +47 64 96 52 01
Internet: http://www.umb.no/noragric

Declaration

I declare that this thesis is based on my own research, and that the use of all other material is duly acknowledged. The thesis has not been submitted to any other university than UMB nor for any previous academic degree. All views and opinions expressed herein remain the individual responsibility of the author, and do not necessarily represent the views of my department.

Ås, 12.05.2007

……..
Signature

Ingvar Nørstegård Tveiten

Acknowledgements

I would like to thank my supervisor Ingrid Nyborg for stirring up my curiosity about the remarkable world of glacier growing, and for her inspiring comments and advice on my work I am greatly indebted to all of my friends in the Aga Khan Rural Support Program for setting me up in Skardu, and for organizing my trips to glacier growing sites in the Karakoram and Himalaya mountain ranges. You treated me as if I was part of your families, and welcomed me with an exceptional hospitality. Special thanks to my local supervisor Mr. Sher Khan who opened doors I could never have gotten through on my own, and whose sharp observations have been invaluable to my enquiries on glacier growing. To Ghulam Mohammad, not only are you a wonderful translator you are also like a brother to me.

Thanks to Liv Ellingsen and Ingeborg Brandtzæg for making my life very easy. I believe there is not a book or a document in the world which you cannot get hold of within a couple of days. Arriving at your well-kept library is like arriving at home.

Thanks to my good friend Anders Romundset, Ph.D. student in geology at the University of Tromsø, for making it a less daunting task to enter the world of glacial and periglacial phenomena. Another helping hand in these matters has been Ole Humlum, Professor in Physical Geography at the University Centre in Svalbard. Thank you for introducing me to the fascinating sphere of rock glaciers. I would also like to thank Professor in geography Kenneth Hewitt for sharing his experience with me on glacier growing in Baltistan.

I feel deep gratitude to the people of Baltistan and Gilgit who welcomed me with generosity, friendliness and huge amounts of chai and chapati. You listened patiently to my never ending questions, and cared for me when I was sick from altitude. And last but not least, without my supportive family and friends I would never have made it through with this project. Thank you all!

Abstract

People in the districts of Baltistan and Gilgit practice ’glacier growing’ with the intention of making glaciers that will enhance water availability. This is done by carrying glacier ice from a naturally occurring glacier up to elevations over 4000 m a.s.l., where it is placed in a dug out cave in a scree-slope. Apart from the ice, gourds containing water are also added to interior of the cave. Then a layer of charcoal, and sawdust or wheat husks is put on top of the ice. The workers close off the cave by piling up rocks to cover the entrance. Connected to this practice is an elaborate system of knowledge that is handed down orally from generation to generation by means of stories and myths. This study is an exploration of the practice of glacier growing and of its implications for local perceptions on water management. Former studies on water management in the Northern Areas of Pakistan have been concentrated on the sophisticated system of irrigation canals which have been in use since ancient times. Glacier growing is directed at increasing the water supply to these canals at times of the year when people experience water to be scarce.

After observations of some of the sites for glacier growing, and by informal interviews with participants of this practice, a grounded theory of glacier growing has been arrived at. Glacier growing is interpreted in context of findings on glacial and periglacial phenomena within the scientific discipline of glaciology, in order to account for how natural processes affect the sites of glacier growing. The locations where glacier growing was conducted are prone to snow accumulations by snowdrift and avalanche activity. At these sites the ground is perennially frozen, which provide conditions conducive to the formation of ice-accumulation in boulder areas, and, in some cases; the formation of rock glaciers.

Glacier growing is also explored as a local knowledge embedded in cultural patterns and values among the people of this area. The perception that glaciers are animated and open to human influence, can be seen as a cultural condition for how the people of this area view glacier growing as feasible to produce new glaciers. In return glaciers can also influence the world of humans, by glacial surges that eat into cultivated land, destroy irrigation canals, and dam up rivers. Glacier growing is understood as a practice which is continually being reinterpreted during encounters between humans and between humans and their natural environment. Currently it is being interpreted into a context of Islamic history making, and into the scientific paradigm of the development agency Aga Khan Rural Support Program.

Table of Contents

List of Figures and Tables

1 Introduction

1.1 Introduction

Glacier growing is a technique used to encourage the growth of ice patches in high altitude catchments of the Northern Areas in Pakistan. The aim stated by its practitioners is to aid the formation of new glaciers in order to increase the amount of water available for agriculture. All the cases of glacier growing that I witnessed, or heard of, were carried out in villages without a glacierized basin. The perception that water availability will increase when having a glacier in ones drainage basin is connected to the fact that glaciers have a significant impact on stream flow, as the release of meltwater from glaciers peak at a later time than the release of meltwater from snow; thus providing water during otherwise dry periods. (Singh & Singh 2001; Stahl & Moore 2006; Østrem 1974).

During my research I have observed five sites where glacier growing has been undertaken, each exhibiting ice-accumulations of varying sizes. Four of these have been made recently by the assistance of the Aga Khan Rural Support Program (AKRSP), while the fifth was made in the 1960's. Data have also been gathered on seven other glacier growing sites of various ages by interviewing people who participated in making them. By these observations and interviews a grounded theory of glacier growing has emerged; meaning that the categories and concepts of the theory are based on those used by the people who practice glacier growing. In addition a random selection of households which get part of their water from a drainage basin containing a glacier growing site have been interviewed. These interviews have provided a basis for understanding local perceptions of the role played by glacier growing in water management.

Data on characteristics of terrain and climate have been used to assess how natural processes may influence on the accumulation of ice at locations where glacier growing has been conducted. We found that many of the locations are prone to avalanche activity during late winter and spring. This may add substantial amounts of ice to the glacier-growing locations, as snow from avalanching melts and then refreezes upon contact with permafrost. Two of the locations physically observed, and two of the locations recorded by interviews, have characteristics common to a group of glacial and periglacial phenomena called rock glaciers. Distinctive to rock glaciers is that they contain big amounts of rocks relative to the amount of

ice they contain. Rock glaciers are known to be formed in terrains of high relief containing permafrost and avalanche activity, also the kind of terrain where glacier growing sites were located.

During interviews with glacier growers and conversations with other people from Baltistan and Gilgit I became aware that glacier growing is mentioned in a number of local stories and anecdotes. These stories were often mentioned when I asked how they had learnt to grow glaciers; hence indicating that these stories serves as vehicles for transmission of knowledge on how to carry out glacier growing. The fact that these stories circulated among people in general as well, and in different versions, gave me a notion that glacier growing may play a role to communicate certain cultural values and themes. Hence I have analysed and interpreted some of these narratives in the last chapter of this thesis.

1.2 Rationale of Study

Literature searches on the topic of glacier growing gave little result. The practice has been accounted for shortly, but concisely, in a report written by AKRSP (Khan 2005); in an article by "Islam Online" (Khan 2003): and is also briefly mentioned in an anthropological monograph (Cruikshank 2005). Due to the lack of academic research on glacier-growing this thesis is intended to serve as a general introduction to this particular feature of society and culture in the Northern Areas, and additionally goes into detail on certain aspects of it.
As the topic lacks previous academic interest my enquiry into it has been of an explorative nature. Therefore the general orientation of my research has been qualitative with emphasise on the generation of theory.

The paper argues that glacier growing is recognized by local people of the Northern Areas as an important aspect of how they manage their water. Therefore the practices and perceptions of this phenomenon can be beneficial to researchers and professionals who are involved in the management of water in the Northern Areas. Glacier growing also has a social and cultural significance which goes beyond its perceived function to increase water availability, as it reveals a particular view on how humans relate to their natural environment. I argue that glaciers are, by the people of Baltistan and Gilgit, perceived as endowed with life; and that this is a basic assumption for how they come to see glacier growing as feasible. Thus, the present paper is also to be regarded as a part of the discourse in social anthropology on how cultural patterns mediate the relationship between humans and their natural surroundings.

Recently glacier growing has been adopted into the scientific context of AKRSP, and their work to increase income for people living in the Northern Areas. This provides opportunity to scrutinize how new forms of local knowledge occur when glacier growing is incorporated into a modern development project. Thus, my thesis should also be of interest to researchers studying local knowledge, and to governments and organizations concerned with issues of local participation in development projects.

1.3 Objectives and Research Questions

The objectives of my research have been:

- to explore practices and perceptions connected with glacier growing in Baltistan and Gilgit, with the aim of generating theory
- to examine the role played by glacier growing in management of water in Baltistan and Gilgit

Connected to these two objectives of my research are five main questions that I have sought to answer:

- How is glacier growing carried out?
- Why do people carry out glacier growing?
- What physical processes occur at the locations of glacier growing?
- What significance does glacier grafting have in local management of water?
- How is glacier growing conceived of in various social contexts of the study area?

Although this thesis does not purport to be a complete treatise on the practice of glacier growing I hope that upon having read it the reader will have gained an understanding of procedures essential to grow a glacier, and of the particular worldview that lies behind such an undertaking. In addition to the human influence imposed upon the locations where glaciers are attempted grown, I will present the reader with natural processes that also impact these sites. The significance with which people of this area attribute glacier growing's role in managing water should also be clear, as well as how the practice resonates with particular cultural values and beliefs.

2 Methodology & Methods

2.1 Methodological Framework

My enquiries into the practice of glacier growing have been guided by the methodological framework provided by 'grounded theory' (Glaser & Strauss 1967). Grounded theory is designed to guide the researcher to discover concepts and categories used by people in the social and cultural setting he/she is studying. In this manner theory 'emerges' from the language and culture of those who are studied rather than from predefined concepts. Such an approach seeks to make a good fit between data and theory. The theory is something which comes out of the research, rather than something which guides the research. Grounded theory, thus, is an inductive approach, in contrast to hypothetical deductive research approaches where research is carried out in order to test hypothesis and theories.

For the research on glacier growing this approach fitted very well since there were few written sources to go to for any background information on this phenomenon. The research necessarily became explorative of nature, and I had to build a theory on how glacier growing was performed from my observations of glacier growing sites and interviews with people who had participated in it. As I intended to get an understanding of the procedures used to graft a glacier, and how the knowledge of these procedures was received and organized; the framework of grounded theory provided me with a concrete set of guidelines which I could follow both during my fieldwork and in my analysis of data.

2.2 Methods of Data Collection

My fieldwork was characterized by three main pathways to data. First there was the observation of a selection of sites where glacier growing had been conducted; then there was the 'focused interviews' of people who had partaken in glacier growing; and last I conducted semi-structured interviews in a village which had grafted a glacier 50 years ago. In addition I acquired several narratives on the origin of glacier growing from local historians, and learnt about AKRSP's involvement in glacier growing through informal conversations with people in that organization.

2.2.1 Observation of Glacier Growing Sites

As there are no sources that can provide complete information on the number and locations of glacier growing sites in the study area, my selection was based on convenience and the constraints provided by the inaccessibility of the Karakorum and Himalaya mountain ranges, where these glacier growing sites are located. The inaccessibility of these areas was increased by each day of my stay as we moved towards winter, facing increasing amounts of snow and wind in the mountains. Since AKRSP had aided the glacier growing of 15 Baltistan villages since 2000, I decided to visit some of these sites as AKRSP staff members were willing to help me reach these sites. Studying these sites would also give me the benefit of knowing the exact date of the glacier growing and the methods used, since I would go there together with people who had actually participated in the event.

Consequently I ventured to four different glacier growing sites that AKRSP had supported. On these sites I measured the location, altitude and aspect of the glacier growing sites using a GPS device. In addition I took notes on the topography of the surrounding environment, and measured grain sizes of the rocks covering the glacier growing site. At two of these locations, Hussainabad and Balghar the cavities where the glacier ice was put, was large enough to allow me go inside of it and have a look at how much ice was present. At the two other sites I could only glimpse the ice accumulation through gaps between the boulders that covered it. The fifth location observed in Minawar was already covered in 60 cm of snow, and consequently I could not observe whether there was ice there or not. Nevertheless I took notes on features of the landscape, and noticed landscape forms reminiscent of rock glaciers. The presence of a rock glacier at this site was later confirmed by descriptions given by people who had visited the place during the summer.

2.2.2 Focused Interviews

We conducted interviews with people who had participated in glacier growing in two villages of Gilgit, and in six villages of Baltistan. These interviews can be described as ‘focused’ (Merton, Fiske & Kendall 1952) in the sense that they were concentrated on the particular topic of glacier growing. The interviews were open and allowed the interviewees to bring up own topics they found important, and to elaborate on their answers. Selection of interviewees was made out of consideration for getting as varied a sample as possible in order to contribute

to further elaborations of the categories emerging in the grounded theory. Basically we would travel to most of the villages we heard had undertaken a glacier growing.

A tape recorder was used during all the interviews with the agreement of our interviewees. Nobody seemed to be bothered by the presence of the tape recorder. When explaining the location of the glacier growing sites we encouraged people to draw them on paper. This proved very useful, and we arrived at a good understanding of how the sites were located.

2.2.3 Semi Structured Interviews

In order to get background information on perceptions on water availability and glacier growing among people living in a village which had attempted to grow a glacier, I carried out 20 structured interviews in the in Hanuchal which is situated in the eastern part of Gilgit. The village was chosen because I had heard accounts that a glacier had formed in the watershed of the village as a consequence of glacier growing. In addition I had hopes of getting access to interview women in this village as I personally know a man from Hanuchal. Due to cultural restrictions most villages in the areas I did my research does not accept foreigners to get into contact with woman living there. Knowing someone from this village quite well opened a door for me to access information from females. Getting their perspectives on issues relating to water management I deem as quite important as women have different uses for water than that of men.

The interviews were designed to be semi structured in order to allow the people whom I interviewed to take up topics which I had not thought of myself. Having a semi structured interview allowed for the interviewees themselves to come with complementary comments to the questions we asked them, and to raise additional issues that they felt as significant.

For my interviews I selected 20 households randomly out of a total of 120 households that got their water from the stream originating from the site where they had done the glacier growing. We decided to interview the oldest person present in the households, in order to get people who might have been born around the time when the glacier growing was done, or earlier.

In three of the households I interviewed the female head in addition to the male head, as I was only allowed too speak to the women in the presence of their husband. The other two women I was allowed to interview alone. In the rest of the households I spoke with the male head. In case of the females whom I interviewed in presence of their husbands I was concerned with

whether this would influence her answers or not. My experience was that this did not happen, as the women seemed quite confident in speaking their own views; views that often differed from those given by their male counterparts.

The interviews were carried out during two days, each lasting around 40 minutes. An interpreter was with me during all of them translating from the locally spoken Shina language to English. Since I knew the interpreter quite well, and we had discussed at length the purpose of the interviews, I have every reason to believe that my questions were conveyed in a manner that preserved their original meaning. Still, translation always entails interpretation, and the indigenous point of view is likely to be somewhat skewed due to this fact.

2.3 Analysis of Data

In grounded theory the collection of data is not controlled by the concern of verification, or by the concern to make ones data representative for the population. It is the development of theory that guides collection of data, and is termed 'theoretical sampling' (Glaser and Strauss 1967). 'Theoretical sampling' refers to how the researcher develops an abstract model of a phenomenon, or a particular situation (Creswell 2007) by coding of the data into significant categories. Ideally the categories should 'emerge' from the research setting, rather than being predefined. Hence, ones analytical categories develop from the analysis of data, which starts already after the first stage of data collection. The process of research continually switches between analysis of data and collection of data. As data is analyzed, new topics and categories may emerge that the researcher wants to elaborate more on; hence further data collection is guided by consideration for developing these analytical categories. The continuous "zig-zagging" between data analysis and collection is termed 'constant comparison'. When the researcher does not find more information that adds substantially to his understanding of the categories he has deemed significant, the categories are seen as 'saturated' (Glaser and Strauss 1967).

This approach to data collection poses the question of how the researcher chooses what to count as theoretically significant. To this question there are no straight answers, and Glaser and Strauss who initially developed the framework of grounded theory have fallen into a heated debate over this topic (Glaser 1992; Strauss and Corbin 1994). Glaser (1992) argues that the researcher's discovery of theory should be guided by his 'theoretical sensitivity'.

Theoretical sensitivity is a sort of 'tacit knowledge' (Polanyi 1967) that the researcher has acquired through his familiarity with theoretical schools in his field, and through his practical experiences from research. This helps him to discover relevant data and to abstract categories from these data. A problem with this viewpoint is that it doesn't give any advice on how such sensitivity is acquired; neither does it explain how a novice researcher without the necessary experience to claim theoretical sensitivity should approach the task of generating theory. The proposition that the researcher is guided by his theoretical sensitivity also collides with the idea that theory should 'emerge' out of the research context.

Strauss and Corbin (1990) propose that theory should be generated from the data by what they call 'axial coding'. Which is a framework directed at identifying causal relationships in ones data. The limitations of this model is that is assumes that there are causal linkages between the described phenomena, which can lead to a forcing of the data into relationships which only exists in the mind of the researcher. My own research has been informed both by a theoretical sensitivity to how human actions are informed by cultural patterns, as well as a search for human and natural factors that causes the observed ice accumulations at the locations of glacier growing.

In my case I collected initial data by conversations with AKRSP staff members and by visiting some of the locations where glacier growing had been conducted. Subsequently I started to interview people who had participated in glacier growing. Each conversation, interview or visit to the field was immediately written down in detail after arriving back to the place where I resided. In agreement with the procedures of grounded theory I started to 'code' the data by taking notes in the margin of the text, grouping it into categories. The properties of these categories was refined and added to by subsequent data collection. Early stages of my research was driven by a concern to whether or not the human interference on the glacier growing sites made any significant contribution to the total amounts of ice found there. My data collection at this stage was geared at obtaining data on human and natural conditions for phenomena observed at the glacier growing sites, thus following an axial coding pattern in search of causal relationships. Later in my fieldwork I became more concerned with exploring the cultural dimension of glacier growing, and collected stories on glaciers and glacier growing which I interpreted in light of themes found in the culture and society of Baltistan and Gilgit.

3 The Practice of Glacier Growing in Baltistan and Gilgit

In this chapter we will explore in detail the procedures connected to glacier growing. By method of focused interviews with experts in glacier growing we have arrived at a grounded theory of glacier growing; that is, a theory based on the concepts and experiences significant to the people who engage in this activity. We begin our task by going through the core categories crucial to make sense of how people in Baltistan and Gilgit conceive of glaciers and ice. Then we will go through the different procedures of glacier growing to see how these categories influence their practices.

3.1 Glacier Growing

‘Balti’ is the traditional language spoken in Baltistan and is an archaic[1] form of Tibetan. A verb in Balti called ‘gang xso’ refers to the activities whereby humans encourage the growth of glaciers. ‘Gang’ here refers to ice or glacier, while ‘xso’ refers to ‘growing’. It is interesting to note that ‘gang’ also has a different connotation, that of ‘filling up’. The double meaning of this word reflects the properties of ice quite well, as the volume of water expands as it freezes to ice. In Gilgit, where Shina is spoken, a similar term for glacier growing is found in ‘gamok sanoke.’ ‘Gamok’ translates as ‘glacier’, while ‘sanoke’ translates to ‘making’. As will be discussed later, glacier growing is of an unknown origin and receives its credibility as a sound practice by reference to myths of big glaciers grown in a timeless past.

3.2 Female and Male Glaciers

Vital to the local understanding of ice and glaciers are the categories of ‘female ice’ and ‘male ice’’ The term for 'female glacier' in Balti is 'mo gang', and the term for 'male glacier' is 'po gang'[2]. In Balti one does not have any grammatical categories for gender, however, the particles 'po' and 'mo' are added to denote the gender of a noun. Hence, the gender categorization of glaciers is not a grammatical phenomenon, but rather exhibits a view of glaciers as having an intrinsic or natural gender. Attributing gender categories to glaciers implies a view on glaciers as animated, and will be discussed at length in chapter 5 of this

[1] Meaning that it has preserved many linguistic features found in old Tibetan texts from the eight century A.D. (Bielmeier 1998)

[2] In Shina, the predominant language of Gilgit, we find a similar denotation: 'sonche gamuk' for female glacier; and 'beero gamuk' for male glacier.

thesis. That glaciers are viewed as animate is crucial, since in order to grow a glacier one needs to ‘marry’ a female and a male glacier.

Explanations of what distinguishes a female glacier from a male glacier emphasized that a ‘female glacier’ is a glacier that is growing and giving off a lot of water. Some added that it has a white or bluish colour. A ‘male glacier’, on the other hand, was characterized as giving little water, moving slowly; and was by some referred to as being black, covered in soil and rocks. An example is the account on this topic given by the glacier growers of Harikon village in Baltistan who travelled to Shigar to get female ice:

> Our forefathers have taught us that the 'mo gang' gives much water, while the 'po gang' gives little water. In Shigar there are two types of glacier. One nallah[3] has a big glacier, but with little water coming from it: that one is a 'po glacier'. Another nallah has a smaller glacier but much water coming from it: that one is a 'mo glacier'. We took ice from the 'mo glacier'. The female is giving birth, so we need that kind of glacier.

This statement also demonstrates the view of glaciers as animate, as something that “gives birth”. To ‘impregnate’ the ‘female glacier’ one has to combine it with ice from a ‘male glacier’. All of the people I interviewed about glacier growing in Gilgit and Baltistan agreed that a combination of female and male ice was absolutely necessary to procure the success of the glacier growing. As the glacier growers I met in Ghwari stated:

> It is important to have both sexes. So our forefathers told.
> The ice which we found underneath the rocks in our own nallah was only of one sex. Therefore it didn’t increase. We had to add the opposite sex to it so it could increase.

In this case, and in all the other cases of glacier growing I encountered except one, ice was already present at the site where they wanted to grow a glacier. The reason why this ice had not already turned into a glacier is explained by the fact that there was only male ice there. In order to make it grow, one needs to fertilize it by adding ice from a female glacier. In the case of Kwardo village ice was not present on the site of the glacier growing, and consequently

[3] ‘Nallah’ is a Balti for term used to denote a side valley carrying a stream.

two parties were sent out: one going for female ice, the other for male ice. Here is their account of male and female ice collecting:

> We were 12 people who collected mo-gang (female) from Shigar, and then walked without break for 12 hours back to Kwardo. The other team went to the Gang Singhe glacier at the other side of Skardu town. There they got po-gang (male) which was covered in soil and rocks. We were not allowed to speak to each other, or to put our baskets filled with ice down on the ground. We carried the ice two and two. Each pair had approximately 30 kg of ice. None of this ice melted, because it was cold. It was in November.

After collecting this ice and bringing it back to Kwardo, new men were standing ready to bring it from there and up to the mountains of their own nallah. Below is a picture, fig. 1, which illustrates how ice is picked loose from a natural glacier. In this case it is ice from a glacier in Shigar valley that is being collected by people from a village that received support from the Aga Khan Rural Support Program to grow a glacier.

Figure 1 collecting ice (Photo courtesy of Sher Khan)

The hardships that people of Baltistan and Gilgit go through in order to secure ice of both genders for glacier growing is also an indication of the importance they bestow upon this process. In all the cases of glacier growing I came to know about in Baltistan and Gilgit, the ice they used to grow glaciers had been carried from far away. Even in the cases where ice was available only a short distance from the glacier growing site they instead chose to carry ice from another valley, to make sure that they got both ‘mo gang’ and ‘po gang’. In Harikon; for example, a group of people went to get female ice all the way from Shigar Valley, a considerable distance taking at least one whole day to walk one way. Considering that on the way back they hauled with them baskets of ice, each weighing 30-35 kg through rocky and steep terrain, we realize that procuring both genders of ice is seen as an absolute necessity. Fig. 2 shows how the ice is being transported in baskets of woven willow-twigs by teams of two and two, who take turns to carry the baskets. This usually involves ascents from lower lying valleys around 2000 - 3000 m a.s.l. up to altitudes between 4000 – 5000 m a.s.l.

Figure 2 Carrying ice to the glacier growing site (Photo courtesy of Sher Khan)

It should be noted that the transportation of ice is done in the months of October and November, when the weather is becoming cooler, dropping below zero in the night. Thus

melting of the ice during transportation is kept at a minimum, and chances are also good that the ice will survive in its new home into the winter, as daily mean temperatures at these altitudes creep significantly below zero at this time of the year.

3.3 Female and male water

Water is also distinguished into categories of male and female called ‘po-shu’ and ‘mo-shu’ respectively in Balti. Every glacier growing mentioned in this thesis also included application of water. The glacier growers in Diamel village, located in Shigar valley, gave an account of what would happen if you failed to use water in the glacier growing:

> When I was young they tried to graft a glacier in the village of Thurgo. It was not successful. It didn't grow because they did not add ‘mo-shu’. ‘Mo-shu’ helps the glacier increase.

However, there was differing opinions on whether one needed to apply both sexes of water, or if it was sufficient to apply water of the opposite sex to that of the introduced ice. A glacier grower of Hanuchal village in the Eastern part of Gilgit was of the opinion that:

> Water from the river is the most important part of glacier growing. We collect water in the autumn when the river is full of melt water from the glaciers. Then female and male glacier water is mixed in the river. You need to mix male and female to get the glacier to grow.

He clearly indicates that one needs both sexes of water in glacier growing. Glacier growers in Harikon practiced this technique as well, while a glacier grower from Balghar thought it sufficient to combine female water and male glacier ice. In the quote from Hanuchal it is also mentioned that one river can have both female and male water in it. Other glacier growers were of the opinion that each river had its own sex, however, there was disagreement concerning which river was female and which was male. A story narrated to me by a pensioned agricultural officer from Baltistan shows us that the sexuality of water not only has to be considered in the practice of glacier growing, but also carries implications in other areas of water management as well:

> Together with a friend I bought some land in village X. We needed more water to develop this land and made an agreement with people from the neighbouring village Y that we would share water from our spring if they would share water from their nallah (stream). So then we got water and they got water. But later one man came to me and he said: “Level with me!” “We don’t like to share water with you!” I asked him for a reason. Then he said: “Well, your water is female and our water is male, we don’t like to share it because our male water is more powerful!”

Whatever motives lay behind the man’s refusal to share water with the other village, this episode demonstrates that the cultural categories of "male water" and "female water" are pervasive in Balti society and carries implications for how water is managed at a local level.

The man who told this story was an educated man who had taken much of his education abroad. Although hesitant to approve of the scientific validity of the distinction between male and female water, he nevertheless seemed to take these categories as manifest, and suggested that scientific research should be conducted in order to prove the difference between female and male water. This further indicates the pervasiveness of these categories and shows that it is a way of perceiving water and glaciers which is not limited to people of a certain social class, but extends to all layers of society.

3.4 Additional Ingredients in Glacier Growing

In addition to ice and water there are certain other ingredients that are used in the process of growing a glacier. Most notable of these is charcoal, which was used by all of the glacier growers to cover the ice after it had been brought to its place. Most people also responded that the charcoal provided insulation for the ice preventing it from melting. Sawdust, or alternatively wheat husk, was also used to insulate the ice by all of the glacier growers. In Harikon they also put pieces of cloth on top of the ice, and a man who grew a glacier in Yulgo used nutshells and branches from willow to cover the ice. A glacier-growing witnessed by geographer Kenneth Hewitt in 1961 was also covered with cloth and twigs. Common to all of these ingredients is their ability to insulate the ice, and that is probably why they are used as well.

More puzzling, however, is the use of salt which was mentioned by four of the glacier growers I interviewed. In Kwardo they explained the use of salt as a method to prevent the ice from being contaminated by animals urinating on the ice, as it is absorbed by the salt. They also applied a good smelling powder called “Kafur” which they maintained would prevent insects and other impurities from landing on the ice. This fear of the ice being contaminated will be further discussed in chapter five.

3.5 Finding a Place to Grow the Glacier

Selecting an appropriate place for the glacier growing was of utmost concern for the glacier growers of Baltistan and Gilgit, and they all gave particular reasons for why a glacier should be grown in one place and not another. Scouting for a suitable place was done in combination with hunting trips, or shepherding of animals at the summer pastures. These scouting trips are not planned by a particular social group, but rather happen by the agency of individual community members. Some of the factors they take into consideration when selecting a proper site are: aspect, relief, shadowing, altitude, and presence of permafrost. The following quote from one of the glacier growers in Kwardo is an example of the importance given to proper shadowing:

> His glacier was about 500 metres further up, and benefits only 3 villages, while the old glacier benefits all. His glacier is in a bad place, because the sun is hitting it all the time. The old glacier is only hit during two months in summer (for two hours a day) the rest of the year it is in total shadow.

“His glacier” refers to a glacier growing of recent date made by a people from a neighbouring village. While the “old glacier” is a glacier they grew in Kwardo. Clearly there is some level of antagonism and rivalry implied in this statement which illustrates that glacier growing is also a matter of social prestige. The fact that glacier growing is usually initiated by individuals who scout a suitable place and subsequently lead the planning and organizing of the endeavour, indicates that it is a practice by which one can acquire some amount of social status. Glacier growers were indeed often referred to as “brave men” or “hard working men”.

Returning to the issue of placement of the glacier growing site I found many similarities between the different villages in how they chose to place their ice. Table 1 below is an attempt to systematize the information on placement of glacier growing sites, and contains

both the sites which I observed myself (marked in gray), and the sites accounted for by interviewing the people who made them.

Village	Year of making	Altitude (m a.s.l.)	Location	Aspect	Surrounding relief	Grain size	In situ ice
Hussainabad 1	2000	4720	Talus slope	North-northwest	Cirque[4] with steep cliffs	Cobble (6-26 cm)	Yes
Hussainabad 2	2005	4520	Talus slope	North-northwest	Cirque with steep cliffs	Boulders (.5-7 m)	Yes
Tasso Gol	2000	4660	Talus slope	North-northeast	Cirque with steep cliffs	Boulders (.5-7 m)	Yes
Balghar 1	2000	4800	Talus slope	East-northeast	Cirque with steep cliffs	Boulders (.1-15 m)	Yes
Minawar	1950's	3770	Talus slope	North-northeast	Cirque with steep cliffs	Boulders (.5-7 m)	Yes
Balghar 2	1966	4750	Talus slope	East-northeast	Cirque with steep cliffs	Boulders (1-15 m)	No
Kwardo	1980	>4000	Talus slope	Northwest	Cirque with steep cliffs	Boulders	No
Harikon	1980	4500	Talus slope	North	Cirque with steep cliffs	Boulders	Yes
Ghwari	2000	>5000	Talus slope	Northwest.	Underneath steep cliffs	Boulders	Yes
Diamel	2000	>4500	Talus slope	West	Cirque with steep cliffs	Boulders	Yes
Hanuchal	1940's	4700	Talus slope	Southwest	Underneath steep cliffs	Boulders (3 -4 m)	Yes
Surongo	1961	Ca.5800	Talus slope	Unknown	Cirque with steep cliffs	Boulders	Yes

Table 1 Placement of glacier growing sites.

From the table we can see that all of the glacier growing sites have been put in a talus slope[5], and all but one is placed in an area of boulder sized rocks; that is, rocks of a diameter more than 26 cm. The reason for putting the ice in such an area is twofold: (1) rocks provide cover against solar radiation, (2) in rock masses like these one can find interstitial ice which has survived the summer. Regarding the first reason, all of the glacier growers had dug out a cave from the talus inside which they had placed the ice and the rest of the ingredients. The glacier growers recognized that this would protect the ice against solar radiation, and those in Kwardo had evidently learned from mistakes made by their ancestors:

[4] A cirque is a hollow, open downstream but bounded upstream by the crest of a steep slope (headwall) which is acrcuate in plan around a more gently sloping floor. Evans and Cox 1974 in Benn, D. I. & Evans, D. J. A. (1998). *Glaciers and glaciation*. London, Arnold. VII, 734 s. p.

[5] 'Talus' is a sloping mass of rock debris at the base of a cliff. The rocks have been dislodged from the mountainside by weathering processes

> Our forefathers tried to grow a glacier up in these mountains a long time ago, but they had no rocks, only greenery. Altitude was very low and the area was very open with much sun coming in. This glacier melted very rapidly and is gone now.

This indicates that consideration is given to altitude, which in most of the cases exceeded 4000 m, with the exception of Minawar. In addition to rock-cover and altitude, aspect is a factor that greatly influences the survival of snow during the summer months. In the northern hemisphere north-facing mountain sides receive less sunshine during the year than south-facing sides. As north was the predominant direction faced by most of the glacier growing sites it seems that glacier growers take this into consideration when selecting a site.
The predominance of locating the glacier in a cirque is another factor that could greatly reduce ice melting during summer, as cirques are bounded by a horseshoe of mountain walls upstream, and thus provide a pronounced shadowing effect. Figure 3 is a picture of the glacier growing site I visited in the nallah of Balghar village. It is located in a cirque surrounded by a steep headwall, and the glacier growing site is marked by a giant boulder measuring 15 m.

Figure 3 Glacier growing site in Balghar nallah

300 kg of ice, water, coal and sawdust was placed inside this cave during the glacier growing that took place here in year 2000. When I visited the site together with the man who led the

glacier growing we could observe a one meter thick ice accumulation under the entire length of the boulder. A stonewall has been built at the entrance of the cave to shield it from sunlight.

In Harikon they applied the same method as in Balghar, here described by one man who participated in that glacier-growing:

> There was already a glacier on that place. We broke the ice and we took some more ice from there and put it under some big boulders. It's a safe place from the sun. There was no sun there.

Part of the practice of glacier growing is thus to find a suitable place in a talus slope where to put the brought ice and water. We found that the ingredients were usually put underneath one or several large boulders, and then walled in by smaller rocks. Common to all of the glacier growers except the ones in Balghar 2 and Kwardo, was a preference for in situ ice. The previous statement from Harikon tells us how the ice they bring is mixed with ice found at the site. This can either be ice found in the permafrost[6] underground, or interstitial layers of ice found between the boulders. Such ice is preserved among the boulders due to the cooling effect of permafrost present in the ground, and the insulation provided by the boulders. In Hanuchal they deemed in situ ice as a necessity when selecting a site for the glacier growing, and would dig into the ground to find an ice patch to grow their glacier on:

> We found a place where water was coming out. This was a sign that there was ice under the soil. We dug down 7 feet and found a layer of ice there. It was male ice. We chose to grow the glacier there. Now it has become big and is breaking up the rocks and moving them.

The glacier grower behind this statement recalled that he had partaken in four previous attempts to grow glaciers where they did not choose a site with in situ ice. All of these had failed, and he presumed that this was caused by the lack of ice in the ground. From table 1 above we see that 10 out of the 12 recorded glacier growing sites was placed on in situ ice.

[6] Permafrost denotes "perennially frozen ground with a temperature colder than 0º for two or more years. Permafrost". (2007). In Encyclopædia Britannica. Retrieved May 3, 2007, from Encyclopædia Britannica Online: http://search.eb.com/eb/article-9108442. The reader should also note that the upper layer of permafrost is called: "the active layer" and is a layer of varying thickness that thaws during the summer.

Figure 4 is a diagram depicting how the ice and water they bring is put on top of ice and frozen rocks in a permafrost environment.

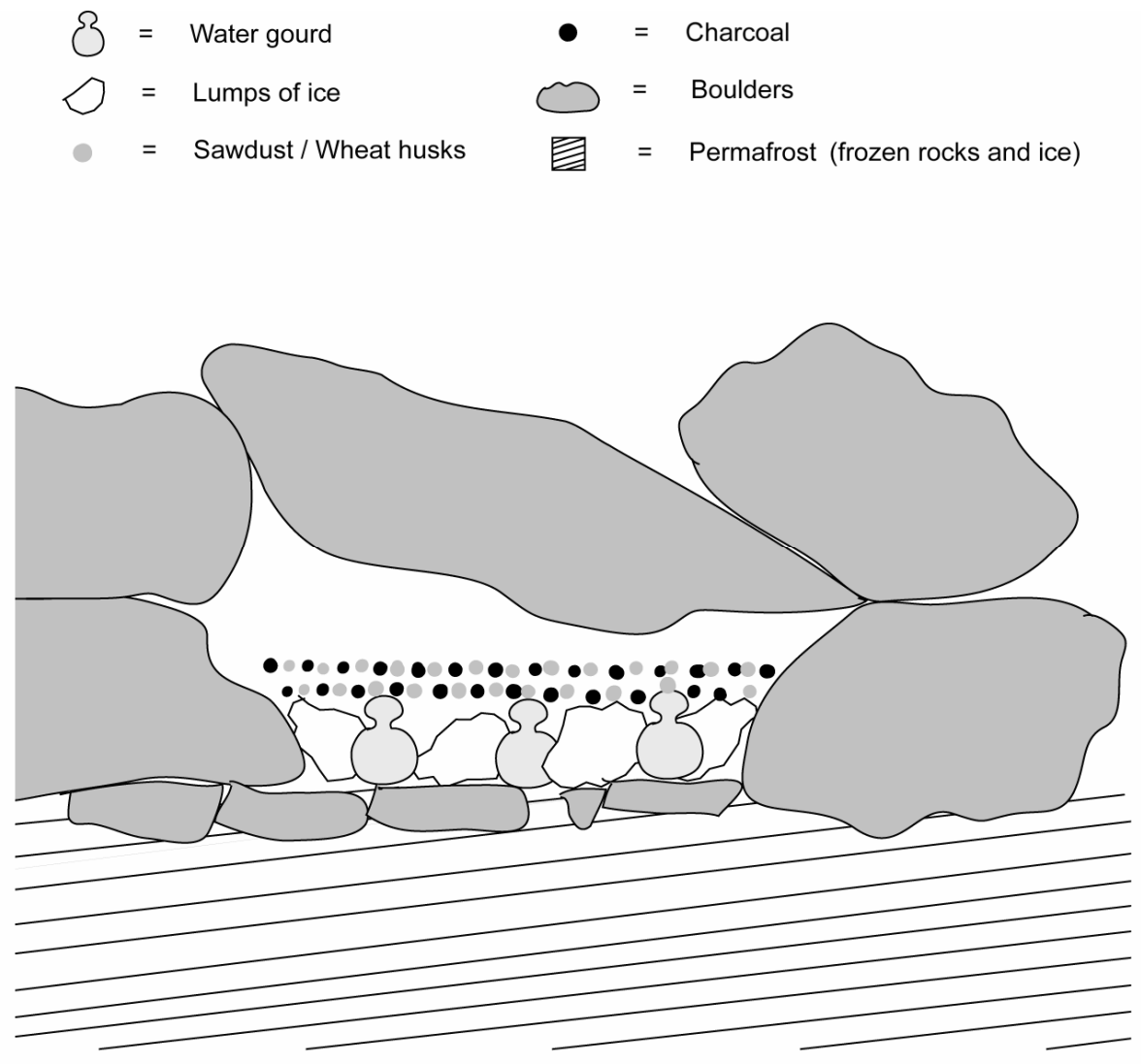

Figure 4 Sketch of a glacier growing site

In the diagram water is contained in gourds. There were, however, different ways of storing water at glacier growing sites; for example, in clay pots, tin cans, or in sacks of goatskin. In Hanuchal, where gourd where used, the glacier grower explained that as the water in the gourd froze to ice the shell cracked, and so the ice became part of the growing glacier.

In figure 5 we can see how the glacier grower places blocks of ice and gourds of water underneath a large boulder. The entrance to this cave was later sealed off by a stonewall.

Figure 5 Stacking ice and gourds filled with water (Photo courtesy of Sher Khan)

The amount of ice was typically around 200-400 kg. Sometimes, however, the glacier growers would collect remnants of ice and snow avalanches in the vicinity, and add it to the pile making it considerably bigger. In the village of Kwardo people went back to the site each summer, in order to shuffle more snow and ice to the pile.

The practices that we have gone through, so far, constitute a grounded theory of glacier growing, in the sense that it is based on the categories and experiences of the people doing this activity. Although there are minor variations to how glacier growing is conducted from village to village, the core categories of ‘glacier growing’, ‘female glacier’ and ‘male glacier’ are used by all of the glacier growers, and constitutes a worldview which is the basis of perceiving it feasible that glaciers can be grown by man. As will be discussed in detail in chapter 5 of this thesis, it is a worldview that sees the natural element of ice as something which can be influenced by human conduct. Glaciers are thus not perceived purely as a natural phenomenon, but as a manifestation of a successful cooperation between humans and nature.

In the next chapter we will go more into detail about the part played by ‘nature’, as we discuss how snow and rock avalanches, permafrost, regional climate, and local climate influence on the locations where people attempt to grow glaciers. But first we will bring glacier growing into the context of natural resource management, as we explore scarcity of water as a rationale for the practice of glacier growing.

4 Managing Water by Glacier Growing

The rationale of glacier growing, which was stated by all of the glacier growers, is to relieve downstream villages from scarcity of water. In order to grasp more about what role glacier growing plays in the management of water in this area we conducted semi-structured interviews with 20 persons from 17 households belonging to Hanuchal village in Gilgit. During these interviews our notion that water is perceived as scarce was confirmed. Out of the 20 we interviewed 17 claimed water scarcity, stating that they had insufficient water, and 18 of the interviewees believed glacier growing to be an effective way to increase availability of water. But what does people here mean when they say that "water is insufficient", and why is glacier growing perceived as something that is going to solve the problem?

In the following chapter we deal with questions related to what role glacier growing plays in the management of water in Baltistan and Gilgit. This discussion is based on the semi-structured interviews we carried out in Hanuchal, from conversations with employees in the Aga Khan Rural Support Program, and from the analysis of previous research on water management in the Northern Areas of Pakistan.

4.1 Climate, Relief, and River Hydrology

Water availability in the Northern Areas is affected by an extreme relief, as the area is home to more than 50 peaks above 7000 m. a.s.l. Precipitation decreases from higher elevations to lower elevations and from south to north (Du 1998; Owen & England 1998). In contrast to the mountain tops above, the inhabited valleys receive miniscule amounts of precipitation. Long term precipitation records[1] from the town centres Skardu (2200 m a.s.l.) and Gilgit (1460 m a.s.l.) show an annual precipitation of 131 mm for the latter, and 222 mm for the former (Fowler & Archer 2004). As a consequence most of the inhabited parts of this region can be classified as semi arid to arid (Du 1998).

At higher altitudes, however, precipitation increases significantly Precipitation measurements at an altitude of 4150 m in Bagrot (Jacobsen 1998) shows an annual precipitation of 704 mm, and Hewitt (2005) characterizes the high alpine tundra at approximately 4000 – 5000 m a.s.l.

[1] 1894-1999

as a humid climate with annual precipitation between 500 – 900 mm.[2] Two thirds of this precipitation falls during winter in the form of snow carried by westerly winds (Du 1998; Fowler & Archer 2004; Hewitt 2007). Incursions by the Monsoon during the summer bring precipitation accounting for one third of snowfall at higher altitudes (Wake 1989 in Hewitt 2007). The Northern Areas is home to some of the largest glaciers outside the polar areas, and contains a vast area of perennial ice and snow cover. Human needs for water in the Northern Areas are catered for by the streams and rivers carrying meltwater from these higher-lying areas. The major challenge in such a terrain is to redirect the water into the cropping fields and pastures. Thus, an intricate network of irrigation canals has been developed in this area since ancient times (Kreutzman 2000, Ehlers 2000)

Seasonal fluctuation in river discharge poses challenges to the farmers of Baltistan and Gilgit as they go through periods of low discharge in the months from September to April, followed by a period of high discharge from May to August (Young and Hewitt 1990). Peak flow in the rivers of this area occurs in July and August, and can cause flooding which damage irrigation canals, roads, and crops. Low flow periods in March, April, September and October, on the other hand, may inhibit the early growth and maturation of crops (Khan, S. pers. comm. Oct. 2006).

Variations in the runoff in streams and rivers vary with the presence of glaciers. In Baltistan and Gilgit we find villages with glacierized basins, and villages without. Presence of a glacier in the watershed affects water availability as the maximum monthly runoff is delayed, and interannual variations in runoff are reduced (Singh & Singh 2001; Stahl & Moore 2006; Wohl 2000; Østrem 1974). This fact has implications for agriculture, as farmers in a non-glacierized basin strive to get enough water for their crops after snowmelt has finished. This links well up to our research, as we discovered that it was villages without glacierized basins that would attempt to grow glaciers. Glacier growers would also come with statements like:

> In Thalley they have a big glacier. People there don't have any problems with water scarcity. We need to make a glacier so that we can also get enough water.

During our visit to the village of Diamel where they had performed a glacier growing in 2007, we also made a stop in Arandu which lies approximately 10 kilometers further up the Shigar valley. Arandu village has a heavily glacierized basin and the *nallah* was carrying water even though we had reached the middle of November. The nallah of Diamel, on the other hand, had completely dried out, and villagers now had to carry water from Shigar River located in the bottom of the valley. Inhabitants of Arandu, however, faced problems of their own, as the advancing glacier had claimed around 40 acres of arable land. Another challenge they faced due to the glacier was the huge amounts of debris it carried. When sedimented onto the bottom of an irrigation canal this debris could cause blockages, and the walls of the canal would break as pressure built up due to the stagnant water.

Other typical source of damage to irrigation canals in the Northern Areas are landslides and flash floods (Kreutzman 2000). Such events can cause interruptions in irrigation lasting from a couple of hours to several weeks, depending on the magnitude of the damage. Thus, the extreme relief of the Northern Areas creates both opportunity and hazard for the local communities. On one hand, the rich accumulations of snow and ice in high altitude areas create a substantial reservoir of water which is often referred to as the 'water towers' of India and Pakistan. On the other hand, these resources can turn into a peril, as sudden flood events, landslides, and glacier advances bring havoc to agricultural land and infrastructure. Due to such events management of water in the Northern Areas contains a high degree of uncertainty.

4.2 Hydraulic Societies

Given the importance of water as the major limiting factor in agriculture of this region, local communities in Baltistan and Gilgit can be termed as 'hydraulic societies' (Emerson 1984). A 'hydraulic society' is a type of society which is organized around the management and control of water (Wittfogel 1957). Emerson (1984) assumes that the level of social organization needed in order to construct canals to irrigate this land led to the early state formations in the area.

As agriculture in Baltistan and Gilgit cannot be rain-fed, colonization of wasteland depends on its distance from a reliable water source, and on the feasibility of constructing an irrigation canal to the source. Such constructions are labour demanding and cannot be undertaken by families or lineage groups alone. Thus a higher authority transcending lineages and families

are needed to organize such efforts. Traditionally local rulers called 'mir' or 'raja'[3] would engage in the construction of major irrigation canals directly by extracting forced labour from the peasants they ruled over, or by granting land to people with resources to invest in the building of a canal (Khan & Hunzai 2000). The building of these canals constituted the economic basis for the raja and his family, a class of military, and a distinct group of functionaries, as they levied taxes from individuals and communities farming this newly irrigated land. At the village level institutions for the distribution of water and the maintenance of irrigation canals took shape. Many of these institutions are still in use today as we shall see examples of in our case from Hanuchal.

In the Northern Areas of today, construction of irrigation canals is still the central focus of infrastructure development, and still carries implications for the social organization of this region. After the abolishment of the old principalities in 1974, an institutional gap arose as there was no government body to fill the space left by the rajas (Khan & Hunzai 2000). Much of the work carried out by the development agency Aga Khan Rural Support Program (AKRSP) in this area since 1982 has been geared at filling this institutional gap. Thus new social arrangements have come into existence which, among other things, have connected local communities to new markets, given access to bank loans and introduced new technology.

A requirement set by AKRSP to the villages that receive support is that they establish a Village Organization (VO). The VO is a coalition of residents from the village who would like to start cooperation with AKRSP. They are obliged to make savings deposits and attend regular meetings. These savings can be used later as collateral to access loans to finance further development projects in the village (Khan & Hunzai 2000). Nevertheless, the most important part of establishing a VO is for the villagers to identify a project that will increase their income generation. This project should benefit most of the households, and be possible to carry out on their own. About 50 % of these projects have involved the building of new irrigation canals, or extension of old ones, and between 1983 and 2000 AKRSP gave technical and economical support to the building of 313 irrigation channels in the district of Gilgit, while 388 such projects were supported in Baltistan (The World Bank 2002).

[3] Before the abolition of the princely states by the Pakistanian government in 1974, Baltistan and Gilgit were divided into several semi-autonomous or independent principalities. Each principality was ruled by a 'mir' or 'raja', who received their power by heritage. The mirs and rajas dominated the peasant farmers aided by a military class and a distinct group of functionaries (Emerson 1984)

One of the villages that has formed its own Village Organization, and carried out the building of a major irrigation canal in cooperation with AKRSP, is the village of Hanuchal in Gilgit. In this village they also performed a glacier-growing in the 1950's. In the following section we will learn how people from Hanuchal perceive the influence of these two developments on water availability.

4.3 Water Management in Hanuchal

Hanuchal is a village in the Eastern part of Gilgit located in a narrow valley drained by the Indus River. It is located at about 1600 m a.s.l., which puts it in the double cropping zone. Wheat is sown in late January to early February followed by maize which is sown in late May to early June with harvest in October. In addition they have orchards with fruit trees, and livestock consisting of goats, sheep and cattle. During summer, goats and sheep are grazed in alpine meadows above the village. Land holdings of the people we interviewed varied between 1.5 to 10 acres. The village

In 1984 the people of Hanuchal started cooperation with AKRSP which led to the formation of a Village Organization. Subsequently they received support from AKRSP to dig a new irrigation canal from a neighbouring *nallah.* This canal was finished in 1988. Traditionally, however, water for irrigation has been diverted from a *nallah* coming down in the middle of Hanuchal. Locals are of the opinion that a glacier has formed in this Nallah due to a glacier-growing that took place there during the 1950's.

Today water from the Nallah, where the glacier growing occurred, benefits both the upper and lower part of Hanuchal village, while the AKRSP canal only benefits people in the lower part. The division of water between the households here is based on traditional institutions which are said to origin back to the first settlement of the area. Title to water is based on title to land and the network of irrigation canals is seen as common property. Rules and regulations for use of the canals are informal and is common knowledge to the inhabitants her. Water is allocated to different parts of the village by a rotational pattern. Each cluster of households receive access to water from the nallah every 18 day, and in the lower lying villages each household cluster in addition receives water from the AKRSP-canal every 14 days. In case of damages to the canal it is the responsibility of the household that owns that piece of land to fix the damage. However, in cases of major damages larger groups from the village will work

together on repairing it. During the summer of 2006 a rock fall had completely blocked the AKRSP-canal, as can be seen in figure 6.

Figure 6 Canal blockage caused by rock fall

This rock fall had caused the canal to be blocked during most of the summer and fall. Still, villagers claimed that they had gotten enough water from the *nallah* as a result of the increasing amount of ice perceived to be caused by the glacier-growing. In fact, when asked the question: “What do you think has been the most important development in your village to increase the amount of available water?” six of our interviewees answered that glacier growing was more important than the irrigation canal. The reason they gave for this was that the irrigation canal would often be damaged, while the water from the *nallah* was a more reliable source. Two people thought the glacier growing and the AKRSP-canal to be of equal importance, while seven people saw the AKRSP-canal as the most important development. Nevertheless, 18 of our interviewees were of the opinion that water levels in the *nallah* had increased due to the glacier growing.

The opinion that water levels had increased was substantiated by the increase in cultivated-land and grassland during the last 50 years. All, except one, of the people interviewed had increased their land during the time they had lived there, by applying irrigation to wasteland. The average increase in land-holdings among our interviewees since they had started farming was around 50 %. Several claimed that it was the increase in water supply caused by glacier growing that had made it possible to add to their land. One respondent, on the other hand, claimed that population growth in Hanuchal had led to the expansion of cultivated land.

Whether or not these testimonies tell us anything about actual fluctuations in water levels is irrelevant for our case. Our concern is how people perceive glacier growing to be influencing their water supply. In this context it is significant that 18 out of 20 people regard glacier growing as a feasible way of increasing water availability. This indicates that glacier growing is viewed as a vital part of managing water in this village.

Still, water is nevertheless conceived of as scarce in Hanuchal, and in the following section we shall look into what the people here mean when they talk of water scarcity.

4.3.1 Water Scarcity in Hanuchal

Here we apply a perspective on "water scarcity" as a relative concept. Water scarcity can be absolute, life-threatening, cyclical, or seasonal (Winpenny 1997). Additionally it depends on factors such as agricultural practices, available technology, and social organisation. Cultural patterns also influence people's view on water, and what is regarded as 'sufficient water'.

Out of the 20 people we interviewed 17 stated that they did not have sufficient amounts of water. When asked what purpose they needed more water for, 14 responded that they needed it in order to cultivate more land. One man stated that: "We have plenty of land, but no water to cultivate it with". Implying that water is the limiting factor of agricultural expansion, and will always be seen as scarce as long as there is more land to be cultivated.

The remaining three interviewees were all women, and said that they needed more water for drinking, washing and cooking. This illustrates some of the gender differences in the studied area, as women are primarily responsible for the tasks of cooking food, washing clothes and fetching water for drinking. Their views on what constituted as the most important development in water supply reflects this division of labour.

Also, in contrast to their male counterparts, they said that purchase of water-tanks was the most beneficial way to develop their water supply. For them having a water-tank would mean that they wouldn't have to go all the way to the river to fetch water, and that they would still have some water left during dry periods. Only one of the ladies had acquired such a tank, while the others wished that their husbands would purchase them one.

Water scarcity in this context is, however, not absolute as the women will find water in the Indus River even if their *nallah* runs dry. Their perception of water scarcity is conditioned by their knowledge of a technology that would make their work to fetch water a lot easier. This reflects our conceptualization of 'water scarcity' as relative.

4.3.2 Glacier Growing and Water Scarcity

Growing season in Hanuchal stretches from February to October. Given the low stream flow of rivers in the months of September and October, water shortage may influence on the maturation of crops. As we have seen the presence of a glacier in the watershed affects the peak period of river flow by delaying it. Thus, glacierized basins will feed the *nallah* with meltwater for a longer period during autumn, than a basin without a glacier.

According to people in Hanuchal the increase in the amount of cultivated land stems from the formation of a glacier in their *nallah*. The glacier growers told that there was a small patch of ice on the location where they conducted the glacier-growing. This patch was deemed as stagnant since it was only male ice there. Hence, they applied female ice and a mixture of male and female water in order to induce its growth. Since then the ice patch has been observed to grow by people who have visited the place. A typical description of the place was:

> The glacier was planted 40-50 years ago. It is located underneath huge boulders and soil, and stretches 800 m down from its original spot. The ice is ten meters thick and has lifted the boulders upward. We can see lots of water coming from that place.

Similar descriptions were common to all of the glacier growers I encountered both in Baltistan and Gilgit. They used to emphasize that the ice masses had started to lift up the boulders and had moved downwards “taking root” as they called it. It was also emphasized that water flow in the *nallah* had increased, and that they had more water during the months of autumn.
As we discussed in chapter 3, glacier growers take into consideration attributes of the surrounding terrain when scouting for a location. In the following chapter we shall go more into detail on how natural circumstances owing to the particulars of the terrain influence on the accumulation of ice at glacier growing sites.

5 The Influence of Natural Processes on Glacier Growing Sites

This chapter is concerned with how natural phenomena like snow-avalanching, permafrost, wind, and temperature patterns influence on glacier growing sites. It is based on observations of five different locations where glacier growing has been conducted, and on accounts given by practitioners of glacier growing. We will interpret these locations in light of possible geophysical processes that could affect them, and how such processes may influence on how accumulations of ice develop at these sites.

5.1 Comparing Local and Scientific Classification of Glaciers

During my conversations with people in Baltistan and Gilgit an intimate knowledge of glaciers and their properties was revealed. They had a detailed classification system for different types of snow and ice, and also exhibited an awareness of the movements and morphology of glaciers. When one considers the big impact glaciers have on the lives of these people this does not come as a great surprise. Not only do the glaciers feed the agriculture of the dry inhabited valleys with water, but they can also act as a hazard by bringing floods, damming up rivers, or by advancing into cultivated land.

In chapter three we saw that people of the Northern Areas classify glaciers into two main categories: ‘female glaciers’ and ‘male glaciers’. ‘Female glacier’ refers to a glacier which is white or bluish, while ‘male glacier’ is a type of glacier covered by a layer of rocks and soil[1]. This local classification match well with scientific categories of glaciers which separate between debris-covered glaciers and glaciers which are mostly free of debris (Benn & Evans 1998). Some of my informants stated that a female glacier is a glacier that gives much water; while a male glacier is a glacier that gives little water. This matches up to the distinction between ‘debris’ and ‘non-debris covered’ as an extensive debris cover thicker than 5-10 mm reduces melting by shielding the ice from incoming solar radiation (Østrem 1956 in Benn & Evans 1998; Nakawo, Fountain & Raymond 2000).

[1] In the high relief mountain terrain of the Karakoram and Himalayas most glaciers carry a certain amount of rock debris deposited by rock fall and avalanches from surrounding cliffs, and usually the snout of glaciers here will be covered in debris. Therefore I think it is reasonable to assume that the category of ‘female glacier’ does not entail that the entire glacier is debris-free, but rather that most of its surface area is free from such debris. ‘Male glaciers’, on the other hand, can be assumed to have most of their surface area in thick debris cover.

Sher Khan (2005) also mentions the local category of ‘barren’ or ‘infertile’ glacier. A ‘barren glacier’ refers to ice which is present in the ground, and which doesn’t move nor increases. It is explained as ‘a kind of permafrost’, and can either be found in between boulders or below the soil surface (Khan 2005). According to Khan’s sources the presence of a barren glacier is essential for the success of a glacier-growing, and has been considered in all of the glacier growing projects supported by AKRSP. The category mentioned by Khan also fits well with accounts given by the glacier growers I interviewed, who pointed out that there was already ice present at the sites they selected for glacier growing, but that this ice was ‘dormant’ and didn’t seem to increase nor to be moving.

The local classification of ‘barren glacier’ can be translated into a wide range of landscape features. It can be small patches of ice in the ground; chunks of ice located in cavities between boulders; remnants of an older glacier covered in talus; or alternating layers of ice and rocks from avalanching. Common to all these phenomena is that they occur in terrains with perennially frozen ground known as ‘permafrost’, and are typical of high relief terrains where rock fall, rock avalanches, and snow avalanches are frequent.

5.2 The Influence of Snow and Rock Avalanching at Glacier Growing Sites

Common to all of the glacier growing sites recorded in table 1, is that they are located in a terrain prone to snow and rock avalanching. All of them are surrounded by steep cliffs, and four of them are located in a north-eastern direction, positioned lee-side of the prevailing westerly winds that dominate during winter. These winds come into the Northern Areas from the south-west, and accumulate snow-cornices on the edges of these cliffs by snow-drift during winter. Avalanche activity from these cliffs during springtime are likely to lead to huge accumulations of snow and rocks in the area below, where the glacier growing sites are located.

All of my informants on glacier growing also mentioned the location below steep mountain cliffs as a primary consideration for the selection of a site. They also stated that the reason for choosing such a location was that the avalanches and snow-slips arriving from the cliffs would contribute to the growing of the glacier. Figure 7 show one of the locations where AKRSP has supported a glacier growing, and is a good example of how glacier growing sites are typically located within a cirque surrounded by steep cliffs. Such a terrain is off course very prone to avalanches.

Figure 7 A glacier growing site is located in the concave between the valley floor and the headwall (Photo courtesy of Sher Khan)

Due to the high altitude (> 5000 m a.s.l.) and shadowing effect caused by the surrounding cliffs, large amounts of snow are still present although the picture is taken in early September month. At these altitudes annual snowfall exceeds 900 mm (Hewitt 2005) In such places ice accumulations are likely to build in the talus, as melted snow trickles down between the rocks and refreezes upon come contact with the permafrost. This would explain the 'barren glacier' observed by the glacier growers when they mounted their own ice on this location.

Figure 8 further illustrates how alternating layers of snow and ice come to be built up gradually as snow avalanches containing rock debris falls onto a permafrost area. The snow gradually melts and then refreezes when it comes into contact with the underlying permafrost. When the snow melts rock-debris that was incorporated into the avalanche snow becomes exposed and forms a layer of rocks on top that insulates the ice underneath. Thus, alternating layers of ice and rocks are generated over time.

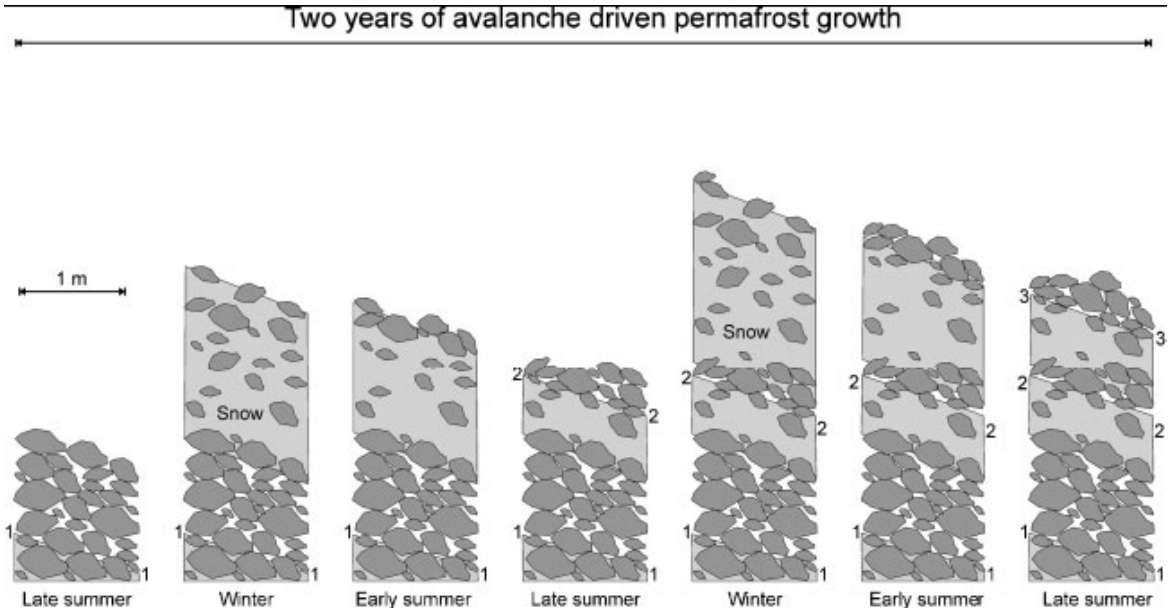

Figure 8 Diagram showing observations on the vertical displacement of the active layer and aggradation of the permafrost table over a period of 2 years in the avalanche runout zone by annual accumulation of avalanche snow containing rock debris. The numbers 1–3 indicate the progressive aggradation of the permafrost table. (Source of figure: Humlum 2007)

5.3 Occurrence of Rock Glaciers at Glacier Growing Sites

Humlum et al. (2007) suggests that when the thickness of the layers reaches a critical level the mass of rocks and ice will start to creep forward by internal deformation, and become small rock glaciers, which are defined as:

> a tongue-like or lobate body usually of angular boulders that resembles a small glacier, generally occurs in high mountainous (or dry polar) terrain, and usually has ridges, furrow, and sometimes lobes, on its surface, and has a steep front at the angle of repose (Potter 1974 in Clark et al. 1998)

Rock glaciers can originate by the refreezing of meltwater into a perennially frozen talus slope, which gradually sets the whole slope in motion as the ice deforms due to its own weight combined with the weight of the integrated rocks (Barsch 1996, Haberlie 1985 in Clark et al. 1989). Accounts of how glaciers had formed at the sites of glacier growing bear strong resemblance to this definition of rock glaciers. Like this account from a glacier grower in Balghar is an example of:

> First the ice slips down into the rocks where it grows roots. Then it starts to break the rocks bringing them up. Then the glacier comes forward. This has happened where they did the glacier growing.

The similarity between what is described by this particular glacier grower and how rock glaciers originate in talus slopes, may be an indication that the glacier growing was conducted at a site where a rock glacier was developing. Considering the fact that most of the attempts of glacier growing I recorded were situated in talus slopes with in situ ice, it is not surprising that some of these locations may happen to be at a rock glacier. Rock glaciers are quite common in the Karakorum at altitudes above 4000 m (Owen & England 1998), which is also the usual height where glacier growing is conducted. I witnessed a distinct rock glacier at one of the sites of glacier growing that I visited myself, as illustrated by figure 9.

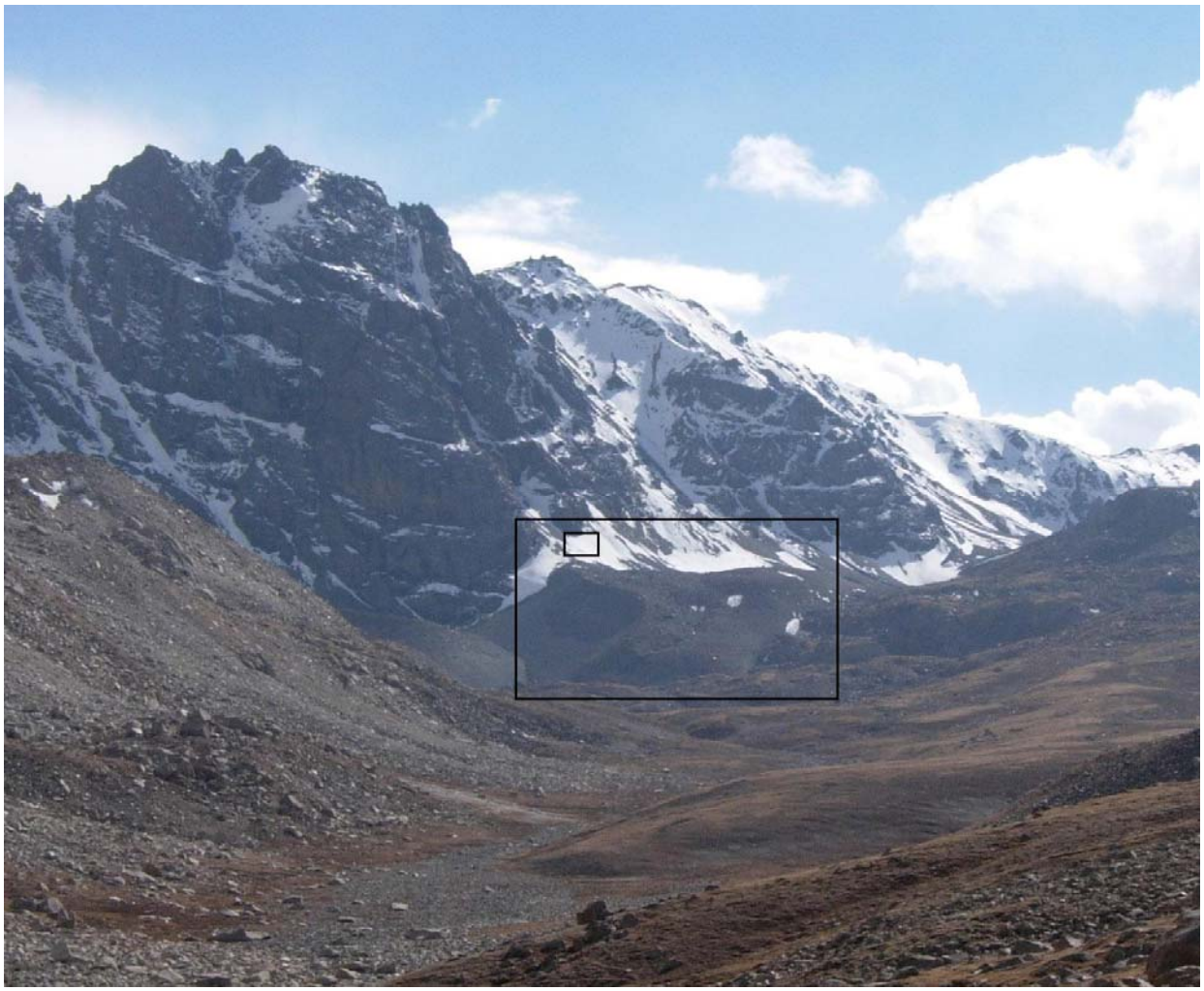

Figure 9 Glacier growing site above Hussainabad. Big rectangle demarcates the position of a rock glacier distinguished by its tongue shape and steep front at the angle of repose. The small rectangle marks the site of the glacier growing performed in 2000.

Hence the glacier growing in figure 9 has been conducted at a location which already contained a rock glacier from before. A similar account of how glacier growing was

performed at the site of a rock glacier was given by geographer Kenneth Hewitt who researches glaciers in the Karakoram Mountains. In 1961 he witnessed a glacier growing conducted by people from the village of Surongo. The location of this particular glacier growing was also in a cirque surrounded by cliffs. Present in the cirque was the remnants of a cirque glacier which had been completely buried in rock falls and avalanches from the surrounding cliffs[2]. The glacier growers dug a tunnel through the rock layer to access the in situ ice, where they put the ice they had transported with them along with the other ingredients peculiar to glacier growing.

A rock glacier is covered by a layer of talus. This layer of talus not only prevents the ice from being melted by direct solar radiation, which is the primary agent of ice melting (Benn & Evans 1998), but also creates a phenomenon known as 'Balch Ventilation' ((Thompson 1962, Barsch 1996 in Haeberli et al. 2006)). The theory of Balch ventilation describes how pockets of air between the rocks in a talus layer acts to insulate the ice from heat, as cold air circulates through the spaces. Bradley (2006) found that the grain size of the talus influence on the conduction of heat, and on the convection of cold air inside the talus layer. Larger rocks lead to larger pockets of air in the talus layer, thus decreasing the amount of heat that reaches the ice by conduction.

Whether or not the glacier growing is performed at a rock glacier, the cooling effects produced by permafrost, debris insulation, and 'Balch ventilation', common to all of the glacier growing sites; is likely to contribute to the survival of ice through the summer. Indeed, all the sites I observed physically during the fieldwork possessed varying amounts of ice. Nevertheless, when considering how yearly snowfall, avalanche activity and snow-slips from the surrounding slopes affect the sites of glacier growing, the contribution humans to the accumulation of ice in these areas may seem small.

6 Local Narratives of Glaciers and Glacier Growing

So far we have heard how glacier growing has been performed in villages of Baltistan and Gilgit in the hope of alleviating water scarcity. In this chapter we will explore the role glaciers play in the culture and history of this area by interpreting local narratives involving glaciers and glacier growing. My notion of 'narrative' stems from the theory of 'narrative experience' by psychologist Jerome Bruner (1991)) who argues that we both organize and constitute our experience of the world through narratives; this can be in the form of stories, myths, legends, jokes, excuses, reasons for doing things, etc. Thus, narratives of glacier growing are here understood as a tool by which the people of Gilgit and Baltistan organize their experience of the world.

The analysis of these narratives are based on anthropologist Clifford Geertz's proposition that human culture can be interpreted much in the same way as written texts (1973). It represents a hermeneutical (Gadamer 1975) approach to culture, where actions and oral statements are interpreted in light of cultural patterns. Such analysis is termed 'thick description' as it describes a particular phenomenon through the meanings it takes on in different contexts.

Geertz' perspective has been criticized for viewing culture as something which exists as 'a whole' outside of the actions of individuals (Barth 1994; Shore 1996). I concur with the view that refuses culture as something existing in itself, outside human agency. In this thesis 'culture' is not understood as a static whole, but as constantly changing through human actions and encounters. Nevertheless, I think that one can talk of 'culture' in the sense of 'cultural patterns' as reoccurring trajectories of human action and speech, built on habits and shared values. These cultural patterns come to shape people's experience of the social and natural environment they live in and guide their actions in it.

For the thesis as a whole the present chapter serves the function of accounting for how certain cultural patterns peculiar to Baltistan and Gilgit shape local peoples' perceptions of glacier growing and endows it with meaning. The stories presented in this chapter are gathered from our interviews with glacier growers, and from conversations with local historians. In addition we will look into how the practice of glacier growing has been interpreted into a national and global discourse on development by a local non governmental organization.

6.1 Glaciers as Animate

For the people living close to them, glaciers can be both a curse and a blessing. Oral traditions in the Northern Areas are full of stories pertaining to how advancing glaciers have claimed land, dammed up rivers, blocked roads and mountain passes. In Arandu, which was mentioned in chapter 4, people will soon have to find a new place to live if the glacier approaching their village continues its advancement. This is not unique to Arandu alone, but has happened repeatedly through the history of the Northern Areas. Many of the glaciers found here are of the surging type (Hewitt 2005), which means that they go through periods of very rapid advancement followed by a period of retreat. Such events can induce large changes to the surroundings when rivers are dammed up or roads become blocked.

Local beliefs that glaciers are endowed with life reflect the plastic qualities of glaciers, and see them as active entities that engage with their surroundings by their movements. Indeed, glaciers that are not on the move are seen as 'infertile' implying that they are lifeless. Such perceptions are not unique to the Northern Areas, but extend too other regions as well where glaciers impact on the daily lives of people. Julie Cruikshank has worked for many years among the Tlingit people of Alaska. Here she found that glaciers was regularly brought up in people's conversations, and talked about if though they were living beings (Cruikshank 2005). Tlingit see glaciers as: "….characterized by sentience. They listen, pay attention, and respond to human behaviour – especially to indiscretion" (Cruikshank 2005, p. 25). In a travel account from the same area (Ariyoshi 2002) a Tlingit man tells that:

> A female glacier has lateral striation and moraine. She's not active. A veil settles across her face. A male glacier is on the move, always showing off, flexing his muscles.

Female glacier here denotes a glacier which has left behind moraine deposits and striation patterns[1] upon her retreat. A male glacier, however, is active and on the move, still advancing. Gender categories among the Tlingit, although opposite of those found in the Northern Areas, come to imply the same perception of glaciers as animate.

[1] Striations are scratches in the bedrock that stems from glacial abrasion.

Another interesting similarity between Tlingit and Balti/Gilgit conceptions of glaciers is the idea that humans can influence on the growth and recession of glaciers. Among the Tlingit there exists a prohibition against frying meat close to glaciers, as it is believed that such activities will induce the glacier to surge forward. Similarly the glacier growers of Kwardo told of practices that were thought to inhibit the growth of glaciers:

> The fourth year after we had planted the glacier it stopped growing because people from the upper village had put impurities there. They had left pubic hairs, carcasses, urine and excreta on the glacier. Because of this the glacier stopped growing.

Glaciers are thus seen as susceptible to human influence and can either be encouraged to advance, by applying the technique of glacier growing, or to recede by exposing it to 'impurities'. In addition the quote from Kwardo tells us that glacier growing is a locally contested practice, and that not all people condone of it. The assumed reason why the upper village of Kwardo wanted to stop the glacier growing was their fear that it would advance onto their land. Similar concerns were recorded in Harikon were they kept the glacier-growing a secret, in fear that the neighbouring village would try to contaminate the site if revealed.

6.2 Glacier Growing in Local Narratives

In this section we shall explore local narratives on the origin of glaciers growing in Baltistan and Gilgit as a "place-making practice"(Basso 1996; Feld & Basso 1996; Gray 2000). Such a perspective emphasizes how particular places become endowed with meaning through the historical imagination of people inhabiting them Accounts of how particular formations in the terrain has been created, or of events that is said to have happened at a specific place, becomes just as much a way of understanding the present as of understanding the past.

During our interviews and conversations with glacier growers in Baltistan we repeatedly encountered a local story about the origin of glacier growing which goes as follows

> Once there was a woman living in the Saltoro Nallah. In this nallah there was a mountain pass connecting Baltistan to Kashgar (China). People from Kashgar used to come on raids to Baltistan killing and plundering. One day a woman, who had become a widow after her husband was killed by Kashgars went up to the mountains. She had carried some gourds filled with water to quench her thirst that she accidentally forgot among some boulders. Some years later a big glacier had developed at that site and had cut the route to Kashgar off, thereby blocking out the invaders from Kashgar. This is the story of how the Kondus Glacier[2] was created.

This narrative condenses widely dispersed issues in the lives of people in Baltistan into one story. Owing to its location at the borders between Pakistan, India, Afghanistan and China, the Northern Areas is a strategic location and has repeatedly been caught in the middle between warring states. During the 15th century Baltistan was repeatedly attacked by foreign forces from north and south, among them armies from Kashgar who sought to conquer Tibet through Baltistan (Holzwarth 1997). In this war many women experienced to loose a son or a husband, and had to care for themselves. An analogy can be drawn to contemporary society where Pakistan and India are in conflict over Kashmir. During the clashes between Pakistanian and Indian forces in the Kargil war in 1999 many men from the Northern Areas were killed as they fought in the Northern Light Infantry (Schofield 2001). Such losses are strongly felt in closely knitted village communities, and the story above is likely to resonate with such sentiments. Thereby creating a historical continuity from the time of the conflict with Kashgar up until todays conflict with India.

The story also refers to the practice of glacier growing and how it was discovered by accident, consequently becoming a blessing for the people of Baltistan by blocking out the invaders. Drawing a line to contemporary issues, the Siachen glacier at the eastern border of Baltistan, not far from the Kondus glacier; today demarcates the frontline between India and Pakistan in the Kashmir conflict. Here fighting has occurred at altitudes of over 6000 m, making the dubious record of being the highest battleground in the world. Glaciers in Baltistan thus acquires the characteristic of being natural boundaries, and the practice of glacier growing takes on a heroic quality as an instrument of fortification.

[2] The Kondus glacier is situated in the district of Khaplu, Northern Areas.

6.3 Religious Themes in Glacier Growing Narratives

During our enquiries in Baltistan we had conversations with a number of local historians on the topic of the origin of glacier growing. Typical for all of them is that they have higher education and regard themselves as Sufis[3]. Their approach to the history of the Northern Areas is based on a mixture between written accounts and oral traditions, and they have a tendency to emphasise history as a process of islamisation. These men were also familiar with the story we just recaptured, however, it took on a new twist, as an Islamic Sufi missionary from Persia[4] was incorporated into the events of the story.

Mir Sayyid Ali Hamadani is believed to have propagated the Islamic faith to Baltistan in the 14th century according to some historians (Khawar 1985 in Holzwarth 1997)[5], and is by the Sufis regarded as a saint. The local historians we talked to incorporated this character into the story we have just heard. In one version of the story the widow is approached by Sayyid Ali when he hears her mourning over her dead husband. Upon learning about her loss Sayyid Ali teaches her how to grow glaciers by telling her that she should carry female, male ice, and water to the mountains and cover it with coal. She then follows his advice and grows the Kondus Glacier. A similar version of the story by another local historian went like this:

> Sayyid Ali Hamadani sent his servant over the border from Indian Kashmir to Baltistan where he had been instructed, by Hamadani, to grow a glacier. Once the task was completed he had to come right back without looking over his shoulder. The servant did as he said, but on the way back he failed to observe his master's commandment and looked back. As a result the glacier flowed onto the Pakistanian side of the border where it swallowed the village of Grong Jing. Had he not looked back the glacier would have flowed into India instead.

Both stories serve to illustrate how people with an interest in propagating their own religion incorporates glacier growing into their historical imagining. In the process glacier growing is

---

[3] Sufism is a mystical Islamic practice which seeks a direct personal experience of God. "Sufism." Encyclopædia Britannica. 2007. Encyclopædia Britannica Online. 8 May 2007 <http://search.eb.com/eb/article-9105856>.
[4] Today's Iran
[6] It is disputed whether or not Sayyid Ali Hamdani ever visited Baltistan. See Holzwarth, W. (1997). Islam in Baltistan: Problems on the Formative Period. In Stellrecht., I. (ed.) vol. 2 *The past in the present: horizons of remembering in the Pakistan Himalaya*. Cologne, Rudiger Koppe Verlag.

endowed with the property of divine providence, as glacier growing is understood as a gift from God. Nevertheless, the failure of Hamadani's servant to obey his command led to disaster, as it destroyed a village on the Pakistanian side of the border. This carries a moral implication that it is wise to follow commandments given by Islamic missionaries and, by further abstraction - to follow the will of God.

It is peculiar that the story should mention the border between India and Pakistan, as no such border existed at the time when Sayyid Ali allegedly arrived in Baltistan, and the nation of Pakistan wasn't even invented. This attribute of the story again leads our thoughts to the ongoing conflict over Kashmir, and establishes a symbolic connection between this conflict and the islamisation of Kashmir which, Sayyid Ali, among others, played a part in.
By incorporating aspects from the conflict with India, and the practice of glacier growing into the account of how a glacier destroyed a village the story is likely to evoke strong sentiments among people in this area, and can thus serve to legitimize a particular religious view.

The story is also a way of imagining what happened at a specific place (Basso 1996), thereby endowing the place with meaning and significance to the local people. Places, including those occupied by glaciers, thus comes to serve as symbols that informs people of historical as well as contemporary events. Considering the volatility of geomorphological processes in the Northern Areas, people inhabiting these areas have to adapt to a constantly changing terrain. Perceiving glaciers as living things that responds to human actions may in light of this be understood as an attempt to endow natural processes with a sense of meaning and direction. Experiences from a landscape which is volatile both in a physical and social sense is by these narratives made into a coherent whole, and is wrapped together by a governing sense of consequence.

6.4 Glacier Growing in the Context of AKRSP

While the stories related to glaciers and glacier growing we have looked at so far is geared at evoking sentiment and emotion in its listeners, local development agency AKRSP attempts to explain the phenomena in terms of physical laws and systematic observation. The local branch of AKRSP in Skardu became involved in glacier growing in 1999, when someone within the organization suggested the use of this method to combat water scarcity in Baltistan. Since then they have supported fifteen different glacier- growing projects in Baltistan by

giving financial support for motorized transportation of the ice, and by hiring in a local expert in glacier growing to supervise the procedure.

An AKRSP- report written by the leader of this project (Khan 2005), seeks to explain the procedures applied in glacier growing within what I would call a 'positivistic science paradigm.'[6] Glacier growing is here rationalized by interpreting its various components as functional in relation to the goal of producing a glacier. For example, it states that the local people involved in glacier growing have: "observation based knowledge of success and failure of the grafted[7] glaciers". This statement is in accord with a positivistic viewpoint since it emphasises knowledge based on observation. It also implies a view of 'indigenous knowledge' (a concept which is used throughout the report) as something which is inherently scientific and based on accumulation of knowledge by observation. Further, the report states that: "scientific measurements are necessary to validate the results of the research (glacier grafting) in different sites", and that: "the RD/MIES[8] will monitor the research sites in the coming years, both through scientific and indigenous means" (p. 15).

The concern with validation of glacier growing must here be seen in connection with AKRSP's dependence on financial donors in order to carry through projects, as AKRSP is enmeshed in a global network of bilateral donors, multi-lateral donors, and private foundations. In this context the impact of the glacier growing practice have to be proven within a global discourse on development. A language that stresses the scientific merits of glacier growing is used to justify the feasibility of supporting such an undertaking. The report also fits well into present concerns within the development discourse to use 'indigenous knowledge' in the implementation of projects, and to make use of 'indigenous monitoring' in order to monitor these projects (Berkes & Folke 1998; Ehlers 2000; Thrupp 1989; Warren 1991). Warren (1991) defines indigenous knowledge (IK) as:

[6] By 'positivistic science paradigm' I mean an approach to science which emphasizes the testing of hypothesis by gathering of data through methods seen as 'objective'. Science is seen as an endeavour which leads to the formation of true knowledge from which universal laws can be generated.
[7] Glacier growing is termed 'glacier grafting' in this report, as emphasise is put on how the transported ice is laid on top of already present ice; hence the carried ice is 'grafted' onto the existing ice.
[8] RD is an abbreviation for the 'Research and Development' section in AKRSP. MIES is an abbreviation for Mountain Infrastructure Engineering Services.

> …knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities.

In this statement indigenous knowledge is first contrasted with the scientific knowledge generated at universities and research institutions, but is later explained in terms peculiar to a scientific context by using concepts such as 'local-level decision making' and 'natural-resource management'. There is a duality in Warren's definition of 'indigenous knowledge', which is also present in the AKRSP report. On one hand 'indigenous knowledge' is treated as something quite separate from science, but on the other hand it is explained as a kind of 'local science', a 'naïve science' if you will; lacking the 'correct' language' of 'proper science.' Indigenous knowledge is thus seen as something ready for application in development projects, as soon as it is translated into a scientific language. Hence glacier growing is, in the context of AKRSP's Skardu branch, viewed as an intrinsically functional practice which can be explained and appropriated within a paradigm of positivistic science.

6.5 Local Knowledge Produced Through Local Encounters

Following Julie Cruikshank's notion of local knowledge as produced through human encounters with other humans and with their environment (2005), t; the practice of glacier growing cannot be seen as a tradition statically locked in a certain space and time, but must be understood as something continuously being reinterpreted and negotiated through encounters at a local level.

In this chapter we have seen how glacier growing is incorporated into narratives of loss, war, islamisation, and development. These narratives also constitute a place-making practice where natural and social changes are interpreted into a given locality to give meaning and continuity. Thus, history is produced at a local level and includes a plurality of voices. The scientific approach to the subject by the engineers in AKRSP further connects glacier growing to a global development discourse, where local practices are sought universalised through science. This thesis can also be understood as a new addition to the already existing narratives on glacier growing.

7 Conclusion

In this thesis I have explored the phenomenon of 'glacier growing' as it is practiced and conceived of in the districts of Baltistan and Gilgit in Northern Pakistan. The role played by this practice in the management of water has also been examined. Glacier growing is carried out by people, who don't have a glacier[1] in the drainage basin where they get their water from. In these villages water scarcity is often felt during the autumn when most of the snow-melt has finished. Formation of a glacier is the desired outcome of this practice, and several of the people who have tried it are of the opinion that it works to produce glaciers.

Nevertheless, observations and accounts of the locations where glacier growing is typically performed have revealed that they are placed in a terrain that is conducive to the accumulation of snow by avalanching and snow slips. The presence of permafrost at these locations is likely to contribute to ice accumulating within the talus as melted snow refreezes. At one of the places I observed a rock glacier at the glacier growing site, and oral accounts from several of the other glacier growing locations also indicates the presence of rock glaciers. Thus, glacier growing is conducted at locations which are already very prone to ice accumulation, and may explain why glacier growing is perceived to work.

The perception that glacier growing is a feasible strategy for the development of a glacierized basin is rooted in the way people of the study area perceives of glaciers as being gendered. 'Female' and 'male' are seen as intrinsic categories to glaciers, and glacier growth is dependent upon the 'coming together' of two glaciers of each sex. This entails a view on glaciers as animate, and I interpret it as a vital condition for how people see it as a feasible action to attempt making glaciers.

The view of glaciers as animate implies that humans can influence on the lives of glaciers, just as glaciers can influence on the lives of people. We have seen that people can act both to increase glaciers by performing the practice of glacier growing, and to diminish glaciers by exposing them to impurities. Glaciers influence on the people of the Northern Areas by providing them with water, but can also bring havoc by damming up rivers or advancing over cultivated land. Stories of glaciers and glacier growing in Baltistan and Gilgit reflects the coexistence of people and glaciers, where glaciers are used as evocative symbols that invoke

[1] With the exception of rock glaciers

deep sentiments among people of Baltistan an Gilgit. The symbolic association to glaciers as natural borders has been analysed in context of the ongoing conflict between Pakistan and India over Kashmir, and in context of the islamisation process of the Northern Areas.

Glacier growing is in Baltistan and Gilgit viewed as a possible method to apply in the management of water, and the local branch of the development agency AKRSP, based in Skardu, are currently giving technical and financial support to village organisations who wants to try it out. As an organisation with a stated aim to increase the income generation of people in the Northern Areas, they exhibit a technical approach to glacier growing, and are currently exploring its potential to relieve water scarcity. Yet, glacier growing is a practice deeply ingrained in cultural patterns of this area, and function and form is not easily separated from one and another. Even if glacier growing is stated by its practitioners as applied in order to relieve water scarcity, the aesthetic values of glacier growing should not be under-emphasised.

References

Barth, F. (1994). Manifestasjon og prosess. Det Blå bibliotek. Oslo, Universitetsforl. 203 s. p.

Basso, K. H. (1996). Wisdom Sits in Places. Albuquerque, University of New Mexico Press.

Benn, D. I. & Evans, D. J. A. (1998). Glaciers and glaciation. London, Arnold. VII, 734 s. p.

Berkes, F. & Folke, C. (eds.). (1998). Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. New York, Cambridge University Press.

Bielmeier, R. (1998). Balti Tibetan in its Historical linguistic Context. In Stellrecht., I. (ed.) Culture Area Karakorum, Scientific Studies, vol. 4 Karakorum – Hindukush – Himalaya: Dynamics of Change. Cologne, Rüdiger Köppe Verlag.

Bradley, G. J. (2006). The Effect of Topography, Latitude, and Lithology on the Distribution of Rock Glaciers in the Lemhi Range, Central Idaho. Moscow, Idaho State University, Department of Geological Sciences. 147 p.

Bruner, J. (1991). The Narrative Construction of Reality. *Critical Inquiry*, 18.

Clark, D. H., Steig, E. J., Potter, N. & Gillespie, A. R. (1998). Genetic Variability of Rock Glaciers. Geographical Annals, 80: 175-182.

Creswell, J. W. (2007). *Qualitative inquiry & research design: choosing among five approaches*. Thousand Oaks, Calif., Sage. XVII, 395 s. p.

Cruikshank, J. (2005). Do glaciers listen? : local knowledge, colonial encounters, and social imagination. Vancouver, B.C., UBC Press. 328 s. p.

Du, Z. (1998). A Comparative Study on the Altitudinal Belts in the Karakorum Mountains. In Stellrecht., I. (ed.) Culture Area Karakorum, Scientific Studies, vol. 4 Karakorum – Hindukush – Himalaya: Dynamics of Change. Cologne, Rüdiger Köppe Verlag.

Ehlers, E. (2000). Sustainability - indigenous knowledge systems and traditional land uses : the Northern Areas of Pakistan as an example. S. 37-63 p.

Emerson, R. M. (1984). Charismatic Kingship: A Study of State-Formation and Authority in Baltistan. Journal of Central Asia 7(2).

Feld, S. & Basso, K. H. (1996). *Senses of place*. School of American Research advanced seminar series. Santa Fe, N.M., School of American Research Press. VIII, 293 s. p

Gray, J. N. (2000). *At home in the hills : sense of place in the Scottish borders*. New York, Berghahn Books. XIII, 266 s. p.

Fowler, H. J. & Archer, D. R. (2004). Spatial and temporal variations in precipitation in the Upper Indus Basin, global teleconnectionsand hydrological implications. Hydrology and Earth System Sciences, 8 (1): 47-61.

Fowler, H. J. & Archer, D. R. (2005). Hydro-climatological variability in the Upper Indus Basin and implications for water resources, Foz do Iguacu, Brazil. IAHS Publ. 7 p.

Gadamer, H.-G. (1975). *Truth and method*. London, Sheed & Ward. XXVI, 551 s. p.

Geertz, C. (1973). The interpretation of cultures
selected essays. New York, Basic Books. 470 s. p.

Glaser, B. G. (1992). *Basics of grounded theory analysis.* Mill Valley, Cal., Sociology Press. V, 129 s. p.

Glaser, B. G. & Strauss, A. L. (1967). The discovery of grounded theory : strategies for qualitative research. New York, Aldine de Gruyter. X, 271 s. p.

Haeberli, W., Hallet, B. L., Elconin, R., Humlum, O., Kääb, A., Kaufmann, V., Ladanyi, B., Matsuoka, N., Springman, S. & Mühll, D. V. (2006). Permafrost creep and rock glacier dynamics, vol. 17, 3. pp. 189-214.

Hewitt, K. (2005). The Karakoram Anomaly? Glacier Expansion and the 'Elevation Effect,' Karakoram Himalaya. Mountain Research and Development, 25 (4): 332-340.

Hewitt, K. (2007). Tributary glacier surges: an exceptional concentration at Panmah Glacier, Karakoram Himalaya. *Journal of Glaciology*, 53 (181).

Holzwarth, W. (1997). Islam in Baltistan: Problems on the Formative Period. In Stellrecht., I. (ed.) vol. 2 *The past in the present: horizons of remembering in the Pakistan Himalaya*. Cologne, Rudiger Koppe Verlag.
Humlum, O. (1997). Active layer thermal regime at three rock glaciers in Greenland. Permafrost and Periglacial Processes, 8 (4): 303-408.

Humlum, O. (2005). The Climatic and Palaeoclimatic Significance of Rock Glaciers. In Svalbard, T. U. C. i. (ed.). Longyearbyen, Svalbard. Accessed 15.03 2007 on World Wide Web:http://www.unis.no/research/geology/Geo_research/Ole/RockGlacierClimaticSignificance.htm.

Humlum, O., Christiansen, H. & Juliussen, H. (2007). Avalanche-derived Rock Glaciers in Svalbard. PERMAFROST AND PERIGLACIAL PROCESSES, 18: 75-88.

Jacobsen, J.-P. (ed.) (1998). Investigations into the vertical temperature and precipitation gradients in two test areas in Northern Pakistan (Yasin and Bagrot). Karakorum-Hindukush-Himalaya: Dynamics of change, vol. 4. Køln, Rudiger Koppe Verlag. 608 p.

Khan, S. (2005). Glacier Grafting. Skardu, AKRSP. 16 p.

Kreutzmann, H. (2000). Water management in mountain oases of the Karakoram. . Sharing water: Irrigation and water management in the Hindukush-Karakoram-Himalaya. Oxford, Oxford University Press. XX, 283 s. p.

Kreutzmann, H. (2005). The Karakoram Landscape and the Recent History of the Northern Areas." In Stephano, B. (ed.) Karakoram: Hidden Treasures in the Northern Areas of Pakistan, pp. 41-76. Torino, Umberto Allemandi & C.

Merton, R. K., Fiske, M. & Kendall, P. L. (1952). The focused interview. 2.utg. ed. N.Y., Columbia University.

Nakawo, M., Fountain, A. & Raymond, C. F. (2000). Debris-covered glaciers. IAHS publication ; no. 264. Wallingford, International Association of Hydrological Sciences. VIII, 288 s. p.

Owen, L. A. & England, J. (1998). Observations on rock glaciers in the Himalayas and Karakoram Mountains of northern Pakistan and India. Geomorphology, 26: 199-213.

Polanyi, M. (1967). The tacit dimension. Garden City, N. Y., Doubleday. xi, 108 s. p.

Schofield, V. (2001). *Pakistan's Northern Areas dilemma*. In BBC (ed.). London, BBC. Accessed 05.05 2007 on World Wide Web: http://news.bbc.co.uk/1/hi/world/south_asia/1491179.stm.

Singh, P. & Singh, V. P. (2001). Snow and glacier hydrology. Water science and technology library ; vol. 37. Dordrecht, Kluwer Academic. XVII, 742 s. p.

Stahl, K. & Moore, R. D. (2006). Influence of watershed glacier coverage on summer streamflow in British Columbia, Canada. Water resources research (42).

Stellrecht., I. (1997). Writing concerning the past in Northern Pakistan - a short introduction. In Stellrecht., I. (ed.) vol. 2 The past in the present: horizons of remembering in the Pakistan Himalaya. Cologne, Rudiger Koppe Verlag.

Stoffle, R. W., Toupal, R. & Zedeno, N. (2003). Landscape, Nature and Culture: A Diachronic Model of Human-Nature Adaptations. In Selin, H. (ed.) Nature Across Cultures: Views of Nature and the Environment in Non-Western Cultures. Dordrecht, Kluwer Academic Publishers.

Strauss, A. L. & Corbin, J. M. (1990). *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park, Calif., Sage. 270 s. p.

Thrupp, L. (1989). Scientized Packages' or empowerment for Third World people. In Warren, D. M., Slikkerveer, J. & Titilola, S. (eds.) vol. 11 Indigenous knowledge systems: Implications for agriculture and international development. Studies in Technology and Social Change. Ames, Iowa State University, Technology and Social Change Program.
.
Young, G.J. and Hewitt, K. (1990) Hydrology research in the upper Indus basin, Karakoram Himalaya, Pakistan. International Association Hydrological Sciences. International Association of Hydrological Sciences. IAHS Publication No. 190, 139-152.

Warren, D. M. (1991). Using Indigenous Knowledge in Agricultural Development World Bank Discussion Paper, 127.

Winpenny, J. T. (1997). Managing Water Scarcity for Water Security. In FAO (ed.). Rome. Accessed 05.09 2007 on World Wide Web.

Wittfogel, K. A. (1957). *Oriental despotism : a comparative study of total power*. New Haven ,. XIX, 556 s. p.

Wohl, E. E. (2000). *Mountain rivers*. Water resources monograph ; 14. Washington, D.C., American Geophysical Union. V, 320 s. p.

The World Bank. (2002). The Next Ascent, An Evaluation of the Aga Khan Rural Support Program, Pakistan. Washington D.C., The World Bank.

Østrem, G. (1974). Runoff forecasts for highly glacierized basins. Norwegian Water Resources and Electricity Board (26): 22.

Appendix A

Checklist for interviews with experts in glacier growing

Learning to grow a glacier

- How did you become interested in glacier growing?
- From whom did you learn?
- What did you learn from this person? (Location, altitude, season, volume of ice, etc.)
- What is the location of the glaciers made by your mentor(s)? And are they still present?

The glaciers

- At which locations have you grown glaciers? (Name of watershed)
- How many of these have survived?
- How big are they?
- Are they located below or above the rocks?
- How much ice used for the growing?
- From where did you take ice?
- Was it ice at the site from before?
- Have you seen ice on the site before the GG?
- Approximate altitude?
- Which direction are they facing?
- Does the area receive much snow? In which months? From which direction?
- When is the last time you saw to these glaciers?

Beliefs and values

- Female/male glaciers?
- Women and glaciers?
- Names of other glacier experts.
- Local name for “glacier growing”.
- Myths and legends about glaciers.

Appendix B

INTERVIEW GUIDE, HANUCHAL

SOCIO DEMOGRAPHIC INFORMATION

1. Sex of respondent
   1) Female 2) Male

2. Age of respondent
   1) 30-39 2) 40-49 3)50 – 59 4) 60-69 5)70 +

AGRICULTURE AND WATER AVAILABILITY

3. How long have you lived at this site?

4. What is the total size of your land?
a). Cultivable Land_____
b). Grass Land/Trees _____
c) Barren Land_____

5a. Does your household need more water?

6b. If so, for what do you need it?

6. How often do you get irrigation for your land?

6b. Has it always been like this?

7. Would you say that your village has more or less water now as compared to when you started farming here?

8. Since you started farming here, have you taken barren land into cultivation?
   8b. When was this? 8c. What made this possible?

GLACIER GROWING

9. Can you tell me what glacier growing is?

10. Have you ever participated in glacier growing?

11. When was this glacier growing performed and how big is it today?

12. Do the people involved in glacier growing get any special benefits due to their work?

13. Has the amount of water you receive changed after the glacier growing?

14. What do you think has been the most important development in your village to increase the amount of available water?

15. Can you describe changes in the weather during your lifetime?

16. Has your workload increased or decreased during your life in this village?

17. Additional comments.