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Risk, vulnerability and environmental hazards in the village of Darkot, northern Pakistan

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Risk, Vulnerability and Environmental Hazards in the Village of Darkot, Northern Pakistan.

By

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THESIS

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ABSTRACT

Conventional approaches to studying environmental risks and hazards have focused on the physical parameters of geomorphic, hydrologic and climatic events - magnitude, duration and frequency - without adequately accounting for the role of human agency in averting disaster and distributing loss. Secondly, where human intervention was recognized it was often in an incriminating way, particularly in work dealing with the developing world or peripheral regions such as mountain areas. Here, humans were portrayed as helpless victims; unable to successfully adapt to their environment or else they were viewed as having played an unwitting role in their own downfall through 'short-sighted' agricultural practices such as overgrazing or deforestation. Since the late-1970s there has been an emerging sub-field in hazards research that has sought to place greater emphasis on the social, economic and environmental conditions that create a state of vulnerability, whereby communities, regions, ethnic groups, classes and nations are more likely to be exposed to hazardous processes and less able to recover from them.

This research, based on fieldwork conducted in the village of Darkot in the Karakoram Mountains, Northern Pakistan, seeks to utilise this 'vulnerability' perspective to study risk and responses to risk by members of the community. In it I argue that losses from environmental hazards - while closely related to the magnitude of the event itself - must also be interpreted with regard to changes in environmental conditions unrelated to hazard events, socio-economic constraints that constrain household responses to risk and slow recovery and the constraints on settlement within and around the community, such that people have little choice but to settle in unsafe locations.

The first section of this work deals with the various theoretical approaches to the study of risks and hazards, with particular reference to the work of Hewitt (1983, 1997) and Blaikie *et al.* (1994, 2001) on the social construction of vulnerability. Physical conditions in the Karakoram and the Yasin Valley are discussed and the various ways in which human activity has modified the landscape. I argue that these mountain communities have developed a variety of 'techniques' that have - for the most part - been successful in managing the risks and hazards associated with such a dynamic environment. Traditional responses to risk, indeed the traditional economy, is being altered however with recent intervention by local and national government, in particular through the work of the AKRSP.

To account for the totality of risk in the community, I have sought to address a number of interrelated elements including the hazards to which households in the community are exposed to, the intervening conditions that exacerbate or avert losses, the methods with which households adapt and cope with danger and loss and the extent to which various households in the community are more vulnerable than others to damaging events. To account for the formation of vulnerability at the community and household level, I have employed a version of Blaikie *et al.*'s (1994, 2001) 'disaster pressure and release model' in which vulnerability is shown to be influenced by events and conditions far removed from what is considered a peripheral mountain valley.

The research was carried out over a period of two months, during which time a number of interviews were carried out within the village, hazard sites and settlement patterns were identified and mapped, and data collected on land-use, population, cropping patterns and agricultural practices within the community.

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Chapter One - Review of Literature, Theory and Methodology

1.1 Risk, Vulnerability and Environmental Hazards in the Village of Darkot: An Introduction

The village of Darkot is a small agricultural community located in the Yasin Valley in the western Karakoram, Pakistan. Oral history indicates that Darkot has existed as a community for at least three hundred years, and there is evidence to indicate human activity and culture for several hundred years prior to that (Dani, 1989; Stein, 1968).

Figure 1.1 The village of Darkot in the upper Yasin Valley. The main settlement is located on the east bank of the river. The remains of a large debris flow are still visible.

Darkot is typical of many other villages in this mountainous region, and is located on a combination of floodplains and alluvial fans. Because these landscape features tend to be gently sloping and close to a source of water (making them suitable for agriculture)

they are often the first choice for settlements in an area with a limited amount of land suitable for such a purpose (Kreutzmann, 1994). The fan surface at Darkot has been modified over the years and is criss-crossed with low terraces and irrigation channels. Settlements such as this have often been referred to as 'mountain oases', a reference to their dependence on glacial meltwater and their ability to transform an arid landscape into one of green verdure (Whiteman, 1984). The land here can only be made productive through these extensive modifications to the physical environment. Most important is the irrigation that transport meltwater from mountain basins to farmers' fields (Butz, 1987). This meltwater provides the basis of agriculture for nearly all Karakoram communities, including Darkot. Terraces, necessary to retain the meltwater and prevent soil erosion, are another important feature of the human built landscape.

Agricultural production in Darkot is both diverse and flexible, sharing many of the same characteristics of high mountain agriculture practiced in other mountain and high-land regions (Cole and Wolf, 1974; Le Roy Ladurie, 1978; Brush, 1988). This includes the keeping of several kinds of animal (goats, sheep, cattle, and *dzo*), the use of high pastures for grazing animals in the summer and occasional cropping. Farmers in Darkot make use of small fields, dispersed over a range of elevations and ecotopes (Rhoades and Thompson, 1975). Small family gardens complement and products available in one of the several stores in the village complement production. A jeep road connects the community to Gilgit via the Yasin Valley, where inhabitants can buy and sell goods.

The mountain ranges of Northern Pakistan are, however, one of the most physically dynamic and active environments on the earth. Peaks are among the youngest

and highest anywhere, and have been subject to high rates of uplift throughout the Quarternary. Episodic glaciation has left vast amounts of sediment, readily entrained by the large rivers draining this upland region or by periods of intense precipitation that characterise this arid environment. During the summer months the monsoon rains (fierce downpours) alternate with extended dry spells and heavy snowfall at high altitudes. The entire region is considered seismically active and earthquakes frequently trigger landslides or other mass movements. There also exists in these mountains the largest concentration of glaciers outside the polar regions, glaciers which sustain a growing lowland population, generate electricity and provide the meltwater essential to life in the mountains. This is a lived environment, "an inhabited wilderness" (Emerson, 1986), but also a hazardous one.

The recurrence of snow avalanches, debris flows, rock and land slides, extreme weather events, floods and glacier-related hazards in the Karakoram has been well documented (Goudie, 1981; Goudie, et al., 1984; Shroeder, 1989; Hewitt, 1997; Bohle and Pilardeux, 1997). Locals acknowledge these risks, and the losses are often averted by individual and community practices that mitigate the danger, some of which will be described in more detail in subsequent chapters. In some cases, however, extreme events overwhelm a community or household's ability to effectively manage risk, lacking either the resources or the ability to recover from or mitigate future danger.

The central aim of this thesis is to examine how the individuals and households that comprise the community of Darkot, in the Yasin Valley, have adapted and adapted to their physical surroundings, with particular reference to environmental hazards. In

satisfying this aim I wish to answer the following questions:

- What are the various physical hazards that the residents of the community of Darkot are exposed to, and what is their distribution through time and space?
- What is the geographical distribution of risk in the community, and what are the processes - social, economic, political and environmental - contributing to its formation?
- What have been the impacts of hazardous events on the community, and what is the social distribution of these impacts? and
- Is the modernization process increasing people's vulnerability to hazardous events or processes?

The thesis has been laid out as follows. Following this introduction, is a review of literature and methodologies relevant to an understanding of risks and hazards in the Karakoram; the second section in this chapter outlines the particular theoretical approach that I have chosen to use in this work. Awareness of the physical environment is a key adaptive strategy throughout the Karakoram, and communities are often aware of its characteristics, landscape features, its opportunities and its potential dangers. Chapter 2 will discuss this material, in a review of the geomorphology, geology, climate and vegetation of Darkot, the Yasin Valley and the Karakoram.

The focus begins to narrow in Chapter 3. My concern here is with human-environment relations in the Yasin area, with the emphasis on strategies to deal with risk: the practices, techniques, and modifications that individuals and communities have made. What are the practices or techniques (Ellul, 1964) that have been developed to allow human activity to be sustained in this environment? Particular focuses in this chapter will be on adaptive and risk mitigating strategies in agriculture, settlement patterns in the

Karakoram, and the problems and challenges of modernization in mountain regions.

Chapter 4 is an inventory of hazards. What specific events and processes were found to be hazards in Darkot? What recurring and ongoing events and processes, characteristic of this environment, must the community deal with? What is their distribution through time and space? In Darkot, this includes seasonal events such as avalanches; low-frequency events such as debris flows; and low-magnitude high-frequency processes such as soil erosion.

Chapter 5 seeks to draw material from the previous chapters together to answer the following questions: What are the combined effects of these events and processes and how does the individual, the household and the community address them at different spatial and social levels? What is the significance of 'vulnerability' in this context? Is it, or is it likely to be, exacerbated by recent and future development? Chapter 6, in closing, offers a synthesis of the material presented and provides some indications of future research possibilities and recommendations.

1.2 Review of Hazards Literature

The literature pertaining to risks and hazards covers a range of subjects and styles. The work on risks and hazards ranges from description of hazardous events in the region of interest (Goudie, 1984; Hughes and Nash, 1986; Bohle and Pilardeux, 1993) to more theoretical analyses which, in turn, span a spectrum from technique-centered control and management of nature to those predicated on social, economic and political inequality as being fundamental causes of disasters (Cannon, 1994; Blaikie, et al., 1994). Works dealing with the Karakoram and other mountain regions display a similar scope. From

travelogues and colonial records, to works of science and history, and recent social and political commentary, this breadth of material can be at times overwhelming; while depth can simultaneously be lacking. The Karakoram regions are still neglected or overlooked by many disciplines, including geography. While mountain areas in general receive less attention than their lowland counterparts, this discrepancy is even more pronounced when dealing with the Karakoram. The difficulty of access, history and politics appear to have made this so.

I have organized this chapter in such a way as to first establish a foundation for the methodology, which follows. To do so, I have set out to frame this present study within a 'certain position'. I begin with a review of the Karakoram hazards literature, followed by an introduction and literature review of the three main approaches to the study of risks and hazards: namely the 'geophysical', 'behavioral' and 'vulnerability' or structuralist schools. This introduction to the study of risks and hazards leads into a more detailed analysis of the concept of vulnerability in the second half of the chapter. I begin this portion with a discussion of the concept of vulnerability; its definition, formation and finally its relevance to this research. I also introduce the 'disaster pressure and release model' used in Chapter 5. This is followed by a review of the research methods that were employed in the course of the research and a concluding comment.

1.2.1 Karakoram Hazards Literature

In this section I briefly review the 'regional' hazards literature of the Karakoram as a way of initially situating the research within a geographical area, as well as the varying interpretative approaches to risk discussed later in the chapter.

The work that has been done on risk, hazards and disasters in the Karakoram can be discussed - very generally - in terms of the three 'schools' of hazards research: the dominant, geophysical approach, the behavioral and the vulnerability (these will be discussed more fully later). The first, the geophysical, focuses mainly - though not exclusively - on the physical parameters of risk (Hughes and Nash, 1984; Goudie, 1981; Shroeder, 1989; Said, 1995, 1997). The emphasis in this work is on the hazard as the determining factor of risk. There is a second body of work which deals almost exclusively with assessing human vulnerability to hazard events. This is concerned largely with food security (Allan, 1990; Dittrich, 1997). A final collection of work falls somewhere between the two, and endeavors to account for the fact that hazardous events originate in landscape features and physical characteristics of the region but at the same time involve human activities and practices which avert or amplify vulnerability.

The regional environment of the Karakoram is characterised by extremes. Extreme topographical relief, extensive glaciation and climatic variability, all contribute to the prevalence of hazardous events in this area (the environmental conditions giving rise to this situation will be discussed in greater detail in Chapter 2). It is not surprising then that extreme events in the Karakoram have been studied in some detail. Most of these overviews of hazards take a 'fearful' environment stance (Goudie, 1981; Miller, et al., 1984), in which human activity is discussed, but only in relation to the tremendous magnitude of natural processes. Brunsden and Jones (1984) and Shroeder (1989) in their regional analysis and Said (1997) in a review of hazards in the Shigar Valley, are more cautious and do briefly mention the way in which these processes affect human activity,

but again their chief concerns are with the occurrence, frequency, magnitude and duration of hazard events such as landslides, debris flows and snow avalanches.

Glacial hazards are among the most prevalent natural hazards in the Karakoram, and include glacial surges, outburst floods, ice dams and glacier related landslides (Hewitt, 1964; 1969; 1982; MacDonald, 1989). Catastrophic landslides, or 'mountainside collapses' (Hughes, 1984) have also been studied in detail by Hewitt (1988, 1998). Climatic events, such as torrential rains, have been addressed by Bohle and Pilardeux (1992) and Hewitt (1992); characteristics of avalanche activity and hazardous site identification by de Scally and Gardner (1993, 1994); and hazards associated with alluvial fans (mudflows, debris flows) by Hughes and Nash (1984) and Derbyshire and Owen (1990).

There is a small collection of literature that fits into the narrow range of the 'vulnerability' school (the bulk of hazards literature on the region seeks to address both the human and physical sides of the equation). Food security and vulnerability to famine is the subject best represented by this approach (Allan 1990; Dittrich, 1997). Dittrich (1997) for example, studied food security in the Yasin Valley, and argues that recent road links have integrated the valley into national political and economic systems. This however has reinforced the vulnerability of peasant farmers to food crises. As food production declines, economic food entitlements are weakened - the benefits (and risks) of the money based economy have not been distributed equally, undermining farmers capacity to cope with crisis. Allan (1990) presents a slightly different set of conclusions from his work in the Hunza Valley, an area historically prone to famine. Household food

security today, he suggests, is relatively high, due in part to better road access (which led to the introduction of subsidized wheat and also a successful potato harvesting program) and greater local control over irrigation meltwater.

Much of the remaining work on hazards in this area falls more easily under the heading of 'human ecological'/'geo-ecological' studies. Although some of these do not make explicit reference to 'vulnerability' they often demonstrate awareness of a range of causal factors beyond the strictly physical parameters of hazard event magnitude, frequency and duration. This literature includes MacDonald's (1994, 1996, 1998) work on risk averting practices and techniques in the community of Askole. Hewitt (1976, 1984) in his work on earthquake hazards in the Karakoram suggests that the evidence indicates that the magnitude of the quake may have less to do with the scope of damage than 'intervening conditions' (housing type, soil conditions, slope, land use) and vulnerability do. Settlement patterns and their relation to hazardous processes in the region are discussed by Kreutzmann (1991) and by Flanagan (2001) in relation to Nomal, Naltar Valley. Finally, Iturrizaga (1997) describes in detail how debris deposits associated with past glaciation and the presence of potential glacier dams have constrained settlement in the valley of Shimshal.

1.2.2 Three Schools of Hazards Literature

What is more violently unusual than natural catastrophe?

- Dorothy Vitaliano, Legends of the Earth (1973)

There exists in hazards research three separate schools of thought. They have been recognized and critiqued elsewhere (Waddell, 1977; Hewitt, 1983a; Tobin and

Montz, 1997), and my purpose here is to review them insofar as is necessary to contribute to a better grounding for my own methodology. The three schools can be roughly described by their emphases as the 'geophysical', the 'behavioral' and the 'vulnerability' schools. While there is some overlap between them, they are perhaps best thought of in terms of 'degrees of lateral thinking' (MacDonald, 1994), or more specifically, as an evolution of the ways hazards, risk and disaster have been understood and interpreted. Each of these 'schools' has emerged from and cannot be entirely divested of, the critiques of those that preceded it.

The first of these schools - the geophysical - is distinguished by an emphasis on the physical parameters of a hazardous event, be it a flood, a landslide or an avalanche. The physical world is understood to be separate from, or is externalized in relation to, human uses, forces and practices. In this vein, Burton and Kates (1964) suggest that hazards be defined as "those elements of the physical environment harmful to man [sic] and caused by forces extraneous to him". This "academic research consensus" (Said 1978, 13) was based upon the assumption that natural disasters were "a result of 'extremes' in geophysical processes" (Hewitt, 1983a, 5). Geologists, geomorphologists, hydrologists, and climatologists, as well as engineers and seismologists, engage(d) in attempts to understand these physical events - in a strictly technical and specialized capacity.

In some cases, a vulnerable population may be an implicit part of the definition - 'there can be no disaster if there are no people' - the focus however remains on physical processes. Cooke (1984, 4) typifies this approach in which:

> geomorphological processes are natural phenomena that only become serious hazards because they have increasingly imposed themselves upon a vulnerable, *often unsuspecting*... community. [italics mine]

Hazards are seen as the imposition of an extreme physical event upon a human population unaware of the existence of those hazards. Davis (1998) describes it as "a way of thinking that simultaneously imposes false expectations on the environment and then explains the inevitable disappointments as proof of a malign and hostile nature" (16); as Hewitt (1983a) says, "the initiative remains with nature" (6).

The important questions to ask thus become those associated with predicting the severity of an impending catastrophe which, "often depends on a knowledge of its exact course: how far is a landslide going to reach?; how fast is a flood wave going to flow down a valley?" (Scheidegger, 1978). The result of this excessive focus on the physical parameters of disaster has been an equivalent amount of spending and research directed towards the prediction of and attempt at ultimate control of environmental extremes through technology. Massive engineering works - capital-intensive solutions - were, and still are, regarded as the most promising avenue for the eventual decrease in impacts from disaster. One controversial attempt included the various plans for implementing flood control in Bangladesh by way of massive embankments, with the aid of the World Bank and Western engineers (Brammer 1990). More recently, technocrats in China have justified the social and environmental upheaval created by the Three Gorges Dam by suggesting it will eliminate flooding on the lower reaches of the Yangtze; this despite little supporting evidence (Li 1997:169).

The second school within hazards research is centered upon the work of Gilbert

White and his colleagues, Ian Burton and Robert Kates (1978). Referred to by Smith (1996) as a "behavioral paradigm" it deserves credit for broadening the scope of the research agenda to include humans as active, decision making agents, something the geoscientists had rarely reckoned with. This new awareness is reflected in Baker's (1976) expanded definition of natural hazards: "The concept of natural hazard is somewhat paradoxical; the elements of a natural geophysical event (e.g. windstorm and surge of a hurricane) are hazardous only when they prove detrimental to human activities" (1).

In 1936 the US Congress passed an important Flood Control Act, which designated the US Army Corps of Engineers as the federal agency responsible for large-scale watershed management. What commenced was an ambitious program of engineering works to control floodwaters and protect property. The approach which began here has characterized much of hazards research for the last fifty years. As Smith (1998) says of the program:

> Although soil and water conservation objectives lay behind the civil engineering, flood control works were constructed on the premise that geophysical extremes [were] the cause of disaster (47).

Since blame was assumed to lie with nature, control and prediction, it would seem, would prove an effective cure. Such goals, during the heady days of the 1930s and 1940s, were seen to be both laudable and attainable. Scientific progress in related fields, meteorology and hydrology, were advancing, as well as the large amounts of capital needed for such schemes.

This view was challenged and moderated somewhat by White (1945), who noticed that despite the money spent, losses from flooding were mounting. White (1945)

advocated a broader approach to flood control, and suggested that a range of non-structural methods be employed, including insurance and stricter zoning regulations, integrated with control works. Implementation of flood-control plans had been premised on positivistic assumptions of rational economic behavior, namely that "individuals in hazardous environments would behave in an economically rational way to maximize all outcomes" (Tobin and Montz 1997:142). White expanded this initial purview to allow room for social factors that may have had a role in governing behavior.

Similar research strategies were employed elsewhere, across a broad range of settings, cultures, and hazards (Burton, et al., 1978). In 'developed countries', 'behavioral' faults were attributed to victims and flood control authorities, who had a 'poor perception' of the hazard, while in developing countries, the increasing incidence of disasters was felt to be compounded by even more irrational, ill-informed behavior by members of preindustrial, 'folk' societies, that overgrazed their land, removed all their trees, or settled on islands of silt in the Bay of Bengal.

Together, the geophysical and behavioral schools have been taken to represent a 'dominant' view in hazards research; dominant in terms of funding, research, influence, and prestige, and associated with the positivistic and reductionist tendencies in the technocracy of the Western world. To paraphrase Hewitt (1983a, 6), the dominant view, in both its behavioral and geophysical branches, has been premised on the following:

> (a) an unparalleled commitment to the scientific monitoring and understanding of geophysical extremes, with prediction regarded as the ultimate goal;
>
> (b) planning and managerial activities with the aim of containing these extreme fluctuations in the environment; and

> (c) the establishment of emergency measures to deal with the aftermath of those extremes.

To fulfill its mandate the dominant view has relied on the preeminence of technology as a panacea, and the social and cultural institutions which promote such a view, and closes off the society from any discussion about other possible or root causes of disasters. Liberal applications of technology are understood to be necessary to bring "a malign and hostile nature" to heel (Davis, 1998: 15). Hewitt (1983) saw this as a monologue, engaged in by Western governments, NGOs, UN agencies, engineers and scientists, a closed system that never adequately accounted for the ongoing social, political, environmental and economic conditions of daily life that prefigured calamity; a monologue, in much the same way that Foucault (1965) viewed the rise of asylums during the 'Age of Reason' (cf. Hewitt 1983a). Within the dominant view, 'hazards' are closely equated with our Western conceptions of disease: conquerable or excisable if only through the application of liberal amounts of technological expertise (Payer, 1988).

Scheidegger (1978) encapsulates this approach to hazards, and its ultimate ends when he writes:

> evidently, if a prevailing status quo is preserved, no catastrophe occurs. A catastrophe generally entails the termination of stable state. At some time and place, a previous state of stability breaks down. Therefore, the first problem in the analysis of a catastrophe is usually the analysis of the conditions necessary for stability and an attempt to understand why those conditions no longer continued (2).

The emphasis here is on a return to stability; nature in this view is reduced to a remarkably unchanging and undynamic condition that approaches stasis. And yet, as later

research suggested, it is within the conditions of everyday life, that the seeds of future disasters are evident, more so than in reconstructions of environmental history. A social construction of natural catastrophe that unmasked the real causes of disaster was called for, engaged in and developed to challenge Vitaliano's (1973) view that what "may be remembered when the normal events of daily life are long forgotten, is the unusual, particularly the violently unusual. And what is more violently unusual than natural catastrophe?", (16) The answer? Ongoing inequality, vulnerability, marginalization, and disenfranchisement. These are often the conditions that preface a disaster; these are the conditions that need to be understood, but there is nothing unusual about them, only that they are allowed to persist and grow unchecked. What was called for in the late-70s and early-80s, was a radical evaluation of the social, political, economical and environmental constructs of life, and how they influenced in turn risks, hazards, and disaster.

The dominant view, despite the critiques that have been leveled at it, continues to hold currency in contemporary hazards management and research. There remains a tendency to focus on the description of physical process(es) involved in catastrophe (Blong, 1986; Hughes and Nash, 1986; Moore and Matthews, 1978); to reconstruct the dynamics of past events; to describe specific types of locally recurring events; and complete hazard inventories for entire regions. Possibly of more importance however, is the continued hold that this view of causes and solutions has on those in a position to most powerfully influence hazards mitigation (Varley, 1994).

> For me, the analysis offered by Interpretations of Calamity is still fresh, incisive and even a little audacious. That this should be so 10 years after the book was published is regrettable. If these ideas can still appear strikingly different, it is

> largely because vulnerability analysis has failed to make significant inroads into the dominant paradigm in disaster management (2).

Beginning in the late 1970s, a growing number of researchers in the field of disaster studies were becoming increasingly discontented with the prevailing orthodoxy and dominant views in the field (Wisner, et al., 1977; O'Keefe, et al., 1976). What these authors began to express, and whose views were later brought together in Hewitt (1983b), was an 'alternative view', at that time at least, a fringe element advocating a new paradigm. These authors sought to situate the underlying cause of disaster not in the environment where it could only be resolved with millions of dollars and often 'Western' technological or engineering expertise, but in the realm of society; in socioeconomic processes and political pressures which contribute to the social construction of vulnerability (Susman, et al., 1983; Wijkman and Timberlake, 1984; Blaikie, et al., 1994). Although many of these 'radical' critiques were 'crudely anticapitalist' (O'Keefe, et al., 1976; Cannon, 1977), they laid a foundation for the concept of vulnerability, which I will examine in greater detail in the theory and methodology section.

There is a breadth of literature that adopts a 'vulnerability' approach to the study of risk and disaster, literature which deals with a broad range of hazards. The earliest of this looked at famine in the Sahel (Wijkman and Timberlake, 1986), an area of study which continues to be strong - both in terms of case studies and theory generated (Allan, 1990a; Copans, 1983). More recent examples on vulnerability to famine include work done by Watts (1993), Watts and Bohle (1993), Wisner (1993) and Dittrich (1997).

Work on natural hazards that utilises elements of the vulnerability perspective in its

analysis includes work on earthquake losses (Asgary and Willis, 1997; Bolin and Stanford, 1999; Coburn, et al., 1984; Davis, 1981, 1984; Doughty, 1999; Hewitt, 1976, 1984; Keefer, 1984; Oliver-Smith, 1992, 1999; Wisner, 1998); snow avalanches (de Scally and Gardner, 1994); landslides (Hewitt, 1998; Pilgrim, 1999; MacDonald, 1989; Hughes and Nash, 1986); and extreme meteorological or climatic events (Dyer, 1999; Dyer and McGoodwin, 1999; Hearn Morrow, 1999; Hewitt, 1992; Waddell, 1983).

While there continues to be an emphasis on the strictly geophysical dimensions of hazards, some more recent publications that have sought to achieve a balance between the two (Alexander, 1993; Blaikie, et al., 1994; Hewitt, 1997; Smith, 1997).

There still exists in hazards research a 'dominant view', one that has gone largely unchanged since a scathing critique of it first appeared nearly two decades ago (Hewitt 1983). Cannon (1994) suggests that to find evidence of the continued stranglehold the positivist interpretation of catastrophe has on policy makers, governments and agencies, one need only look to the focus of the 1990s, the United Nations "International Decade for *Natural* Disaster" [emphasis his], which

> betrays the strength of the old outlook. Not only does the approach of the UN Decade fail to distinguish the naturalness of hazards from the human causation of disasters; it also (by focusing on the behavior of nature) encourages technical solutions to the supposed excesses of the as yet untamed side of nature (17).

For similar, though more direct, attacks on the Decades' stated objectives see Mitchell (1997).

'Agent' specific studies which incorporate a 'vulnerability' perspective include a large body of work done in respect to floods (Adger, 1996; Brammer, 1990; Chan, 1997;

Haque, 1997; Mustafa, 1998). Many of the contributions in this area have come from anthropology, especially the perennial flood hazard in Bangladesh (Islam, 1990; Zaman, 1993, 1997). Mustafa (1998), who assessed community level vulnerability in the Punjab (Pakistan) also incorporated a structural analysis of the flood hazard, identifying both macro- and micro-scale pressures that contribute to the construction of vulnerability. The low priority of the provision of basic needs by the government and the 'bureaucratic ethos of water-related bureaucracy", insensitive to the needs of the small farmer (294), is identified as a primary architect of vulnerability at the national scale. Locally, the concentration of resources (financial and otherwise) at both community and household levels exacerbated the problem. Control of the water by a few wealthy families meant that many had little or no say in the management of the resource and by extension the level of hazard that they were exposed to. Porter-Gibson (2000) has also incorporated an assessment of vulnerability into her work on flooding in China.

My own thesis represents another contribution to this body of literature from a vulnerability perspective and is the first such study on Darkot, and one of only a few pieces of research that is concerned with the Yasin Valley (Moughtin, 1984; Hughes, 1984; Dittrich, 1997; Stoeber, 2000).

1.3 Conceptual Framework for the Thesis

> The definability of a hazard... is more than mere awareness and often requires high scientific knowledge, i.e., we must understand in order to define precisely.
>
> - Ian Burton and Robert Kates [1964]

From the preceding literature review, it should be evident that there are several

different approaches that one could choose to adopt to study in more detail risks and hazards in a high-mountain community. One could choose to focus on the parameters of the hazard event: magnitude, timing, areal extent of deposits. Alternately, one could focus on the ways in which the population had altered their environment, and failed to successfully adapt to their surroundings or the focus could be on the conditions that give rise to a vulnerable population. This is the conceptual framework that I have chosen to use in this research and which is discussed in the following section.

To begin, I have included a review of the terms 'disaster', 'risk', and 'hazard' - as they have traditionally been defined, and more importantly, how I interpret them, and what their meaning is in this thesis. I then continue on to a discussion of the concept of 'vulnerability'. In the section following I review the methods of data collection and analysis used in the course of research. First, some working definitions.

Quarantelli (1995, 1998) has continued to press for an agreed upon definition of the term 'disaster', so far unsuccessfully. Most commonly employed definitions are preestablished numerical parameters. Sheehan and Hewitt (1969) defined disasters as those events leading to 100 deaths, 100 injuries, or $1 million in damages. Glickman, et al. (1992) employ a definition that uses 25 deaths as the threshold. These arbitrary definitions do not readily translate to other locations, however, because other aspects of scale are ignored. For example, a flood that destroys all the homes in a village is a disaster, but would not register at the global scale if only a few hundred homes were lost (Horton, 1994). Additionally, not all losses can be assigned a dollar value: it would be difficult to put a price on the loss of arable - and not easily replaced - land in a mountain

environment; and losses totaling $10 million would be devastating in some countries, an amount easily absorbed elsewhere. Other definitions adopt a more qualitative definition, ranging from vagueness - "the interface between an extreme physical event and a vulnerable population" (Susman, et al. 1983: 264) - to specificity, as in Torry (1978) where natural disasters are seen as "geophysical events"

> that culminate in physical damage to a community, or communities, so severe that most or all major public and private facilities no longer provide essential social and economic services without extensive replacement or repair. This definition applies whether or not people are killed (517).

Others suggest that disasters are only "the extreme situation which is implicit in the everyday condition of the population" (Baird, et al., 1975; Jeffrey, 1973, 1982); that it "brings to the surface the poverty which characterizes the lives of so many inhabitants" (Hardoy and Slatterthwaite, 1989: 203).

The term 'disaster' has thus often been used to refer to an event of a certain magnitude (e.g. 100 people killed, 1000 injured, $1 million in damages). There are at least two problems with such a view however, first, the losses associated with damaging events in the Karakoram, may not exceed such arbitrary parameters, but will undoubtedly qualify as a disaster if, for example, there were significant losses of agricultural land or animals, the mainstays of the village economy. Secondly, the use of the term diverts attention from the ongoing 'crisis' that characterizes daily life for many of the world's most vulnerable people. Interpreting disaster in such terms also promotes it as a 'spectacular' event, one that erupts unexpectedly, reinforcing the dominant view of risks and hazards that this type of work seeks to challenge - directly or indirectly. My

occasional use of the term reflects this concern. As I shall demonstrate in Chapter 5, events in Darkot were 'disasters' in the life of the community, events that overwhelmed their abilities to cope, required significant outside assistance, and the consequences of which are still felt, two decades later, and also that in some places, 'disaster' is a chronic condition, prefigured by history.

A second term in need of clarification is the word 'risk'. 'Risk', says Reddy (1996) is distinctly modern construct: "Moderns had eliminated genuine indeterminacy, or 'uncertainty', by inventing 'risk'. They had learnt to transform a radically indeterminate cosmos into a manageable one, through the myth of calculability" (237). Castel (1991) takes this even further, arguing that the obsession with the prevention of risk in modernity is built upon

> a grandiose technocratic rationalizing dream of absolute control of the accidental, understood as the irruption of the unpredictable... a vast hygienist utopia plays upon the alternate registers of fear and security, inducing a delirium of rationality, an absolute reign of calculative reason and a no less absolute prerogative of its agents, planners and technocrats, administrators of happiness for a life to which nothing happens (289).

'Real life' is not so easily packaged however. One of the aims of this thesis is to demonstrate that the "myth of calculability", with its emphasis on numerical data to the exclusion of subjective reality, is unsuited to examining the risk associated with daily life in the community of Darkot.

When employed in an actuarial context 'risk' may be reduced to a statistical likelihood, whereas it may take on a more 'subjective' meaning for a farmer debating the chances of, or need for, rain. In the context of environmental hazards, risk is most often

defined as "the probability that a hazardous event will occur at a specific location" (Mitchell and Bernstein, 1987: 4). O'Riordan (1986) takes a similar stance, and defines 'risk' as "the combination of the nature and consequences of an event and likelihood of its occurrence" (273). Ewald (1991) adds that "[a]nything can be a risk; it all depends on how one analyses the danger [and] considers the event" (199). Risk is now generally used to embrace all the factors which may endanger people.

In my own work I take a more nuanced approach to risk. Risk, in my own view, is more encompassing, consisting of a hazard, a vulnerable population, intervening conditions that exacerbate or mitigate losses, and methods of coping and adaptation to environmental extremes.

The final term I wish to clarify is the word 'hazard'. The continued use of which by the scientific, engineering and policy-making community led Cannon (1994) to remark that

> the focus of the 1990s United Nations 'International Decade for *Natural* Disaster Reduction' (emphasis his) betrays the strength of the old outlook. Not only does the approach of the UN Decade fail to distinguish the naturalness of hazards from the human causation of disasters; it also (by focusing on the behavior of nature) encourages technical solutions to the supposed excesses of the as yet untamed side of nature (17).

It is necessary then to clearly define what is meant by the term. The dictionary definition might refer to 'risk or peril' or 'a source of danger'. Natural hazards, the technocratic community would assert, are "geographical phenomena such as earthquakes, storms and floods that have the potential to threaten people and communities" (Mitchell and Bernstein, 1987: 4). Hewitt and Burton (1971) offer a more comprehensive interpretation

whereby a natural hazard is: "a function both of the physical event and the state of human society, including specifically the adjustments adopted to cope with the hazard and with the state of preparedness". Tobin and Montz (1997) write that: "A natural hazard represents the potential interaction between between humans and extreme natural events. It represents the potential or likelihood of an event (it is not the event itself)" (5). In this work, I have chosen to use the term in its broadest sense, i.e. that a hazard is any process or event of natural or technological origin, that harms, hinders, or threatens the life or livelihood of individuals, households or communities. Hazards can be as clearly defined as a debris-flow, a discrete event at a point in time, or an ongoing process such as sedimentation or erosion.

The preceding definitions lay the initial foundation for the research. Risk is a central theme of this work, and as later chapters will discuss, the community of Darkot has experienced what can be referred to as 'disasters', i.e. events that overwhelmed the community's ability to recover and required outside assistance, and also that many people are affected on an almost continual basis by hazards of one sort or another. There is a need, however, to also account for the socially, economically and politically derived condition of vulnerability that is differentially distributed among the various households in the community. To this end, the following is an outline of the theoretical framework of the concept of vulnerability, and a discussion of its applicability to this study.

First, what is vulnerability, and how has it been defined? Secondly, how is it accounted for? What is the cause of vulnerability, and can these conditions be measured in a meaningful way? Finally, what is the relation of the concept of vulnerability to this

research?

1.3.1 The Concept of Vulnerability

In recent years the question of vulnerability has broadened significantly the scope of hazards research. As a concept it has the potential to reorient a field of study with tremendous potential for both theoretical and practical contributions, and as such is both intriguing and exciting within hazards research, but also as a tool for engaging work in other fields. As a concept in the hazards literature it rests on very little in the way of theory. Instead it is used to refer to any number of scenarios or cases, without ever moving beyond empirical definitions. Vulnerability has accordingly come to mean a number of different things. Liverman (1989) for example identifies dozens of authors using this term and related ones (marginality, resilience, susceptibility, adaptability, fragility). For some authors it is enough to be aware of it and make passing reference to it, although this does not necessarily indicate an active engagement with the concept or its attendant responsibilities. At the same time, others have been criticized for using it indiscriminately, to the extent that environmental conditions have been overlooked in a quest for incriminating social conditions. And finally, in many instances the term has simply been incorporated into prevailing views, with no attendant change. This is in itself problematic and a significant reminder of the work that still needs to be done. "[U]se of the word 'vulnerability' does not indicate a real determination to engage with vulnerability analysis in the sense of 'social' causation... [of] how social and economic systems place people at different levels of risk from nature's hazards", writes Cannon (1994: 16). Just what is vulnerability however, and what is its relevance to this research?

1.3.2 Defining Vulnerability

One of the first definitions of 'vulnerability' came from Westgate and O'Keefe (1976) who defined it as:

> the degree to which a community is at risk from the occurrence of extreme physical or natural phenomena where risk refers to the pejorative probability of occurrence and the degree to which socio-economic and socio-political factors affect the community's capacity to absorb and recover from extreme phenomena (cf. Jeffrey, 1982: 7).

A similar definition appears in Susman, et al. (1983), in which vulnerability is:

> the degree to which different classes in society are differentially at risk, both in terms of the probability of occurrence of an extreme event and the degree to which the community absorbs the effects of extreme physical events and helps different classes to recover (264).

Blaikie, et al. (1994) propose that the term be taken to mean:

> the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or society (9).

Vulnerability is, in short, a socially, economically, politically or physically generated condition that undermines a household, community, nation or social group's ability to avoid disaster, and in the even of a disaster, recover from it.

1.3.3 On the Causes of Vulnerability

A number of authors have sought to establish a causal structure of vulnerability as a way of identifying underlying factors that ultimately give rise to unsafe conditions. In this section I review two ways of accounting for the formation of vulnerability.

Watts and Bohle (1993) have made some attempts towards establishing a causal structure of vulnerability particularly as it relates to famine and hunger. Their work can

be used - at least in a preliminary way - to establish a framework for interpreting risk in Darkot. They write:

> It is a truism of sorts to say that it is mainly the poor that suffer from [disasters]. But not all poor people are equally vulnerable... indeed it is not necessarily the poorest who face the greatest risk... there is a multiplicity of factors that co-determines whether an individual will suffer (Watts and Bohle, 1993: 45).

As Liverman (1989) has shown, vulnerability has been defined in number of different ways. Many of these definitions begin with the specific empirical forms which they assume (cf. Watts and Bohle, 1993: 45). Vulnerability is thus defined as "the risk large sections of the population are deprived of entitlements" (Sen, 1991: 37) or "the degree to which different classes of society are differentially at risk" (Susman et al., 1983: 246). A more useful starting point is provided by Chambers (1989) who starts from the properties of the system which give rise to vulnerability, rather than the forms it assumes. For Chambers (1989), vulnerability is

> the exposure to contingencies and stress, and difficulty with coping with them. Vulnerability thus has two sides: an external side of risks [what I would refer to as 'hazards'], shocks and stress to which an individual or household is subject to; and an internal side which is defenselessness, meaning a lack of means to cope with damaging loss (1).

Chambers' definition of defenselessness is not totally commensurate with my research in Darkot however, where - as I will show in Chapter 3 - the community's households have developed a number of techniques to avert or minimize risk. The community is not defenseless; their defense mechanisms on occasion are in many cases, subverted or overwhelmed.

Chambers does point to three coo-ordinates of vulnerability which are useful:

1.) the risk of exposure to hazards, stress or shock;

2.) the risk of inadequate capacities to cope with hazards, stress or shock; and

3.) the risk of severe consequences of, and the attendant risks of slow or limited poverty (resiliency) from hazards, crises and shock.

From this perspective, the most vulnerable individuals, groups, classes and regions are those most exposed to perturbations, who possess the most limited coping capabilities, who suffer the most from crisis impact and who are endowed with the most circumscribed capacity for recovery. Vulnerability can, in other words, be defined in terms of exposure, capacity and potentiality.

Watts and Bohle (1993) use these co-ordinates to propose a theoretical framework, a causal structure of vulnerability that I would like to review here. Any such framework they suggest, must be able to 'map' historically and socially specific realms of choice and constraint - the degrees of freedom, the call it - which determine exposure, capacity, and potentiality (46). Although the authors are concerned with accounting for hunger, their ideas can be used to point in the direction of a 'social space of vulnerability' that we might use to better understand the interplay between risk and disaster and the role of vulnerability in Darkot.

The use of the term "social vulnerability" by Watts and Bohle (1993) is an attempt to disaggregate poverty and to emphasize the relational position of individuals, households and social groups in the context of a specific society (Bohle, 1992, 1993, 1994; Watts and Bohle, 1993). Watts and Bohle (1993) draw on three theoretical bases (entitlement, political economy and empowerment), to form a tripartite structure, in

which each side of the triangle is represented by one of the theoretical 'legs'. As they perceive it, vulnerability is a cumulative process of long-term transformations and short-term events triggered by economic, political, social and cultural processes, possibly deteriorating as a result of unstable ecological conditions, which, taken together, have a negative impact on the well being or security of a population.

Bohle (1993) breaks this down further into two main types of vulnerability. First is vulnerability to short-term "conjectural crisis" in which the declining command over food, one's own labour and monetary income is due to sudden entitlements failure. An example of this -would be declining production-based entitlements due to price increases (see Chapter 5 for an example related to this study). A second type of vulnerability is associated with a long-term "structural crisis", involving the underlying socio-economic and political structures and relations that catalyze "conjectural" crises (eg. unequal socio-economic structures, unjust access to resources and means of production, systems of surplus appropriation and exploitation, and other conflicts influencing social relations between gender, groups and classes). The work of Watts and Bohle is theoretically sound, however the use of a triangle to illustrate their ideas falls somewhat short. A second way of visualizing the formation of vulnerability, and that is closely related to the work of Watts and Bohle is the 'disaster pressure and release model' developed by Blaikie et al. (1994, 2001).

In the 'disaster pressure and release model' risk is interpreted as being the complex interaction between vulnerability and a hazard. In the model, the term 'hazard' refers to "the combination of extreme natural events which may effect different places

singly or in combination (coastlines, savannas, rain forests, etc.) at different times (season of the year, time of day, over varying return periods, of different duration)" (Blaikie et al. 1994: 21). Vulnerability, they understand as being the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of an extreme event. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or society. Some groups in a society are more prone than others to damage, loss and suffering. Key characteristics of these variations include gender, caste, ethnicity, disability, age or seniority. Vulnerability also has a spatial and temporal element to it. Since it is livelihood and not just life and property that are at issue, the more vulnerable groups are those that find it harder to recover after a disaster. The term livelihood refers to the command individuals; families or households have over a range of resources or entitlements.

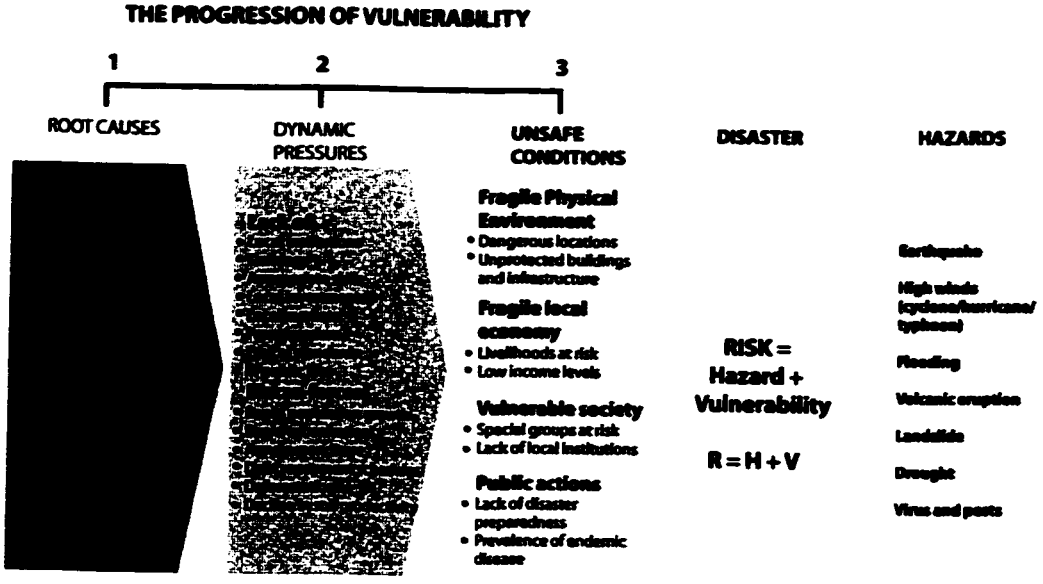

Figure 1.2 Disaster Pressure and Release Model (Blaikie et al., 1994, 2001

In the model, reproduced above, vulnerability is shown as a series of contributing factors rooted in social, economic and political relations. These can be far removed from the place where vulnerability is evidenced in daily life. The model allows us to account for, in an albeit simplistic way, what they authors refer to as root causes which lead to dynamic pressures and result in unsafe conditions (Blaikie et al., 1994, 2001; Wisner, 1998; Cannon, 1997).

The occurrence of a disaster as a discrete event (bounded by time and space) requires us to trace a progression that connects the impacts of a disaster on people through a series of levels of social factors that generate vulnerability. A similar model has been used by Blaikie and Brookfield (1987) and Blaikie (1985a, 1985b, 1989) to account for land degradation in the Sahel. The social conditions the model seeks to account for can be - and often are - quite removed from the disaster and the unsafe conditions it is preceded by, expressed in daily life as a vulnerable society.

The model, while it is somewhat arbitrary, is probably better understood as being a series of scales, rather than a causal progression of "if A is true, followed by B, C will be the result". In other words, the actual links between what they refer to as 'root causes' and which culminate in 'unsafe conditions' may be nothing more than an adjustment of perspective: stepping back to view the larger context of risk. That is the way I wish to employ their model in my own study, that risk must be contextualized not only within the daily life of a community, but often within the regional life a state or province, and indeed within the national political and economic structure. Vulnerability is not evident simply at the village level for example, as a nation, Pakistan is vulnerable to shifts in the global

economy and world markets and shifts in power, as the events of early September, 2001 have shown. The model does however permit an initial accounting of these various conditions which, although far removed from Darkot, have a very basic effect on the community.

The model begins with the identification of root causes, or a snap-shot of the state of the nation. These are identified by the authors as economic, demographic and political processes, that affect the allocation and distribution of resources among a population. They are a function of the economic structure, legal definitions of rights, gender relations and other elements of the ideological order connected with the functioning (or not) of state power and often the military and police. Root causes reflect distribution of power in a society. People who are economically marginal (the homeless, urban poor, minorities) or who live in peripheral or marginal areas (isolated areas, highland regions, arid or semi-arid, coastal or forest ecosystems) tend also to be of marginal importance to those with economic and political power (some regions, such as the Northern Areas of Pakistan, while consistently marginalised are also of great strategic importance to the state). Dynamic pressures, the second step in the progression, are processes and activities that 'translate' root causes into unsafe conditions. Dynamic pressures channel the root causes into particular forms of insecurity that have to be considered in relation to the type of hazards effecting those people. These groups have less secure access to resources as a result of relational or global pressures: population growth, epidemic disease, rapid urbanization, war, foreign debt and structural adjustment, as well as export promotion, mining, hydropower development and deforestation.

The way dynamic pressures channel root causes into unsafe conditions can be seen clearly with relation to endemic diseases, malnutrition and rural-urban migration. People's health and basic nutritional status strongly effect their abilities to survive stresses, shocks or disruption to their system of livelihood. This status is important for their resilience in the face of external shock. A chronically undernourished population or one weakened by disease will succumb more easily in the event of a famine; chronically malnourished people are also more susceptible to disease when their immune systems have been weakened. Age distribution is also an important factor. The elderly and the very young often suffer disproportionately from certain stresses (heat, cold, hunger) when their livelihood systems are disrupted. Gender must also be considered (Bhatt, 1998; Bari, 1998; Jiggins, 1986; Rivers, 1982). Vaughn (1987) for example has used oral evidence in women's songs and stories in Malawi to reveal a much different experience of famine.

> [Women] along with the very old and very young, were more likely than men to end up relying on government handouts... Women stress how frequently they were abandoned by men, how harrowing it was to be left responsible for their suffering and dying children, how they became sterile, and how they were humiliated by the feeding system (Vaughn, 1987: 23).

The activities of daily life comprise a set of points in time and space where physical hazards, social relations and individual choice converge (Hewitt, 1983a; Oliver-Smith, 1986a; Maskrey, 1989; Palm, 1990). Patterns of vulnerability emerge at this convergence, the point at which several socio-economic and personal characteristics of people have a bearing on vulnerability to disaster. Here are found sometimes (but not always) the effects of gender, age physical disability, religion, caste or ethnicity. All of

these may play a role in addition to poverty, class or socio-economic status.

The final stage in the 'pressure and release model' is the creation of unsafe conditions, expressed at the level of the community or household. The term unsafe conditions refers to the specific forms in which the vulnerability of a population is expressed in time and space in conjunction with a hazard. Examples of this include people residing in unsafe locations such as floodplains or steep slopes, the inability to afford safe housing or buildings, lacking the protection of (or being victims of the discriminatory policies of) the state, or being targets of discriminatory state policy, having to engage in dangerous livelihoods, or having minimal food entitlements, or entitlements prone to rapid disruption. This progression of processes and pressures converge here, in the formation of a vulnerable population, with insecure livelihoods, and minimal food entitlements on the one hand, and on the other, a hazard.

One useful example of applying this model of disaster comes from the region of concern in this thesis, the Karakoram Mountains, and the effect of road construction on vulnerability. This example is based on work originally done by D'Souza (1984), Davis (1984) and Coburn, et al. (1984) who looked at the relationship between hazards and settlement patterns in the Karakoram. They suggest that until the late 1960s or early 1970s, the *baipash* was the most predominant type of housing. Walls were made of stone masonry, with timber bands at regular intervals. The roof was a series of interlocking timber beams, covered with packed earth for insulation. These buildings were locally specific, and more importantly, were reasonably well adapted to a seismically active environment (Coburn, et al., 1984). From the late-1960s on, however, there was a

subsequent shift towards the increased use of unreinforced concrete in construction. Walls were not attached properly to the roof and few people had experience working with steel reinforcements. Additionally, most buildings continued to be located on steep slopes because nearly all arable land here is required for agriculture. The result was a highly dangerous situation, precipitated by several (seemingly) unrelated factors.

The complex interaction referred to above was the outcome of a shortage of traditional building materials, which promoted the use of concrete in construction. There was reduced concern about building safety which took less precedence to other issues affecting risks of a chronic, daily nature and finally, new buildings were not constructed using aseismic (earthquake proofed) building techniques.

The shortage of materials and skills was related to several 'dynamic pressures'. Population growth had contributed to the loss of forest cover. Slope materials are already unstable (glacial till, moraine, alluvial soil) and road construction had encouraged the legal and illegal harvesting of wood. Carpenters and other skilled tradespeople traveled south on the KKH to Gilgit, Lahore, Islamabad and Karachi, or to the Gulf States to work. This out migration of labour was encouraged by the government of Pakistan: workers remitted foreign currency to family at home, which in turn could be used to reduce balance of payments deficits.

The road meanwhile, was used to import concrete, which was considered 'modern' and more appealing (Coburn et al., 1984). The construction of the road was linked to the war with India, a military alliance with China and increased political control in the Northern Areas. The progression from global scale root causes to dynamic pressures to

unsafe conditions, while at times tenuous, is probable. When a moderate earthquake struck the mountains of Indus Kohistan in December 1974, the losses were inordinately large (Hewitt, 1976). Thousands of people were killed many times that injured.

1.3.4 Vulnerability: in Closing

The vulnerability perspective is based on the theory that under development is not a temporary state or condition, but rather an ongoing and deliberate process of marginalization and impoverishment, perpetuated by technological dependency and unequal trading arrangements between rich and poor nations (Susman, et al., 1983; Blaikie, et al., 1994). Within 'developing' countries it leads to the process of marginalization shown in the figure below. Disaster simply reinforces the gap between rich and poor, and even during 'normal' times the poorest sections of society are pressured to over-use resources and land, and, when the inevitable occurs, conventional responses serve to accelerate under development and marginalization (Smith, 1997: 50).

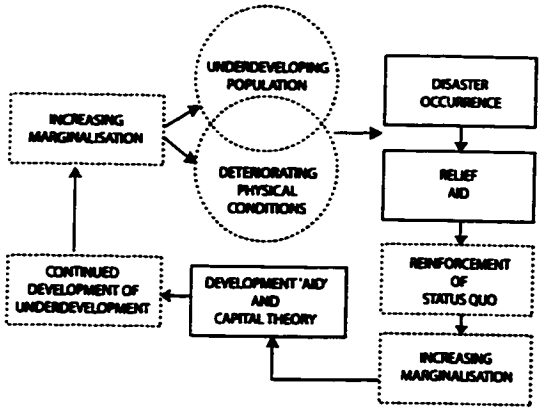

Fig 1.3 Marginalization Cycle (after Smith 1997: 50)

The vulnerability perspective of hazards challenges the prevailing view on several fronts, and is itself distinguished by the following. First, that natural hazards, or as some

have advocated unnatural hazards, are not primarily dependent on, nor are they adequately explained by, physical processes alone (Hewitt, 1983:24). Disaster - the realization of a hazard - is not explained solely by environmental conditions. Blaikie, et al. (1994) argue that, particularly in 'developing' countries, increasing poverty has created the conditions amenable to the creation of a large rural and urban proletariat. For example, the rural poor: displaced from their land in huge numbers, and left with little alternative but to work as landless laborers cultivating cash crops, and landless laborers who flock to the city in search of employment. Often they end up in the shanty towns, often in exposed and unsafe locations; ravines, hillsides, floodplains or the chars (shifting islands of silt in the Bay of Bengal). As Smith (1998) points out, "the severity of disaster impact is related more to human exploitation than to the stresses imposed by nature" (48).

Secondly, this approach to hazards also questions the assumption that disasters are such unusual phenomena in the contexts in which they occur. The natural processes that create floods, severe storms, or drought are physical characteristics that reflect the environmental characteristics of an area much more accurately than, for example, urbanization. The re-/occurrence of disaster is related to human (social, economic, political) processes that create and/or maintain inequality. Vulnerability is correlated to the range of resources commanded (Sen, 1981). As Oliver-Smith 1986, 1991, 1999) has demonstrated, the avalanche that killed 4,300 persons in the town of Yungay, Peru, was a disaster 500-years in the making. It began, he argues, with the Spanish colonial conquest, that expropriated indigenous lands forcing those people to live in marginal conditions. Thirdly, in both the behavioral and geophysical views, human activity is regarded as

irrational or inadequate, particularly in the "Third World" [sic]. "Individuals did not seem to have complete understanding of the environment in which they were settling or functioning", writes Mitchell (1979: 204). As a result, members of 'folk' societies appeared to engage in activities that were essentially debilitating - totally unawares. An often cited case was that of Himalayan deforestation, which supposedly led to increased run-off, erosion, landslips and downstream flooding (Karan and Iijima, 1985; Ives and Messerli, 1989).

On this point the structuralist/vulnerability school asserts that people are not to blame for their own misfortune. It is not that they engage in irrational, hazard inducing behavior; or that they lack 'perception'; rather these individuals have little choice but to occupy unsafe locations. The emphasis is not on information that hinders perception, but on social constraints - be they poverty, gender, or disability - that leave no alternative but to settle in unsafe locations. Susman, et al. (1983) cite the example of the 4 February, 1976 earthquake in Guatemala, in which:

> Some 1,000 people died and 90,000 were made homeless in Guatemala City, almost exclusively in the slum areas of the city... Most of the poorest housing... is in the ravines or gorges which are highly susceptible to landslides whenever earth movements occur (Latin America, 9 April 1976, cf. Susman, et al. 1983: 275).

Wisner (2001) writes that even more pronounced conditions were partially responsible for losses in the recent earthquake in El Salvador. Furthermore, capitalism (and more recently 'neo-liberalism' and 'globalization') have created gross imbalances, and the conditions which lead to rural overpopulation and continued growth in already vulnerable cities (Lima, Mexico City, Guatemala City, Dhaka).

Fourthly, given that disasters are characteristic rather than 'accidental' features of a place, mitigation is understood to be predicated on widespread social change. Proponents however reject the 'modernization' theory the behavioralists ascribed to, (i.e. that industrial societies have typical patterns of loss from, and protection against, nature's extremes, while 'folk' (agrarian) societies have others). It is assumed that 'progress' and 'modernization' were laudable and present, and that eventually 'folk' societies would become industrial and that all would enjoy the benefits of relatively secure 'post-industrial' life (Blaikie, et al., 1994: 12). Prevailing autocratic forms of 'development' are also criticized. Maskrey (1989) showed that Peru has in fact become more vulnerable to hazards as the population shifted from mountain communities to large, earthquake prone cities such as Lima, where the poor live in unsafe conditions.

Finally, the vulnerability paradigm makes clear that in order for disaster reduction and development to be effective, any solutions must be from the "bottom-up", or at least informed by it (see RADIX, February 2001). Local knowledge and community involvement must take a precedent over imported technology. Seed banks, crop insurance, and credit for tools and assets lost in a disaster are far more valuable in the long-term than expensive embankments, warning systems or retaining dams. Measures such as these would help to stabilize the rural base and help to slow out migration to unsafe rural areas, while conversely, technical aid increases vulnerability by creating dependency (Smith, 1998: 50).

Hewitt (1983a) sums up the main tenets of this approach when he writes that "natural hazards are not explained, nor uniquely dependent on the physical processes that

may initiate damage" (Hewitt, 1983a, 24). The emphasis here turns instead on the social construction of vulnerability, and on its differential distribution throughout the world, the key argument being that of O'Keefe, et al. (1976) who demonstrated that the losses from disaster were rising - especially in less developed countries - and that such a rise could not be adequately accounted for by a change in earth surface, or sub-surface processes, or population growth. There is still no evidence, with the possible exception of climate change, that the earth was becoming more malevolent: only that certain segments of society were becoming more vulnerable.

Second, hazards were shown to depend upon concerns, pressures, goals, risks and, above all, "orchestrated social changes that are tangential to, if not wholly indifferent to the particular society-environment relations where a disaster has occurred" (Hewitt, 1983a: 25).

Third is the extent to which disasters are not explained by conditions peculiar to a calamitous event but rather to the ongoing social order and the marginalization inherent in everyday life. As Bolin and Stanford (1998), working with victims of the Northridge Earthquake, and Gillis Peacock, et al. (1997) with those of Hurricane Andrew, have demonstrated, it is the poor, and often women and ethnic minorities who were already marginalised, that felt the brunt of those particular disasters. This explains why the poor of Guatemala refer to the capital's 1976 earthquake as a "classquake" (Susman, et al., 1983).

With this in mind, I now wish to outline the methodological approach that I used in the field, and in the course of writing.

1.4 Methodology

Hazards have often been interpreted in an ecological framework, which distinguishes between natural events and their interpretation as natural hazards (or resources). Nature, it is argued, presents humankind with a set of opportunities and risks which vary greatly in their spatial distribution. Opportunities include the many different ways in which people utilize nature for their production (raw materials, energy sources) and to service their livelihoods (absorbing or recycling waste products). The risks inherent in nature consist of a wide range of hazards that put constraints on production (e.g. frosts affecting agriculture) and on other aspects of livelihoods and safety (avalanches, earthquakes, floods, etc.) (Cannon, 1994).

Conventional analysis of the relationship between humankind and the environment has tended to emphasize nature as a set of determinants, without adequately integrating nature with social and economic systems. Cannon (1994) suggests instead that the environment is itself a social construction. Opportunities and risks are fashioned by varying characteristics of different types of social systems, and the differing demands each society puts on nature, combined with the varying impacts that nature may have on varying types of social system. This means that there are no really generalized affordances and effectivities in nature, but instead there are sets of unequal access to opportunities and unequal exposures to risks which are a consequence of the socio-economic system.

Much conventional analysis of disasters considers a direction of causality that proceeds from the hazard through spatial variability to the impact on society. The

argument of this thesis is that explanation of disaster causality is only possible by understanding the ways in which social systems themselves generate unequal exposure to risk by making some groups of people, some individuals, and some societies more prone to hazards than others. In other words, disasters are not 'natural' (not even sudden ones) because hazards affect people differently within societies, and may have very different impacts on different societies (e.g. earthquakes of equal energy may cause devastation in one society but not another).

Inequalities in risk (and opportunity) are largely a function of the principal systems of power operating in all societies, which are normally analyzed in terms of class, gender and ethnicity. These is turn may be seen as social structures rooted in (and mutually influencing) the patterns of national and international economic and political systems. In other words, to understand the relationship between humans and nature, it is more important to discern how human systems themselves place people in relation to each other and to the environment that it is to interpret natural systems. How do social and economic systems place people at different levels of risk from environmental extremes?

In recent years, the question of vulnerability has broadened the scope of hazards research. As a concept it has the potential to reorient a field of study with tremendous potential for both theoretical and practical contributions. As a concept however it rests on very little in the way of theory. Instead it is used to refer to any number of different scenarios or cases without ever moving beyond empirical definitions. Vulnerability has instead come to mean a number of different things. Liverman (1989) identifies dozens of

authors using this term and related ones (marginality, resilience, susceptibility, adaptability, fragility). For some authors it is enough to be aware of it and make passing reference to it, while others have been criticized for using it indiscriminately, to the extent that environmental conditions have been overlooked in the quest to identify implicating socially produced conditions (Brookfield, 1999). As a concept, vulnerability does not rest on well developed theory, nor is it associated with any widely accepted indicators or methods of measurement. In part, this can be explained by the fact that epistemologically it is incommensurate with 'measurement'.

In order to understand 'hazards' then it becomes necessary to evaluate the ways in which social systems themselves generate unequal exposure by making some groups of individuals, households, and societies, more prone to hazards than others. That is one of the aims of this research.

My own view is based on an ecological interpretation of risks and hazards, in which the context of human existence, and the threats to it, are considered within a broader social and environmental framework. In this view, I understand risk to consist of a hazard, vulnerability, coping mechanisms and intervening conditions of danger. A hazard is defined as a naturally occurring process or event that endangers human activity. A second component of risk is vulnerability, generated largely by social, economic and cultural forces. There also exists among communities and households the ability to adapt to environmental hazards and uncertainty, but certain constraints serve to limit the range of possible adaptations (gender, surplus of labor, cash). Furthermore, these mechanisms of adaptability, and the vulnerability of various individuals, and households, change with

the introduction of new techniques, these are what Hewitt (1997) refers to as "intervening conditions of danger". The communities of the Karakoram are in the midst of transition. Traditional agriculture and the barter and subsistence based economies that were typical of many villages, are changing. Population growth and migration place increasing demand on already scarce resources. In some valleys, deforestation has left the slopes bare and unstable. The tendency towards cash crops, and the reliance on imported foodstuffs, once again, qualitatively change the nature of risk in the community.

Finally, we must acknowledge human adjustments and coping (cf. Hewitt, 1997). Human beings are remarkably resilient and creative. The agricultural system in Darkot for instance is very flexible, and has developed in part in order to exploit the dynamic environment in which the community is located. The practice of transhumance, having a variety of crops under cultivation, and leaving fallow a strip of land parallel to known debris flow channels all serve to minimize risk.

To account for the range of factors that contribute to risk in Darkot it is necessary then to situate further discussion within the context of the physical environment. Where is the community located? What are the geophysical processes evident in the area and how do they contribute to risk? It is necessary also to situate the discussion within a human ecological framework. Settlement patterns within the community, the nature of agricultural production, the role of gender in risk, and increasing 'development' all change, in a fundamental way, the ways in which a community and individuals are able to respond to environmental hazards. Chapter 4 then addresses the next factor of risk, hazards themselves. What are the hazards that the community has had to, has to, and

might possibly need to face? What is their distribution through the community? And finally, the community's range of adjustments: how do vulnerability, adaptability, and coping with hazards interact with one another? What I am hoping to do, is to account for the range of factors that contribute to or affect risk and vulnerability within the community of Darkot.

1.4.1 Methods

The data on which this thesis is based came from several sources including analysis of the literature on the Karakoram, both historical documents and current scientific and social-sciences research, interviews as conversation, participant observation, the acquisition of a photographic record and scientific measurements. The major part of the data was collected over the course of a six-week field season (June-July, 2000). Because this research is part of a broader research program under the supervision of Drs. Kenneth and Farida Hewitt studying risks and hazards in several different communities in the Karakoram, Darkot was selected in order to investigate context, hazards and cultural features of a 'typical' Karakoram communities. Other studies examined risk in Nomal, in the Naltar Valley (Flanagan, 2000) and Askole (Flanagan, 2001).

The examination of documents was done in the months preceding and following the field season, and was limited to published articles on the Karakoram, many of which were discussed in the preceding literature review. There are some published accounts of travellers visiting the area in the 19th and early 20th centuries, as the British sought to secure the high mountain frontier from a possible Russian invasion (Hayward, 1870;

Drew, 1873, 1875). References to Darkot are also available from some of the later explorers including passages in the works of Wilfred Thesiger (1968) and Aurel Stein (1998). These published accounts enabled me to corroborate data that was collected during the field season, as well as provide insight into changes in environmental conditions.

The initial weeks of my field season were occupied largely with finding my way around the community and introducing myself and the work I was doing to various people. During this time I benefited immensely from the assistance of Inayat Khan, a local school teacher who spoke very good English and acted as an intermediary and translator. With a compass, 50m tape and handheld GPS unit, Inayat and I identified a number of sites throughout the village where hazard events had caused loss and/or damages to homes, fields, animals and property. These sites are discussed in more detail in Chapter 4, but included the identification of 5 historic and active debris-flow channels, 2 avalanche runout zones that directly affect settlement, flood-zones, rockfall sites, and areas of intense soil erosion and are resulting in the ongoing loss of productive land. With a tape, compass and GPS, these sites were identified and precise co-ordinates obtained. In the case of the debris flow channels, data was collected on slope, channel measurements, and the depth and areal extent of debris deposits. The original extent of cultivated land was also determined, as well as measurements made of the amount of land put back into cultivation since the event.

An extensive series of photographs was taken at hazard sites, and were compared with several 'benchmark' photographs from the early 1980s, provided by David Nash of

the University of Bristol, in order to confirm changes in land-use and the amount of land under cultivation. Following my return from the field, these sites were mapped using 1:250,000 base maps digitized in AutoCAD and the map detail produced using Adobe Illustrator and MAPublisher.

The third set of data that I obtained is represented by the informal interviews that were conducted with Inayat's assistance and 'participant observation'. Following the identification and mapping of hazard sites, I attempted to interview the head of those households most directly effected, ie. those whose homes were originally located on the debris flow fan, households with fields located in avalanche runouts, or those families whose lands were at risk from soil erosion. In nearly all instances, the interview was conducted with the male head of the household. This is slightly problematic because the long-term consequences of a hazard event, such as food shortage or increased labour, may very well effect women more directly than men. Women's work and place in this society are discussed in more detail in Chapter 3, and here I should just note that in Islamic society, opportunities to discuss with women their lives, living conditions, work, roles, and concerns are, for male researchers, limited and my experience was no different. At most of the interviews I conducted women, most often younger, unmarried women and children, were present, but I did not feel free to address specific questions to them. Two interviews were conducted at which I was able to address questions to women, who were the sisters of my interpreter and guide.

The interviews were all loosely structured around a conversational approach to data collection. They were often conducted outside the home in an informal group setting

with several or more men contributing their experiences and thoughts to the questions asked. Questions were asked about the significance of 'risks' in the community and for them personally, how they managed risk and what (if any) were the consequences of hazard events on their lives and on their household. These conversations were recorded in a notebook during the interview and questions arose in the normal course of discussion. Fifteen interviews were conducted in this manner over the course of the field season. Not all households that were effected by the hazards in question were interviewed however. A large number of households had left the area following the loss of their land, some relocated further up the valley while others moved to neighboring Ishkoman. Similarly, members of many households spend the summer months in fields located away from the village proper. Where possible, Inayat and I travelled to these fields and met with men there, or interviews were conducted when they returned to Darkot to irrigate those cropped lands near their homes.

A second set of interviews were conducted in conjunction with the first and were of an even more informal nature. For these, there was no 'formal' selection procedure, interviewees would be found working in their fields, walking along the road, and at or in the summer pastures located in tributary valleys. Questions during these interviews were focused more on the practices, techniques, and organization of daily life. Cropping patterns, harvests, type and number of animals kept by the household, household size, and resource use for example. A second focus of this data gathering was the importance of monetary income to the household, the household's labour strategy and their views about the construction of two major roads through and from Darkot, the money for which was

provided by the national government. This information was used to better establish the context for interpreting risk in the community, establishing a basis for further study as well as 'filling in' some of the contextual material required for the study. An additional nine interviews were conducted in this way.

Prior to all of the interviews and 'research' oriented conversations that I had, Inayat (who was well known in the community) would introduce me and I would outline the purposes of my research and my interest in the activities, social organization, and hazards in and around the community. I also informed people that a copy of the completed research would be available from Nusrat Ali Khan, at the local dispensary, when it was completed, along with any photographs that I had taken on their behalf.

While all of these interviews were conducted on what could be termed an 'informal' basis, they were guided by my interest in 5 areas of life in Darkot and ultimately the relationship of each to risk and vulnerability. At the beginning of the field season, soon after my arrival in Darkot I wrote down a list of questions that could serve to guide the conversation and in some cases, jog my memory. The areas of interest and the related questions were:

Agriculture:

- What is planted? Where and when?
- When are crops harvested?
- Summer pastures: where are they located? Who uses them and for what purpose(s)?
- What are the problems facing agriculture in the community? Upper Yasin Valley?
- Has there ever been a shortage of food?
- Is there always enough water for irrigating crops? and what happens when there is not?
- Are summer pastures a form of minimizing risk?

- Does each 'community' within the village have its own pastures? How is access controlled?

Development:

- What do you think about the money being spent on jeep roads?
- Do you think these roads are necessary or good for the community?
- Would you have preferred to see the money (25 *lakh* rupees, appx. $Cdn 1000) spent in a different way?
- What sort of changes (social, economic) have gone on in Darkot in the last 30-40 years?
- What would you like to see happen?
- What do you think the future holds for the community?
- Do you own this land? How many *kinar* do you farm?
- Can this land be bought/sold/passed on to children?
- Do you have any source of income? or is your livelihood based solely on what you grow and your animals?
- Are you more or less dependent on cash income than 30 years ago?
- How many different crops do you grow?
- What are they used for?
- Where do you get the seed?
- How much of a say do you have in village affairs?
- Are you becoming more or less vulnerable to:
  - -fluctuations in the environment?
  - -changes in the village?
  - -the market/cash based economy?
  - -changes in agricultural production?

Social/Cultural/Historical:

- To which tribe do you belong?
- How long have you lived in this community?
- Why did you settle in this area? Did you have a choice?

Physical Setting:

- Has there been more/less rain/snow in the last few years?
- Has there been any change in the course of the river(s) and streams?
- Have there been any changes in the glaciers?
- What physical changes have gone on here as a result of human occupation and activities?

Risks and Hazards:

- What are the biggest problems you/your household must deal with?

- How do you deal with them?
- What are the most serious threats to your livelihood? to your (agricultural) land?
- Have there been any changes in the frequency, severity, distribution and or duration of extreme natural events in the last decade? two decades? earlier?
- How do these events effect you/your household? crops?
- Have you received any outside assistance to deal with the problem? (AKRSP?)
- What is the solution to this problem? Is there one?

Some additional data was provided by the local health officer, including a recent census count and data on disease patterns and incidence. No clear patterns emerged from this data, save the prevalence of infections among the very young and among the nomadic Gujar people who summer in the valleys above Darkot, but it did allow me to establish a fairly good picture of the health concerns in the community, and the risks associated with it.

1.5 Summary

As this chapter has sought to demonstrate, vulnerability is but one component of 'risk'. In the remaining chapters of this work I seek to demonstrate that risk is in fact composed of several interrelated, and interlocking processes.

Chapters 2-4 are contextual chapters, which further establish the framework within which risk can be understood. As Butz (2001, personal communication) has said, "vulnerability exists in the intersection and mutual-imbrication of natural processes, landscape characteristics and social circumstances at the local level, but contextualised by events and 'actors' (George, 1976) at the larger scale". It is to the context of risks and vulnerability that I turn my attention next, in particular, the landscape characteristics and features of the Karakoram. In this setting, a study of risk must be firmly rooted in both the environmental precursors of a hazard event and ongoing natural conditions, as well as

the social, economic and political landscape that can serve to either shelter people from environmental hazards, or make them increasingly vulnerable to their consequences.

Finally, if the root causes of calamity are understood to be socially constructed, several positive steps towards the averting future disaster can be made. First, it opens the discussion of disaster to those people most affected by it. When the discussion about risk and disaster is segregated into the sphere of the technocrat, arbitrary decisions are made and often implemented at great expense without once consulting the people who are supposed to be benefiting from such mitigation. Alternatively, if the causes of disaster are situated within the social and economic realm, solutions become immediately more 'knowable'. As long as disaster is regarded as being 'out there' in the environment, it remains a largely unpredictable and expensively-controlled phenomenon. I agree with Hewitt (1983a) when he suggests that:

> (a) most natural disasters, or damages in them, are characteristic rather than accidental features of the places and societies where they occur;
>
> (b) the risks, pressures, uncertainties that bear upon awareness of and preparedness for natural fluctuations flow mainly from what is called 'ordinary life', rather than from the rareness and scale of those fluctuations; and that
>
> (c) the natural extremes involved are, in a human ecological sense, more expected and knowable than many of the contemporary social developments that pervade everyday life (25).

Chapter Two - Physical Geography of the Karakoram

2.1 Introduction: the Context of Risk (I)

In order to understand risk and the role of vulnerability within the community of Darkot, it is necessary to first situate this discussion within the broader ecological context of environmental conditions and human activity in the region. Chapter 1 established a conceptual framework for this study. 'Risk' was defined as consisting of the overlap between several distinct but interrelated phenomena. These were: (i) a hazard (environmental, technological, biological, social), (ii) intervening conditions of danger (soil type, topography, housing type, land-use), (iii) vulnerability, and (iv) coping or adaptation mechanisms which converge and mutually reinforce one another to create or minimize the totality of risk in a given place (Hewitt, 1997). The purpose of this chapter is to establish the environmental context of risk and vulnerability. Environmental conditions are 'separable' from vulnerability only when we insist that natural processes are but one ingredient of risk. Socio-economic conditions alter people's vulnerability - as I will demonstrate in later chapters - often independently of environmental conditions. How then do particular landscape features and environmental conditions in the Karakoram Mountains and the Yasin Valley, relate to risks and hazards? What are those elements of risk that originate in the physical environment? And what are characteristic features of this environment as they relate to risk? What aspects of the physical environment reflect risks - real and potential - and is there a history of extreme events from which we can infer that such natural, hazardous processes are indicative of daily life?

The emphasis when discussing these conditions will be to demonstrate that natural disasters, or the damages associated with them, are characteristic rather than accidental features of the Karakoram area (Hewitt, 1983). Mass-wasting processes and other, high-

frequency, low-magnitude processes (soil erosion, siltation of irrigation canals, water shortage), what Groetzbach (1988) refers to as *alpine elemental events*, are normal environmental features of this region. From the early 19th century onwards, the Karakoram has been portrayed by Western visitors as a region characterized by seismic activity, erosion, sedimentation, uplift, and glaciation; an area of intense geomorphic activity and processes that regularly endanger human activity (Drew, 1873, 1875; Henderson, 1859; Knight, 1895; Mason, 1929, 1935). In doing so it is important to note that formal 'modern' knowledge of this region is largely a product of exploration, discovery and on-going research. The earliest descriptions in Western literature of the area are those of 18th and 19th century explorers and adventurers: Hayward, Younghusband, Drew. While many of these early visitors were concerned with the location of strategic passes and colourful descriptions of local inhabitants, they do offer a glimpse of historical environmental conditions, and provide a useful benchmark with which we can evaluate contemporary conditions (Drew, 1875; Hayward, 1870; Mason, 1929, 1935; Stein, 1968). Research on glacial activity over the last century, for example, has benefited from the detailed maps and photographs from the late-1800s (Hewitt, 1989).

More recent Karakoram research was stimulated in the early 1980s by a more relaxed political climate and two multi-year projects: the International Karakoram Project and the Snow and Ice Hydrology Project. Additional work since then has broadened our understanding of physical processes at work in the Karakoram and the region's Quaternary history. The material on environmental conditions in the Karakoram includes work on geology and geomorphology (Hewitt, 1968; Brunsden and Jones, 1984; Derbyshire, et al., 1984; Derbyshire and Owen, 1990; Shroeder et al., 1993; Goudie et al., 1984; Owen, 1989; Searle, 1991), hydrological characteristics of major tributaries

(Ferguson, 1984; SIHP, 1985), altitudinal arrangement of geomorphological processes (Hewitt, 1993), and descriptions of current and past glaciation (Holmes, 1993; Shroeder et al., 1993).

I begin this chapter with a brief introduction to the physical geography of the Karakoram. In doing so it is important to note that formal 'modern' knowledge of this region is largely a product of exploration, discovery and on-going research. The earliest descriptions in Western literature of the area are those of 18th and 19th century explorers and adventurers: Hayward, Younghusband, Drew. While many of these early visitors were concerned with the location of strategic passes and colourful descriptions of local inhabitants, they do offer a glimpse of historical environmental conditions, and provide a useful benchmark with which we can evaluate contemporary conditions (Drew, 1875; Hayward, 1870; Mason, 1929, 1935; Stein, 1968). Research on glacial activity over the last century, for example, has benefited from the detailed maps and photographs from the late-1800s (Hewitt, 1989).

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(Ferguson, 1984; SIHP, 1985), altitudinal arrangement of geomorphological processes (Hewitt, 1993), and descriptions of current and past glaciation (Holmes, 1993; Shroeder et al., 1993).

The second section of the chapter focuses on environmental conditions in the Yasin valley and the area near Darkot. Because there is very little research on the Yasin, I have had to draw upon, and make frequent reference to, the literature on the physical geography of the Karakoram. From this broader literature we can infer and describe some of local hydrological, geomorphological, geological, and climatic characteristics of the Yasin Valley. I have supplemented this material with my own observations, and with what little work that has been done there (Huzita, 1965; Hughes, 1984; Matsushita, 1965; Moughtin, 1984; Searle, 1991).

2.2 Geography of the Karakoram

The Karakoram Mountains are among the highest and most geomorphologically dynamic regions in the world. There are five peaks here >8000m and more than 36 >7000m (Shroeder, 1993). They are located at the western end of the Trans-Himalayan mountain belt, bordering the northwestern margin of the Himalayas and connecting the Hindu Kush and Pamir mountains. Tectonically, the Karakoram represent the intercontinental collision of the Indian and Asian plates (Gansser, 1964; Le Fort, 1975). This accounts for why much of the region is seismically active (Coburn, et al., 1984; Hewitt, 1976, 1984) as well as for its being one of the more rapidly rising mountain belts in the world (Zeitler, 1985; Mehta, 1980; Ferguson, 1984).

Denudation is intense and involves a number of processes. These include frost shattering (Hewitt, 1968; Goudie et al., 1984), chemical weathering by salts involving crystal growth (Goudie et al., 1984), granular disintegration (Goudie et al., 1984), glacial erosion (Goudie et al., 1984; Li Jijun et al., 1984) and mass movement processes (Brunsden and Jones, 1984; Brunsden et al., 1984). The Karakoram have also undergone three periods of extensive valley glaciation during the Quarternary (Derbyshire et al., 1984), resulting in intensive erosion and extensive till deposits. The region, then, is a product of the combined influences of intense tectonic activity, extremely high rates of erosion and sedimentation, and massive glaciation.

The larger part of the Karakoram lies in the Upper Indus Basin where huge rivers drain a vast area of mountains and valleys. Relative relief in these deep main river valleys often exceeds 4000m and they are characterized by steep and unstable slopes. This is due to the combined influences of high uplift rates and intense denudation. Relief in tributary valleys often exceeds 2000m from sharp ridges to streambeds. Smaller melt water streams deposit material slowly and continuously especially following spring snowmelt or summer rainstorms. Agriculturally, these smaller deposits of sediment are among the most important geomorphic features of the Karakoram. They combine relatively flat terrain with arable and terraceable soil, and an accessible water supply. Most settlements are located on these fans or ancient terraces (Kreutzmann, 1994).

Contemporary glaciers cover some 16,000 km^2 of the Karakoram and include some the largest outside polar regions. However they are the remnant of the last of three main periods of glacial advance which scoured the region in the past. Main valleys are filled with large post-glacial deposits, in places as much as 700m deep. Perennial snow and ice covers much of the area above 3500m; mountain ridges are snowbound for most or all of the year, and the higher valleys contain the largest amounts of snow and ice in

the subtropics including several thousand individual glaciers, though it is dominated by some 20-30 ice masses of a large size (Hewitt, 1997). Despite the extreme continental location, heavy snowfall at high altitudes and steep slopes lead to vigorous ice streams.

Glaciers account for many of the losses attributable to natural hazards in the last 200-years. Surging glaciers result in increased erosion, sudden, local floods, and prevent movement to traditional hunting areas, firewood sources or pastures (Hewitt, 1997). There have been at least 35 glacier dammed lakes since the 19th century, affecting downstream communities as far away as the Indus plains (Hewitt, 1989b).

The entire region is characterized by high-frequency, low-magnitude events such as soil erosion and sedimentation, that contribute to environmental risk in this inhabited environment. Recent glaciation has left huge sedimentary deposits which are easily entrained, and the overall landscape is one of constant transition, formation, and deformation. Combinations of intense precipitation, seismic activity, and steep slopes are contributing factors in the prevalence of mass-wasting events including landslides (which can dam rivers and result in catastrophic flooding when they are breached), debris flows, and avalanches (Brunsden and Jones, 1984; Goudie, 1981; Miller, 1984; Shroeder, 1993; Bohle and Pilardeux, 1997; Said, 1997; Hewitt, 1997; Iturrizaga, 1997).

The Indus River is possibly the country's single most important natural resource, providing much of its irrigation water and generating almost all of its electricity. The river and tributaries of the Indus Basin provide water for over 100 million people living in the dry, sub-tropical lowlands of Pakistan. Much of the water is derived from snow- and glacial-melt (above 2500m), although for the eastern tributaries of the Indus monsoon rains are the predominant source of moisture. Flood flows are common between July and late September when flow volume increases beyond the drainage capacity (Beg, 1993). The bulk of Karakoram runoff is derived from glacier ablation. The seasonal cycle of

snow and ice melt depends primarily on gross solar radiation but weather variations (especially cloud cover or fresh snowfall) may substantially reduce net insolation and river discharge. Marked diurnal runoff cycles are characteristic of Karakoram tributaries: afternoon or evening peaks are understood as the day's melt water from the ablation zone. Flow does not cease at night, instead there is a seasonally varying background contribution which could arise either from the greater delay experienced by melt water conveyed subglacially from distant parts of the glacier or from delays due to storage in firn, crevasses, or at the glacier bed away from conduits (Ferguson et al., 1984; SIHP, 1985).

Figure 2.1 The Indus River at Passu.

Melt water - from smaller permanent ice-fields and melting snow - is the main source of moisture for crops planted in the arid and semi-arid valleys of the Karakoram (Butz, 1987). Rivers are often too turbulent to safely draw water from. Water is delivered through extensive networks of kin/community controlled irrigation channels.

This extensive use of, and dependence on, melt-water creates systemic vulnerability in some villages. For instance, ongoing sedimentation of irrigation channels decreases water flow, and sometimes threatens crops (Butz, 1987). Irrigation channels are also vulnerable to damages/destruction from debris-flows and landslides. In any event, reconstruction or clearing out of channels is an immediate priority for communities because they need to ensure the survival of crops (Butz, 1987; Kreutzmann, 2000; Stoeber, 2000).

Climatic conditions vary considerably throughout the Karakoram according to altitude, aspect and vegetation cover. Generally the region has been characterized as possessing a "dry continental Mediterranean climate", with several additional characteristics. Whiteman (1981: 6-7) describes these as:

a.) continentality accentuated by 'mountain mass' effect. Temperatures tend to be higher because there is little vegetation cover at lower levels, and so solar radiation is absorbed and converted into long wave radiation.

b.) being in a pronounced in a rain shadow, and receiving the diminished effects of the summer monsoon and westerly depressions. When rains do penetrate, they are intense and can cause considerable damage through debris-flows and mudslides (Bohle and Pilardeux, 1992; Hewitt, 1988, 1992).

c.) having a strong gradient of rainfall with altitude. Most valley floors receive between 100-200mm of annual precipitation, while adjacent ridges >1000m will receive twice this amount. Even greater amounts of precipitation occur above 6000m, and at least 2000mm must fall to ensure the formation of glacial ice.

At the micro-level, climate places a considerable constraint on agricultural activity. Radiation is important because it influences photosynthetic potential and has an effect on temperature, evaporation, and water balance. The importance of melt water in this arid

environment soon becomes clear.

Vegetation is altitudinally controlled (Paffen et al., 1956). Along the valley it is sparse, desert steppe type. At higher levels it is replaced by temperate coniferous trees and then alpine meadow.

2.3 Physical Geography of the Yasin Valley

> *Looking down on a valley pockmarked from centuries of environmental upheavals, the most striking aspect of the Yasin Valley settlements is their vulnerability.*
>
> - R.E. Hughes, 1984:253

The Yasin Valley lies in the Hindu Raj Range and western Karakoram, an area which encompasses all the country along the northwest frontier of Pakistan, south and east of the Afghanistan border and west of the Ishkuman (-Karambar) River. At the northern limit of the valley lies the Darkot Pass, which provides a strategic route to the Wakhan corridor which much of the boundary between the Afghanistan and Pakistan. To the east lies the Ishkoman valley and to the west, Chitral. From the Darkot Pass the valley runs south to Yasin, and then southeast to Gupis. The Yasin River is the main tributary in the valley, and joins the Ghizer River near Gupis. The Ghizer River flows southeast for just over 100km through Gilgit to meet the main Indus River at Jaglot (see *Figure 2.2*).

The habitable length of the valley is just 54 km long. Constricted at the southernmost end, the entrance to the valley just West of Gupis narrows to between 450 and 800m. Here the Yasin River flows quickly through a deep, narrow gorge to join the Ghizer River. Granitic outcrops and steep scree mark the lower section of the valley slopes. The river here tumbles through a series of cataracts which slowly give way to broad flood plains further up. Agriculture in this lower section is restricted to terraces, and small plots of land immediately adjacent to the river.

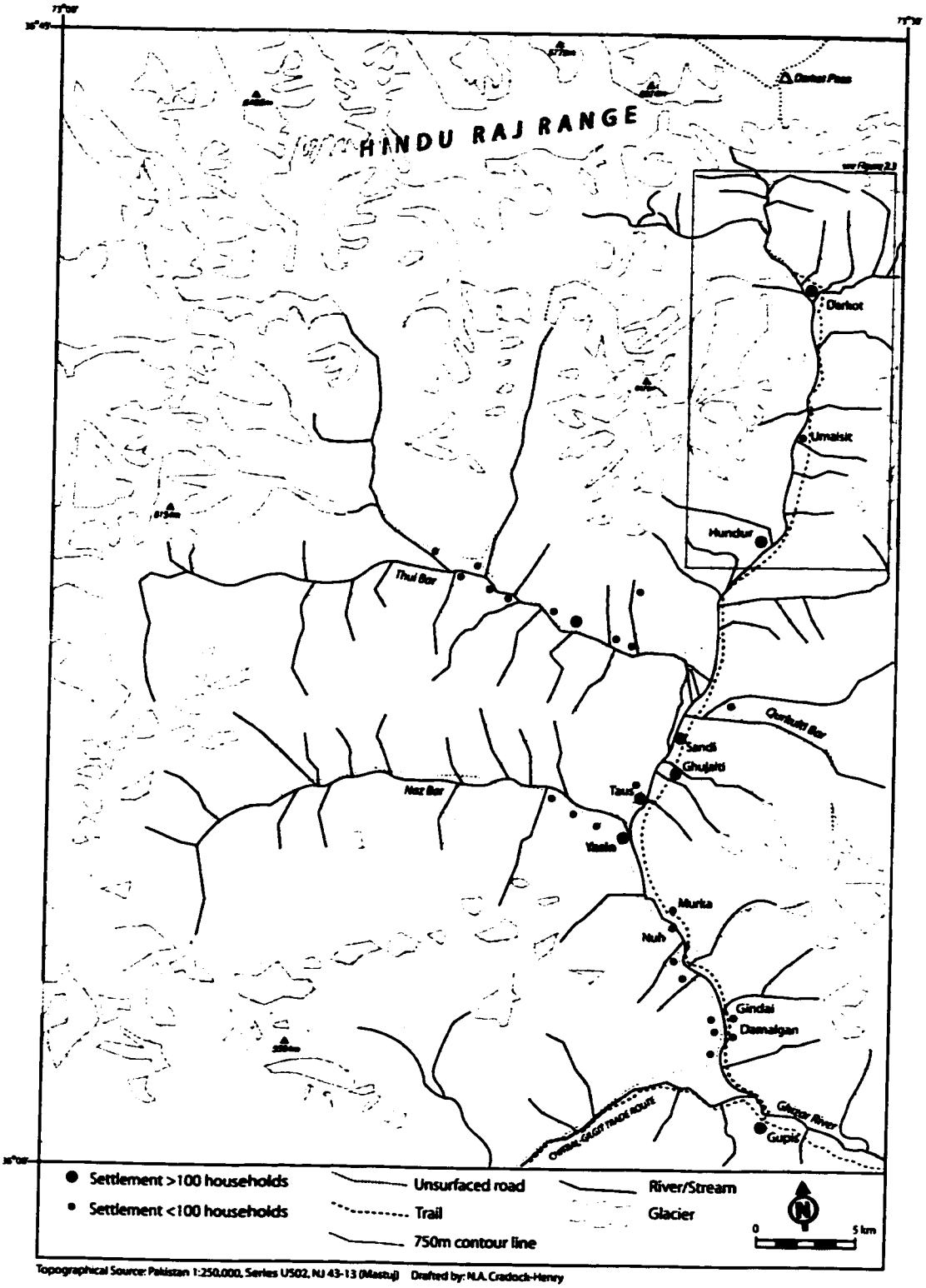


Figure 2.2 Map of the Yasin Valley (N. Cradock-Henry)

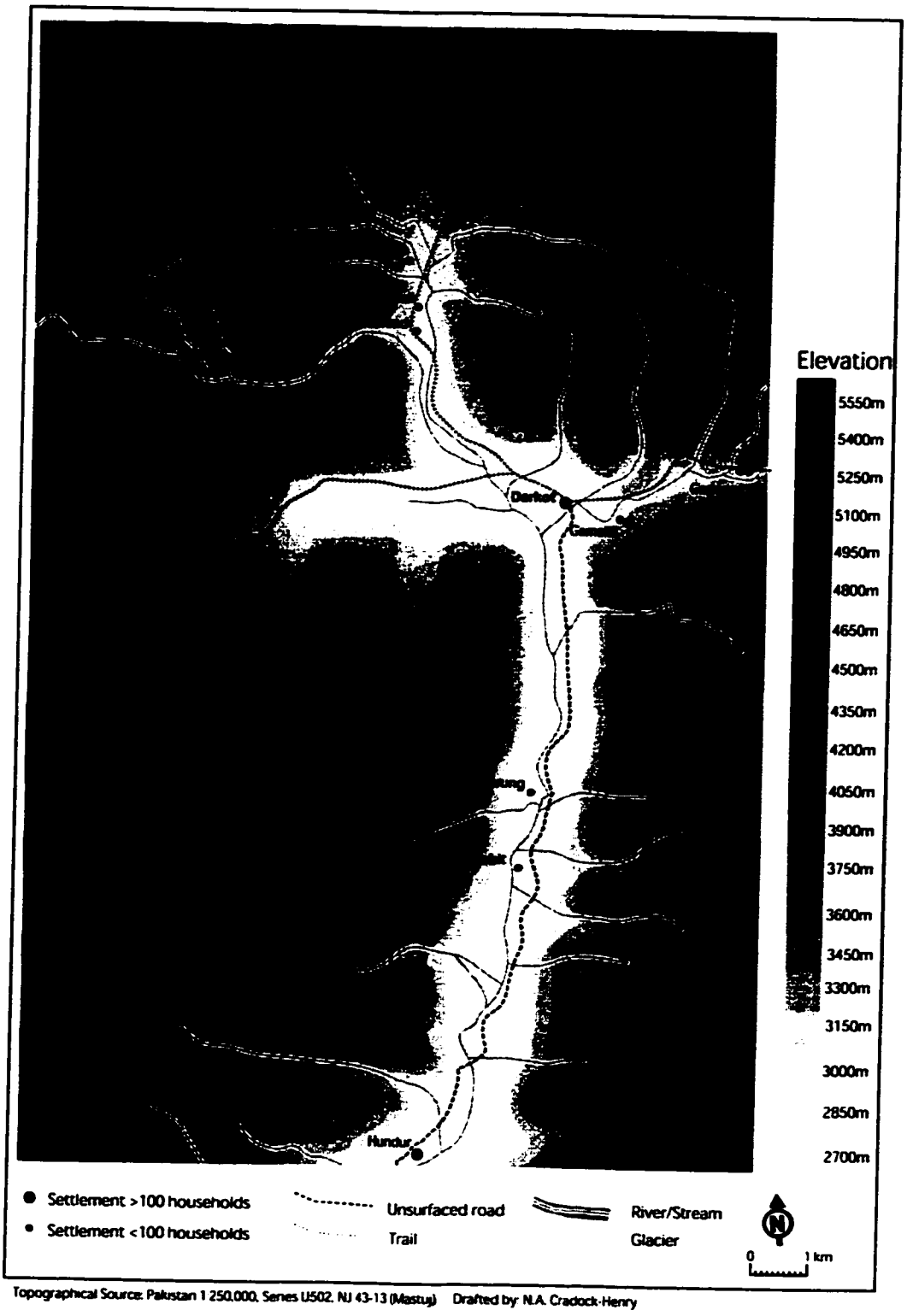


Figure 2.3 Map of the Yasin Valley at Darkot (N.Cradock-Henry)

Yasin village, the largest community in the valley, is located on an extremely rare terrace, the surface of which has been modified extensively to make it suitable for agriculture. Between Yasin village and Barkulti the valley consists of a series of broad floodplains bordered by terraces, and interspersed by with low- and intermediate low-angle outwash fans[1] (Hughes, 1984). These fans are still being formed by the deposition of rocks and soils from tributary streams (*nalas*).

Northwest of Darkot are the glaciers of the Ghamu Bar massif, descending almost to the valley floor. Just beyond the village, are the remnants of a catastrophic rockslide which at one time dammed the upper portion of the Yasin (Darkot) River (Hewitt, 2000, personal communication). Beyond that, the valley steepens quickly as one ascends the 4900m pass (*see Figure 2.3*)

The valley floor at the southern entrance to Yasin is approximately 2164m asl and at the north 2712m asl, a drop of only about 500m over its 54 km length. The average gradient of the river is around 1:100. The river largest drops are through a series of flood plains separated by cataracts, the largest of which are at the villages of Barkulti and Yasin. For the full length of the valley, the valley floor is bounded by steep scree slopes. These slopes often reach the maximum possible angle of repose (37°), above which stand near vertical rock faces, providing a ready and ample source of material. The valley sides rise to spur crests of 4720-4870m asl and immediately behind these, the mountain peaks rise to 5490m asl in the south, and over 6400m asl in the north around Darkot.

While there is - as yet - no hydrological data for the Yasin River, we can infer some the river's characteristics from those shown by other tributaries in the Upper Indus Basin. Most of the water in the Yasin River basin is derived from snow- and glacial-melt

[1] Low-angle fans are designated as 2-8° and intermediate low-angle fans as 9-15° (Hughes, 1984)

(above 2500m). The monsoon rains in the late summer months, make an additional contribution. Flood flows are common between July and late September when - due to precipitation - flow volume increases beyond the drainage capacity (Beg, 1993). In the Yasin Valley, frequent floods have been reported at Barkulti and Umalsit where the river is forced between the debris from an old landslide (D. Nash, 2001, personal communication). Flood waters at Umalsit in late-June, 2000, tore away the only road bridge connecting the upper portion of the valley.

Figure 2.4 The Yasin River at Darkot.

The seasonal cycle of snow and ice melt depends primarily on solar radiation. Hence weather variations (especially cloud cover or fresh snowfall) can substantially reduce net insolation and river discharge. Marked diurnal runoff cycles are characteristic of many Karakoram streams, and the river at Darkot is no exception. Afternoon or evening peaks derive from the day's melt water from the ablation zone during the summer. Flow does not cease at night. There is a seasonally varying contribution which from ground water and, especially, from the delayed melt water conveyed subglacially from distant parts of the glacier or from delays due to storage in firn, crevasses, or at the glacier bed away from conduits (Ferguson et al., 1984; SIHP, 1985).

From daily observations between early-June and August of the Yasin River at Darkot, it is clear that almost all of the water derived from glacial melt. This accounted for the noticeable daily variation in flow rate, which was lowest in the early morning and highest in the late afternoon. I was told that during the winter very little water flows; though the river remains ice free, and has sufficient water in it for human needs. Localised flooding is a problem, and residents of the most affected community - with the help of the AKRSP - have constructed levees to contain the problem. These however are insufficient during periods of peak runoff (see ***Figure 2.4***). Stoeber (2000) suggests that discharge of local rivers and streams is low in relation to the central and eastern parts of the Karakoram, particularly in the southern portion of the Yasin drainage area. The reason for this may be that only a small area in the drainage reaches the highest level of precipitation at 5000m[2].

The flood plains consist mainly of abraded channels - with or without peaty soils, grasses and mosses. The valley terraces may once have had natural tree and shrub

[2] Annual precipitation between 5000m and 7000m has been estimated by Hewitt (1989: 14) to be 1000mm-1800mm; above 4500m Owen and Derbyshire (1989: 34) put annual precipitation at 2000mm.

vegetation, but as with the former barren outwash fans, these have been transformed with considerable effort for agricultural purposes. Willow, poplar and walnut are the predominant species grown on terraces. People I spoke with in Darkot and in Umalsit reported to me that many of the tributary valleys were once tree covered but are now totally denuded because of the demand for timber, which is used in construction, for fuel and fodder. One of the last areas to have natural cover was an area of 150 ha just south of Darkot, which was cleared 20-30 years ago (Hughes, 1984). It consisted of several stands of dense willows. In Gasum, one of the communities that makes up Darkot village, several hectares of willow remain. This grove of trees is frequently scoured for fuel, and recent harvesting has removed the reinforcing properties of the trees from the river bank, resulting in increased rates of erosion.

2.3.1 Geology and Geomorphology

Available geological data on the Yasin Valley is more limited than for other parts of the Karakoram, but work of note on the Western Karakoram includes early exploration by Hayden (1915), the Italian expeditions of Desio (1959, 1963, 1966, 1975), and Casnedi (1979, 1983), and the work of Matsuhita and Huzita (1965). Buchroithner and Gamerith (1978) published a geological map of the Pamir-e Wakhan including a geological survey of the northwestern Karakoram. Additional mapping has been done by Ivanec et al. (1956), Stauffer (1975), Tahirkheli (1979, 1982) and Pudsey et al. (1985) and Pudsey (1986). Searle (1991) provides the most recent and detailed review of the geology of the Western Karakoram.

Figure 2.5 The view looking south down the Yasin Valley from Darkot. This photo was taken 2 years after a large debris flow destroyed a portion of the village. (Photo courtesy of D. Nash)

Hughes (1984) suggests that the geology of the Yasin Valley has not been studied in as much detail because of the valley's remoteness and the difficulty of reaching exposed rock surfaces high up on the valley sides above the great scree slopes. Nonetheless, the geological structure seen along either side of the Yasin valley is relatively clear; the fresh rock surfaces are evidence of currently active physical weathering processes.

The Yasin Valley is considered seismically active (Hughes, 1984). Two major earthquakes have been recorded in the area in the last century - at Qurkulti Bar in 1943, a tributary valley of the Yasin Valley; and in the Darel Valley, 1972, southwest of Gupis (refer to *Figure 2.3*).

The landforms in the Yasin Valley are typical of the Karakoram. The whole of the valley was glaciated, some parts having a typical U-shape and other features such as hanging valleys, polished rock surfaces and moraine deposits. The oldest recognised

glaciation in the main Yasin Valley is estimated to have taken place as recently as 50,000 years ago (Hughes 1984: 260). The valley floor is thick with Holocene sedimentation accumulated behind landslide barriers. Weathering is taking place then on recently glaciated valleys that are also being continuously uplifted.

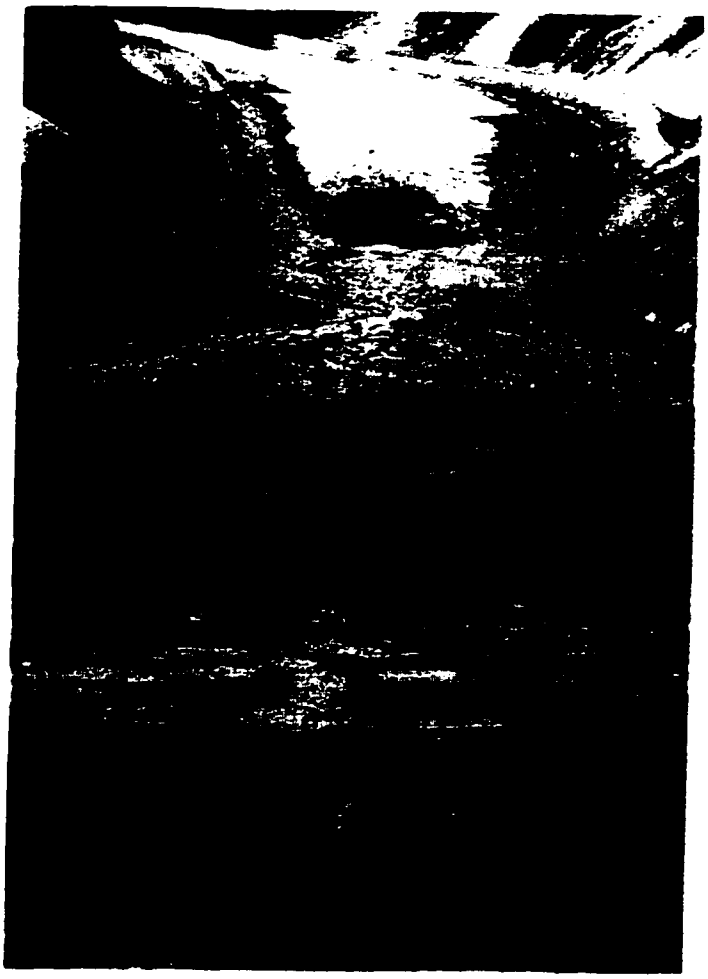


Figure 2.6 The Ghamu Bar Glacier across the valley from Darkot descends almost to the valley floor. (Photo: courtesy of H. Kreutzmann)

As *Figure 2.3* shows the south end of the valley coincides with the present southern limit of active glaciers. Northwards, traveling up the Yasin, the frequency and size of glaciers increases. The established pattern is that glaciers descend most often from larger north facing tributary catchments (these receiving the least amount of solar

radiation throughout the year). In the Yasin Valley, up to the northern watershed most glaciers are north facing. Hughes (1984) reported that the glaciers above Darkot were very active, surging almost to the valley floor an average of every seven years.

The valley floor is bordered by steep slopes, a mixture of rock faces (30-90°) and high angle scree slopes that rest near the natural angle of repose for angular rock debris (37°). The debris results from mechanical weathering; because gravity is the sole means of transportation, screes form below. A much finer material, consisting of sands and silts, works its way between the coarse rock and partially cements the whole mass together. It is estimated that as much as 57% of the valley sides are covered with these scree slopes, with those on the west side being slightly larger (i.e. >500m high) (Hughes, 1984). There is also a noticeable difference in percentage cover for each side of the valley, with the west side being 72% covered with scree slopes compared with 42% for the east side. This noticeable difference is due to the valley's orientation, with the west side experiencing considerably longer daily periods of sunshine, a greater diurnal temperature range and resulting in a greater degree of weathering.

Incised into the rock outcrops and located between the high angle scree slopes are a total of 43 tributary valleys of varying size, out which issue 33 sediment fans. These are of varying size, shape and angles of repose, and form an almost continuous zone along either side of the valley. Deposited debris is normally water transported and water worn, mostly subrounded to round stones. A gradation of material is observed with the boulders and cobbles being washed to issue point, and the gravels - and occasionally sands - being washed to the fan boundary. Some of the steeper fans consist of uniformly massive angular boulders. These probably result from rock avalanches, catastrophic flows of unweathered rockslide material (Hewitt, 1998).

Figure 2.7 The Yasin Valley near Darkot.

Hughes (1984) categorised outwash features into types based on their angle of repose. Low-angle fans were defined as resting at 2-8°; intermediate ones at 9-15°; while flood plains were classified as roughly horizontal. Fan features reportedly cover a total of 2,600 ha. - 46% of the valley floor, and include 20 low-angle fans, which account for a total of 800 ha. Low-angle fans ranged in size from 15 to 215 ha. and were evenly distributed along the valley, but were noticeably larger on the east side, where the average fan was 94 ha., compared with 41 ha. on the west side.

The valley floor is comprised of 12 active flood-plains, which normally contain braided river channels. The flood-plains cover a total of 1900 ha. and result from the silting up of the valley behind naturally formed dams. Associated with some of the flood plains are terraces. These indicate previous blockages, periods of land uplift and possibly dam breakage. Any terraces resulting from uplift are too old to be dated by observation, giving an idea of the rate and extent of vertical movement. The largest of these terraces are at Yasin village where there are two evident. Low terraces (1-20m above the river

level) cover about 1000 ha, and middle terraces (located 20-100m. above the river level) cover about 450 ha.

Other features seen on the valley floor include two rockfalls to the south of Yasin village, better described as mountainside collapses (Hughes, 1984) or catastrophic landslides (Hewitt, 1998). The two slides cover approximately 150 ha., each one has flowed from recognisable scars, like waves of water, across the valley to meet in the middle as a low terrace of sandy hills up to 50m high. There are deposits of a similar collapse issuing from Dulung Bar *nala* north of Darkot.

All the outwash features and the two rockfalls in the valley are of large size and many of these, rather than fringing the valley sides, have in fact reached the centre. In fact, ten low-angle fans, six intermediate fans (equally from both sides of the valley) and two rock falls have at one time blocked the main river. These blockages have been permanent long enough to create the twelve upstream floodplains previously described. The fans also account for one temporary blockage (with no after-effects), and have on six occasions reportedly altered the course of the river (Hughes, 1984). Out of the thirty-three outwash fans, only ten have caused no secondary effect to the valley floor, indicating just how active land-forming processes here have been.

2.3.2 Climate

There is little in the way of climatic data for the Yasin Valley, the nearest meteorological station is in Gupis, at the foot of the valley. Hughes (1984) provides a 30-year temperature and precipitation mean from this station shown below. More recent data is provided by Jacobsen (1998), in a comparison of micro-climatic data between the Yasin and Bagrot valleys. But it is for only two years, and somewhat limited in application.

	Temperature		Rainfall
Month	Max.°C	Min.°C	Mean total
January	3.6	-5.4	7.2
February	5.9	-3.0	11.52
March	12.1	2.0	16.08
April	17.0	6.9	24.48
May	21.4	10.4	36.48
June	28.6	16.0	9.84
July	31.7	19.4	13.92
August	31.0	17.9	14.88
September	26.5	13.8	6.98
October	37.2	7.6	6.72
November	12.2	1.3	3.84
December	22.8	-3.7	9.84
TOTAL ANNUAL PRECIPITATION:			116.78mm

Table 2.1 Climatic Data for Gupis (after Hughes, 1984)

Reimers (1992) has identified precipitation regimes for the western Karakoram, and suggested that two precipitation peaks were evident in Yasin, one in May, and another in late summer. What can be said about the climate in the valley is simply that it is characterized by low rainfall (<130mm/year), and high aridity. Some residents that I spoke with indicated that the micro-climate had been changing over the last twenty years. Less overall precipitation was reported, although because of the absence of any long-term climate records, this is difficult to corroborate.

2.3.3 Vegetation

Reports by early European explorers suggested that much of the Yasin and its tributary valleys were densely forested up until the mid-1900s (see Hayward, 1870; Drew, 1873; Thesiger, 1960; Hughes, 1984). This was confirmed in talking with villagers. Species of tree included walnut, juniper, poplar, and willow. Much of this wood has been used in building and for fuel. Some fruit trees - particularly apricot and mulberry - are still grown in Darkot and elsewhere. These are found mainly in places of marginal soil conditions, or on sites exposed to mass-wasting.

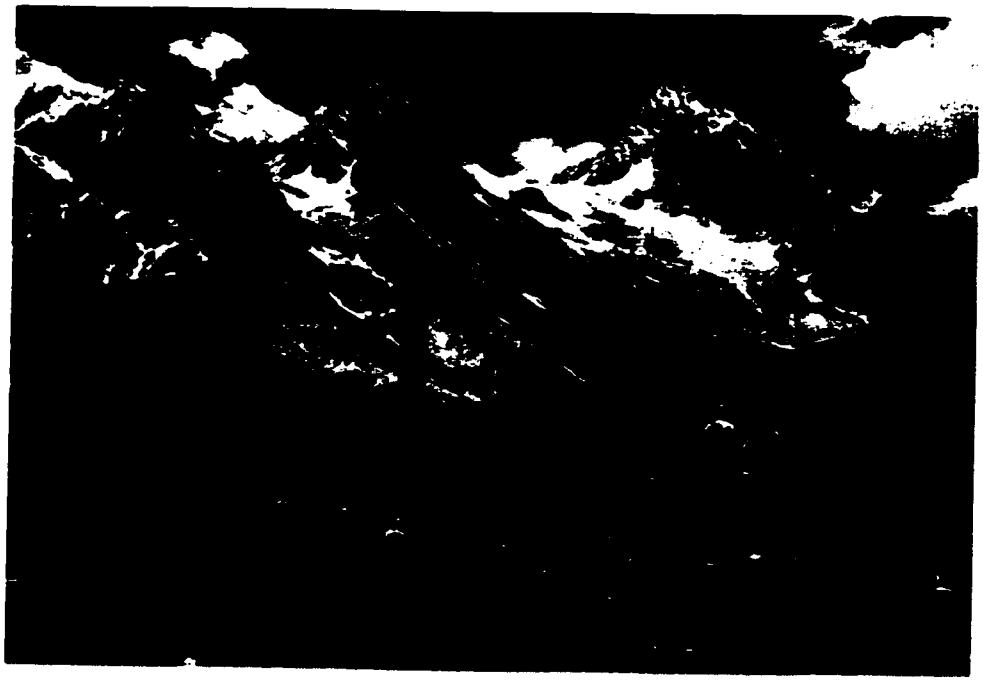


Figure 2.8 Near Dulung Bar. While vegetation may be sparse above 3000m, the land is still an important resource, used the village as summer pastures.

Du's (1998) classification of the Karakoram altitudinal belts - semi-arid, arid, super-arid, high-cold super-arid, high-cold arid, and high -cold semi-arid - is a useful tool for describing the Yasin valley. The semi-arid belt is identified by montane shrubby steppe, montane coniferous forest, alpine meadow, subnival and nival belts. Vegetation includes *Artemesia brevifolia* and *Rabdosia rugos* on lower slopes in tributaries, above this, coniferous forest consists chiefly of *Juniperus excelsa* - found at elevations of up to 3600-3800m asl.

2.4 Conclusion

As this chapter has sought to demonstrate, the Karakoram region is a highly dynamic environment. There is a long history of extreme events here, reflecting its geotectonic and geomorphic origins and its continued morphology. Characteristic of this landscape are vast deposits of easily entrainable sediment in the valleys, and extensive

glaciation. Mass movements are common, as are earthquakes and glacial hazards. Temperatures exhibit a vast range: spatially and seasonally, searing heat in valley bottoms and little annual precipitation, while above 3500m, there is permanent snow and ice and snow accumulations of up to 2000mm a year.

Nonetheless, the Karakoram is an 'inhabited wilderness' (Emerson, 1986). The mountains support a range of human activities, which have evolved and adapted to this environment. The purpose of the next chapter is to demonstrate the extent of interaction between environmental characteristics and landscape features, and human activity, practices and techniques, and to discuss how this contributes to the formation (and aversion) of risk in the village of Darkot.

Chapter Three - Human Activity and the Karakoram

3.1 Introduction: Context of Risk (II)

As outlined in Chapter 1, the perspective on risks and hazards that I have chosen to use in this study, suggests that 'risk' is formed at the interface between several interrelated but distinct phenomena: a hazard, intervening conditions of danger, a vulnerable population and mechanisms for coping or adaptation; with its roots in the practices and activities of daily life (Hewitt, 1983; 1997). In order to better understand risk and risk aversion at the level of daily life, it is necessary to establish a context for daily activity. Chapter 2 began to establish this context with particular reference to the physical environment. The Karakoram region was shown to be a dynamic environment in which a number of environmental features (periodic glaciation, steep terrain, high rates of erosion, and seismic activity) combined to produce a landscape characterised by frequent extreme events. Verticality was shown to be the prominent landscape feature, and alpine elemental events (Groetzbach, 1998) were shown to be both frequent and characteristic of the region. Risk in the Karakoram was shown to be related to the dynamic physical environment.

The aim of this chapter is to further establish context, this time in the realm of social, cultural and cultural ecological practices and activities; in the myriad of cultural adaptations that manifest themselves in settlement patterns and traditional resource management skills (Jodha, 1998; Kates, 1980). This includes the ways in which risks are averted, and the mechanisms in place for coping with loss. The purpose of this chapter is to examine the coping and adaptation side of the risk equation.

The material presented covers a range of subjects in varying detail. I begin with a brief review of the history of the community. Following this history I discuss settlement patterns and population characteristics. What, for example, is the distribution of population relative to high risk areas? Elsewhere, population growth in mountain regions has been blamed for deforestation, ecological destruction and subsequent erosion and flooding (Karan and Iijima, 1985; Eckholm, 1975; Ives and Messerli, 1989). Is there any evidence for this in Darkot?

The division of labour by gender is a prominent feature of Islamic societies (Abu-Lughod, 1986; Bari, 1998; Armstrong, 2000). Women and men have different roles in the public and private spheres. These roles are more flexible among certain groups, and yet they are an important feature of daily life that will contribute to or mitigate exposure to hazards. It is necessary that we inquire about the range of hazards faced, in particular, by women in mountain communities. The reason for this is that traditional belief patterns generally serve to channel resources away from women and towards men (Bari, 1998; Fothergill, 1998). Without access to resources, women may be more vulnerable to extreme events. The division of labour may also expose women to different, and even more, risks than men.

The second section of the chapter addresses in some detail the subject of mountain agriculture. There are two main reasons for this. First, agricultural production has formed the basis of the community economy throughout the Karakoram (Allan, 1990; Dittrich, 1997) and so it deserves to be studied. Secondly, traditional patterns of resource management can be seen as a mechanism for adaptation and coping. Practices and

techniques of mountain agriculture for example that are directed towards risk aversion (MacDonald, 1994, 1998; Rhoades, 1986) rather than the maximization of production.

This system of agriculture, which has features in common with other adaptive strategies particular to mountain regions, is well suited for life in this region (Rhoades, 1986; Groetzbach, 1988). Household command of a range of resources or entitlements (Sen, 1981), including fields, animals, and additional property, provide a measure of security in the face of uncertainty. The use of land at various altitudes, and the practice of transhumance that is characteristic of village life, point to the necessity of understanding these adaptive techniques. Are they primarily techniques of risk aversion? What are the consequences in the event of a disaster? Losses in these mountains are more likely to be of productive agricultural land or supportive infrastructure (terraces, irrigation channels) than material goods. How does a household absorb these losses which can result in short- or long-term deprivation? What is the role of transhumance or vertical zonation in distributing risk? Are there vulnerabilities inherent in high mountain agriculture? This material is covered in some detail, and will be referred to frequently in subsequent chapters.

In the third and final section of the chapter, I discuss the increasing role of 'modernization' or 'development' throughout the Karakoram, and in the community of Darkot in particular. My particular concerns are with road construction and the Aga Khan Rural Support Program (AKRSP) as vectors for modernization. What effect has road construction had in the Northern Areas? What changes have AKRSP policies and programs had in regards to cropping patterns? the local village economy? agricultural

production? Does modernization and the shift towards a market economy qualitatively change the nature of risk and vulnerability? Are risks alleviated or exacerbated by modernization? What effect does this have on traditional mechanisms for coping with uncertainty? The steady intrusion of the 'discourse' and agenda of modernity and development (Escobar, 1989) into mountain regions brings with it incremental changes, changes that are rarely examined in advance. As Beck has demonstrated with respect to late-modernity (Beck, 1992, 1997) the process of modernization may in fact have unforseen consequences for risk.

Risks, hazards, and vulnerability are not easily quantified. Rather, they are embedded in everyday relations and negotiations of power, gender, wealth, and politics, while at the same time being clearly influenced by conditions in the physical environment. The extent to which this is true in Darkot is what this chapter seeks to investigate.

3.2 Historical Background

3.2.1 History of Yasin

The Yasin Valley extends 54 km from Gupis in the south to Darkot in the north, a strategic corridor, leading to the Darkot Pass and beyond to the Broghil Pass, gateway to Wakhan in Afghanistan. It was likely used as a trade route or for seasonal hunting, with permanent settlement dating as far back as the 10th century C.E., when Bidat controlled the Gilgit territories and established a Buddhist monastery in Yasin (Dani, 1989). All that remains of the region's Buddhist history is a stupa carved into a rock at the top of the pass. It was also over the Darkot Pass that the Chinese general Kao Hsein-chih led his

forces in 747 C.E. for the successful invasion of Yasin and Gilgit (Stein, 1968:52).

Currently, Yasin is predominantly Ismailia Muslim. Islam is thought to have been brought to the valley between 1120 and 1160 C.E. when Shamsheer Ishan subjugated Punial, Yasin and Chitral. From the 12th to 19th centuries there are a number of vague references to the valley existing either as an independent state or as a refuge (Hughes, 1984). Between 1842 and 1852 the Gilgit territories, with the backing of the British, came under the control of the Kashmiri Sikh Dogra forces and by 1860 they were well established. Mir Wali was placed in Yasin as governor, and it was he who was initially thought responsible for ordering the assassination, in 1870, of George W. Hayward, an English adventurer and spy. The latter part of the 19th century was one of only nominal peace in Yasin, as Malik Amen pursued the establishment of his authority through brute force.

Also during the latter part of the 19th century, Yasin was of strategic importance in the struggle for domination over the high mountains between Britain and Russia. Before his death in Darkot in 1870, the British explorer G.W. Hayward brought the valley to the attention of European interests as a strategically placed route to the Afghan frontier, during the period that Kipling referred to as "the Great Game" (Kipling, 1901; Hopkirk, 1990; Moyer and Brysac, 1999). The more recent history of the valley is entwined with the partition of India in 1947, and the subsequent ceding of the Gilgit area to Pakistan.

I can only speculate about what these changes meant for the lives of villagers during this period. There is no written record of these changes, and 'village-level' history

was difficult to obtain, though such work has been done elsewhere in the Karakoram (see MacDonald's 1998 discussion of the Upper Braldu for example). What can be said with reasonable confidence however, is that during the pre-colonial period Yasin was both relatively prosperous and strategically important. However, the valley entered the 20th century with a seriously defeated and depleted population, an impoverished economy and an ugly political scene. In seems likely that the glacial advances of the Little Ice Age would have disrupted local trade and the pastoral economy, perhaps then, almost entirely dependent on agricultural production, creating hardship for a number of communities. The picture during this time was bleak.

3.3 Settlement, Community and Population

Before discussing settlement patterns in the Yasin Valley and the spatial arrangement of the community of Darkot regional settlement patterns will be briefly addressed. The most common features of settlement throughout the Karakoram can be summarized as the location of permanent communities along arid valley floors and agricultural production made possible by the use of intricate networks of meltwater from higher elevations (Kreutzmann,1994). Where pastoralism is practiced, use is also made of seasonal abodes in semi-arid or sub-humid zones at higher elevations.

The altitudinal zone of permanent settlements in the Karakoram ranges from 1400m in the lowest valley bottom to 3500m in the headwaters of tributary rivers (Kreutzmann 1994: 339). Lower elevations may have been preferred for early settlement because of the longer growing period for crops which in some valleys permits double-cropping (Kreutzmann, 1994). There is evidence for a gradual shift of settlements from

main river valleys into tributary valleys several centuries ago (Buddruss, 1985; Jettmar, 1989).

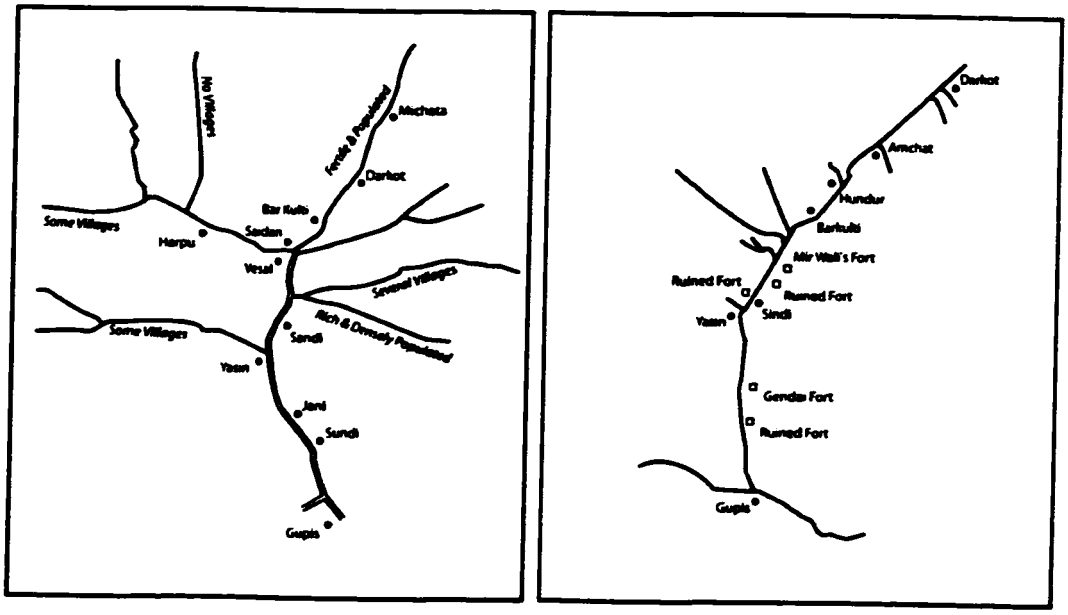
The dependence on meltwater for agricultural production is a key feature of regional settlement patterns in the Karakoram which will be discussed in more detail in *3.4 Karakoram Agriculture*, and I mention it here only in passing. The communities and lush irrigated fields of the Karakoram are often referred to as 'oases' (Stephens, 1953; Whiteman, 1985; Kreutzmann, 1988); verdant green fields in an otherwise arid environment. These are made possible only through extensive and complex networks of gravity-fed irrigation channels which deliver water from the nival zone to fields (Butz, 1987). Land at higher elevations is used for cropping and, more commonly, high mountain summer pastures.

Kreutzmann (1994) suggests that the dependence on meltwater and the need for flat or terracable land led to the identification of glacio-fluvial terraces and sediment fans at the confluence of tributaries with main rivers as the most convenient sites for settlement (338). Present settlement patterns in the region are a combination of scattered 'oases', and contiguous villages, forming a linear chain of cultivated lands on river terraces (Kreutzmann, 1994: 339). Many have high pastures nearby that can be accessed on foot. A large number of these communities are now connected to one another by jeep road, reflecting the long history of intra-regional trade (Kreutzmann, 1991).

3.3.1 Settlement Patterns in the Yasin Valley

The main portion of the Yasin Valley is 54 km long, and is now home to approximately 25,000 people. The largest settlements, with populations of between

3,000-5,000 persons, are Yasin village, Sandi, Taus, and Barkulti. The entire population is Muslim, the majority belonging to the Ismaili sect. Burushaski is the predominant language spoken in the area, followed by Khowar, Pashtu, and Gujari. Urdu, the national language of Pakistan, is also spoken mainly by men.



Hayward (1870) McNair (1883)

Figure 3.1

In Hayward's (1870) letters to the Royal Geographical Society in London we find the earliest references to the distribution of villages in the Yasin valley. They were recorded as: Gindai, Dumyal, Yasin, Gujatti, Sandi, Barandos, Hundoor, Dariara, Maskh, and Darkote. McNair's (1883) survey for the India Office names 11 settlements in Yasin, of which 6 were fortified with towers. According to Hughes (1984), by 1921, 21 settlements were named, and by 1934 there were 30. At that time, only Yasin was reported as having a tower, indicating a decreased emphasis on local defense (Hughes, 1984:269). The change and expansion of settlement distribution may in part reflect better

quality mapping, but also coincides with known increases in the valley's population (Hughes, 1984; Kreutzmann, 1991).

Hughes (1984) estimated that the amount of arable land in use in the valley had changed very little since 1934, and probably had already approached the maximum valley surface area which it has been economically feasible to convert for agricultural purposes. Approximately 57% of the valley floor has already been utilized by settlement and agriculture, nearly all of this on alluvial fans and old stream terraces.

According to Hughes (1984), 51% of the floodplains, which equal 1100 ha., are used for agricultural activities, mainly grazing. Crops are planted on all of the low terraces in the valley; and the intermediate terraces were farmed until only recently (Moughtin, 1984). Low- and intermediate-angle outwash fans used by the inhabitants are characterized by radial fields which follow the contours of the land form (Hughes, 1984). One of the widely practiced techniques for minimizing risk, particularly on lower angle fans, is to leave a strip of barren ground parallel to stream/river channels, starting at the issue point and descending to the main river (Moughtin, 1984; Hughes, 1984). This is the active zone of water flow, out of the tributary valleys. The width of the channel depends on the hydrology of the tributary valley and the degree of incision into the fan. For example, the barren portion of the fan at Darkot is broad and flat and with each passing year the issuing stream changes its course.

3.3.2 Arrangement of Settlement in Darkot

The village of Darkot consists of several distinct communities on either side of the broad expanse of the river. All of the land is slightly sloping. From the river bank to

the road, which marks the upper limit of development, on the main, east-bank settlements there is a mean change in elevation of only 6°. From south to north the settlements are: Chaquarkushi, Dass, Dalgramm, Khatgramm, Heryachim, Ziyaratyaray and on the other side of the river, Gasum. Two additional settlements in the main valley are occupied only from May to October: Moshuting and Ashtanimakhduring. *Figure 3.2* shows the approximate distribution of settlements in the village, and the location of the two largest debris-flows.

Smaller settlements - both permanent and seasonal - are located to the north and east of Darkot in tributary valleys. These are also shown in *Figure 3.3*, along with the major tributaries and glaciers.

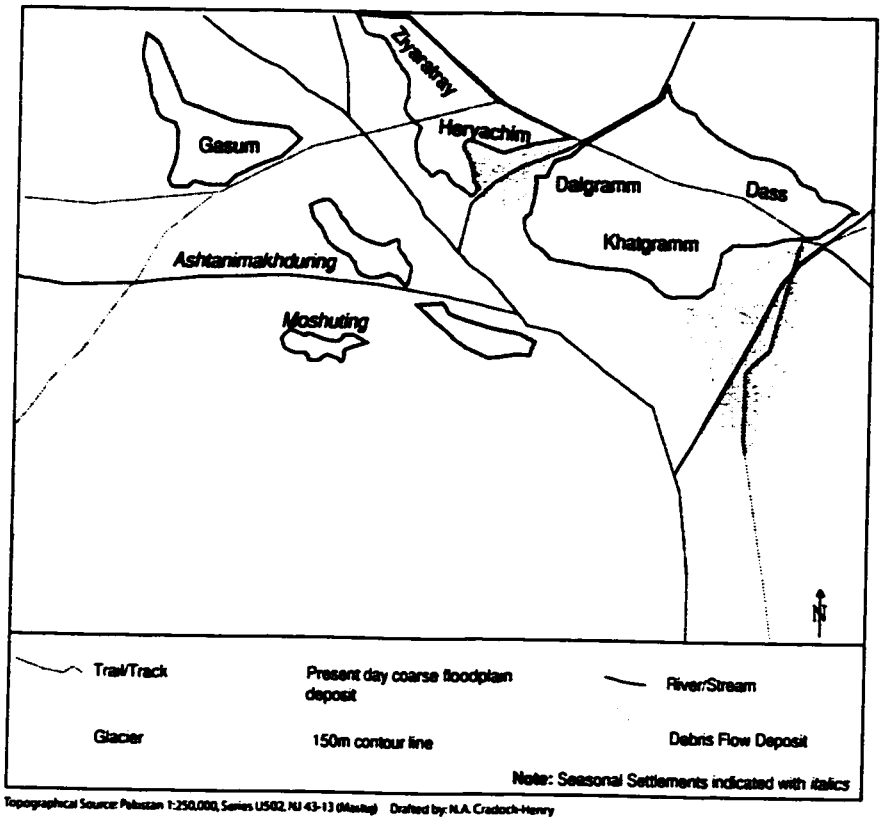


Figure 3.2 Map showing the arrangement of settlements that make up the village of Darkot.

3.3.3 Housing in Darkot

The village of Darkot consists of approximately 300 permanent households. An additional 100 temporary homes are located in the summer pastures to the north and east.

Nearly all the houses in Darkot are traditional *baipash* (fig. 3.3), described by Pott (1965), and summer dwellings consist of a circle of stones with brush roof. A *baipash* is a single-storey dwelling, square to rectangular, with a slightly domed roof. Richer families build multiple units together, often housing three generations, while poorer ones are confined to a single unit. Dittrich (1997) estimates the average family size to be 12.2 members, ranging in size from 4 or 5 to 20 persons and more (32). Using recent census data (July, 1999) collected by the local health-care worker, I calculated the average household size to be 8.9 persons

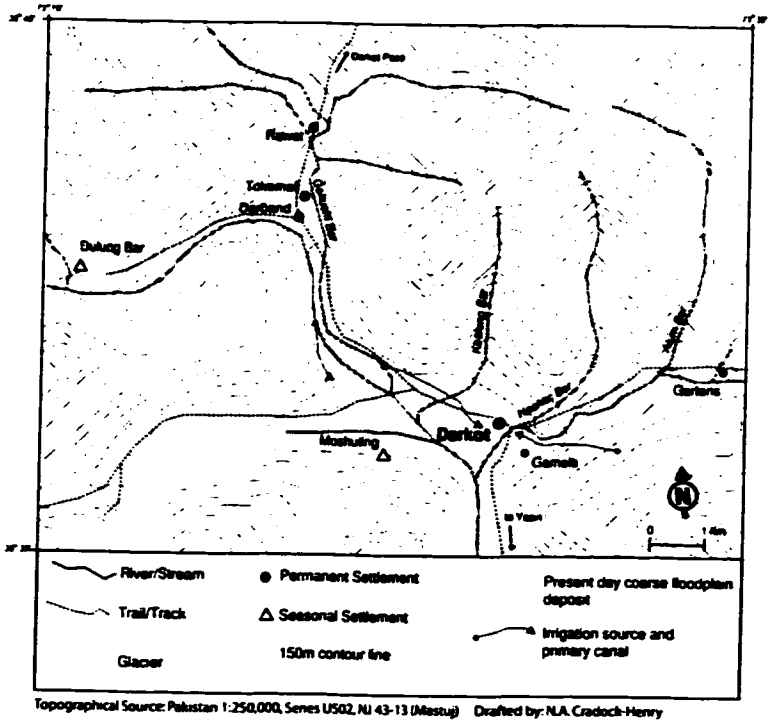


Figure 3.3 Map of Darkot and surrounding area

Figure 3.4 A traditional *baipash* dwelling.

Inside each main room, six carved columns support a complex timber roof. The interior of the dwelling is divided up into a series of areas, each having a well defined social function. Cooking takes place in the main living area, in a single unit dwelling, or in a separate area, in the case of a multiple unit dwelling.

Most of the newer houses are still constructed in this fashion, other types of construction being much more expensive. There are only a few homes in Darkot that are not based on the baipash. One belongs to a retired army officer, another to a successful farmer, and the third to the family of the AKRSP field officer in Gupis. Government buildings such as the clinic and schools, as well as the mosque, are made from concrete.

3.4 Population

Historical data and anecdotal evidence suggests that population growth in the village has been quite high. The available data for the Yasin Valley appears to confirm this trend. According to the 1931 Census of India, the population of Yasin stood at nearly 8,000 persons. By 1981 this number had grown to 20,347 (Government of Pakistan). A census conducted by Lohr (1997) put the 1992 population at 27,468, an increase of 35%. Dittrich (1997) says that between 1972 and 1992 the population increased by 70% from 15,200 to over 27,000 (29). This rapid population growth was cited by residents in Darkot as one of the key factors in the recent (<30 years) loss of forests in the upper part of the Yasin (see *4.3 Erosion and Flooding*), and by Dittrich (1997) as one of the reasons household food security in the valley is increasingly tenuous.

The valley's inhabitants are of various origins which can often be traced back through oral traditions and immigration. Many of these chronologies date back to immigration events several generations ago, but some are more recent. The language situation reflects this heterogeneity. The majority speaks Burushaski, including assimilated former immigrants. Khowar is the language of the former nobility and six other languages are spoken by a small number of people (Stoeber, 2000).

A recent census (July, 1999) conducted by the health worker in Darkot, put the current population of the area at 2,351, divided among 262 households. This number, however, includes communities in tributary valleys, included in the census for administrative reasons. Because of the limited time available for the research and the considerable distances involved in traveling to outlying villages I did not include these communities in

my study. I visited several of these communities, on occasion for the purposes of photographing Darkot from above and when traveling to and from summer pastures.

Community	*# of Households*	*Population*
Dass	49	424
Dalgramm	63	576
Khat Gramm	46	468
Gasum	27	257
Gartunze*	45	385
Gamelti*	17	129
Gekushi*	15	112
Total	**262**	**2,351**

Note: Communities marked with an asterisk (*) were not included in this study, but are, for administrative purposes included with the communities of Darkot.

Table 3.1

3.4.1 Notes on Households and Social Organization

The average household size in Darkot is 8.9 persons, but there is tremendous range in family size: up to thirty members. These large households consist of joint nuclear families of several brothers and sometimes cousins who combine their economic activities and resources instead of separating and building their own houses. Inheritance of land, its produce and assets passes from father to eldest son, the younger sons having a share in the produce of land rather than the fields themselves. This avoids the uneconomic practice of "parcelling" land to its eventual depletion (Moughtin, 1984). This serves is a risk-averting practice - promoting diversity in the economic basis for the household - and will be discussed in more detail in Chapter 5.

The growing importance of monetary income in Yasin has however increased the tendency for splitting up formerly large households. Households now occasionally

separate, divide their fields and - apart from the youngest brother and his family who inherits the old house (*ha*) - construct new homes. This is done on the family's land, generally in the vicinity of the old building. By this means, clusters of houses (*deh* = village) come into existence, which are generally inhabited by related families of joint patrilineal descent, that is by people of the same *qom*. Several such *deh* form villages with officially recognized names. In larger villages, a number of households beyond the *qom* cluster but below the village level, combine to form a neighbourhood, generally called a *giram*, which has a predominantly social and/or ritual function, as during marriages or burials. In former times the members of the *giram* combined their labour capacity to bring manure to the fields, a practice slowly coming out of use. Now, this work is generally done by members of the individual households.

The villages of Yasin were under a *lambardar*, a functionary of the Yasin raja, who was head of this former principality until 1972, when traditional rule was abolished. Throughout the 1980s village organizations were established as a form of self-government, prompted by the activities of the AKRSP. For the purposes of handling communal affairs, Yasin has been divided into three groups of villages or local councils: Yasin proper from the south to the centre; Selgan from the centre to the north; and the Thui Valley (Stoeber, 2000) (see *Figure 2.2*).

As to state administration, the villagers elect members to Yasin's Union Councils. Yasin is also represented in the District Council and the Gupis-Yasin Subdivision is entitled to one seat in the Northern Areas Council, the highest representative assembly of the Northern Areas. Executive power in the Yasin *Tahsil* (administrative division) is in

the hands of a police officer (*thanadar*) and a civil administrator (*tahlsidar*) both stationed at Yasin village. The old raja today occupies an unofficial but influential position.

The household is the main productive and reproductive unit in the valley, as throughout the Karakoram.

3.4.2 Gender and distribution of labour

One of the important features of daily life in the Karakoram is the distribution of labour by gender (Felmy, 1993; F. Hewitt, 1989). As we shall see in a later chapter, this has a direct bearing on risk. The different activities carried out by women in particular, expose them to a much different set of hazards than men. In this section, I briefly introduce the subject of women in Islamic high mountain communities (for a fuller discussion of this topic see Hewitt, 1987, 1989, 1991, 1999), the distribution of labour and its relationship to risk, and the impacts of modernization on women's work.

The differing roles of women and men play an important part in daily life in the villages of Northern Pakistan. Islamic and earlier customs have dictated the part that women in particular play, although these are changing with 'development' and not always for the better (F. Hewitt, 1989). The following is a brief review of literature on work done by women researchers in the mountain community and a discussion of gender constructs in the Yasin Valley and in Darkot. One of the difficulties in commenting on this subject is that opportunities for me to speak with women about their lives were limited. Interactions with women were very proscribed, and so I had to rely on men to answer my questions - which research elsewhere suggests is rarely an accurate or

adequate reflection of the reality of women's lives (Mehta, 1995, 1996). In Chapter 5 I shall examine more closely the implications of this division of labour as it pertains to risk.

One of the most prevalent themes in recent literature on gender, development and mountain areas, has been the changing role of women as the modern cash economy infiltrates and soon subverts the traditional village systems of barter and trade (Herbers, 1997; F. Hewitt, 1989, 1991). F. Hewitt (1999) discusses these changes in relation to a community in the Hushe Valley. Women in Hushe are responsible for almost all the work related to food production, including pastoral activities. This work is done in addition to their roles as primary care givers. Wood must be collected, animals must be herded and taken up to pasture, milk must be curdled, butter churned. Men's roles in Hushe have traditionally been associated with preparing the land for sowing, building homes and terraces, timber-cutting and other heavy labour. Men are also responsible for marketing animals, fruit products, and some handicrafts. The traditional economy is changing. An increasing number of men, for instance, are finding work as porters or guides for foreign tourists, joining the army or road crews, becoming teachers or going to the Middle East - all activities that women are excluded from because of purdah rules. Hence the burden of displaced 'traditional' labour is falling on them.

Herbers (1997) observed similar changes in the Yasin Valley. And although the opportunities for women there are limited, some have found work with various Aga Khan institutions, or for the Government Health Service as Lady Health Visitors or nurses. Other women are self-employed. In Darkot for example, the wife of the community

health worker was a seamstress, and even fixed rips in tents. Those that do find work still must face a number of obstacles both social and economic. Because of the gendered division of labour in the valley, work previously done by a woman must be replaced as such. The amount of work done by the remaining women is thus usually increased. Another example comes from Mehta's (1996) discussion of changes in the Central Himalaya, in which researchers and other outsiders have overemphasised the role of the cash economy - dominated by men - and have rendered invisible the full extent of the critical roles that women play in agricultural production. Opportunities for me to observe women's productive, let alone reproductive, roles and work in Darkot were limited. I have relied here on my own limited observations and the work of women researchers who have conducted studies in the Yasin Valley (Moughtin, 1984; Herbers, 1997).

The Muslim community in Yasin belongs to the Ismaili sect, but in spite of the relative freedom afforded women as compared to the Shi'ites, it is a male dominated society. Land is passed from father to sons for example, limiting women's access to resources, which has important consequences for their vulnerability to damaging events. Women in Yasin are betrothed between twelve and sixteen years (or even earlier in the case of wealthy and powerful families, seeking to create favourable alliances). After marriage ceremony, it is customary for the girl to spend a further year in her father's house before moving to her husband's village and household, where a long apprenticeship is often served under the tutelage of her mother-in-law or the senior wife of the household head. Divorce (i.e. sending a women back to her parents' home) is uncommon. If the husband dies and there are no children, or the women is young enough

to re-marry, she returns to her parents' home. If there are children, the woman will remain in her late husband's household.

The division of labour between men and women in the Yasin Valley has important economic consequences particularly because of the marked seasonal variation in agricultural work resulting in greater leisure time for men than women during the winter months. Men plough, plant and harvest crops; supervise animal breeding and husbandry; mill grain for flour, construct and maintain irrigation channels and when possible have outside employment. Womens's tasks include all care of young children, all household affairs such as cooking, preparing milk products, preserving fruits and vegetables for winter and oil production from the apricot kernels, as well as drying and preparing seed for the following year. All women will plant and tend their own vegetable gardens as well as weed the main crop fields. Women are also responsible for fruit gathering and tending trees, supervising the grazing and milking of animals (mainly goats and sheep), chaffing grain, making clothes and bed linens, and finally, the daily collection of water which can involve a long and slippery journey to the river in the winter time, the only water source that remains unfrozen (Moughtin, 1984).

In Darkot women are involved in food production. The larger fields of wheat and barley, I was told, are prepared, planted, and harvested by the men, though on several occasions I noticed women checking on the young plants and weeding. The home garden plot is managed by women and some of the young children, who are often called upon to till soil and pull weeds.

Pastoral activities appear to be designated according to gender. Animals are taken

up to the daily high pastures by men or a group of young boys. Where the entire family had established permanent summer homes at the pasture, women and children seem to be more involved in herding and tending the animals.

Purdah was observed in the village. Women were not frequently seen outside the home. Young women came down from permanent pastures to sell milk and cheese in the village, and were often seen collecting firewood.

Despite the lack of social and economic resources available to women, they manage to fare reasonably well in the traditional system. Their relative seclusion has led researchers to wrongly conclude that they lack power in the society, and are poorly respected by their husbands and other family members. It has also led to research that underestimates the importance of women's work in maintaining the subsistence economy (F. Hewitt, 1995; Bari, 1998).

The ideology of the sexual division of labour between men and women plays a central role in constructing gender identities in Pakistan (Bari, 1998). Because women tend to be excluded from the public, male dominated sphere, they are denied access to resources not considered necessary to the performance of reproductive roles such as higher education and technical skills, perpetuating economic dependency. As F. Hewitt (1987, 1991, 1998) has shown however, this is a false dichotomy. Women often transcend the boundaries between 'public' and 'private' spheres, and perform much of their work outside the home. This work is seldom recognized but is nonetheless an integral part of the household strategy for survival. F. Hewitt (1987) writes: "women are the keepers of tradition. In the strictest sense, they maintain the way things have been

done, by doing them that way" (61). This represents part of the 'hidden' or 'shadow' labour of women, as they replicate patterns, practices, customs and knowledge (Illich, 1982, cf. Hewitt, 1987), which, particularly in times of stress is an integral part of the informal economy and survival strategy (Bari, 1998). These reproductive roles include child rearing, food preparation, preservation of fruits and vegetables and preparing milk products.

The question of risk and gender in the context of the Karakoram mountains has not yet been dealt with adequately, though some preliminary observations can be made from work done elsewhere. As was noted earlier, the influence of religion in the daily life and culture of the Northern Areas is pervasive. There are varying systems of belief within Islam, however, and these affect the influence and responsibilities of women. Among Shias for instance, women are more confined to and responsible for the activities in the private space (the home and its immediate surroundings), than are Ismailiis, with whom I worked in Darkot (Flanagan, 2001, personal communication).

Generally speaking, the Islamic belief system channels access to social and economic resources away from women and towards men (Fothergill, 1998; Bari, 1998). Women do not inherit land and tend to have less control over income-earning opportunities and cash within their own households. In addition, there are few opportunities for them to gain off-farm skills. Literacy rates also tend to be lower for women than for men: 3% literacy among women, and 15% among men (AKRSP, 1995).

Women do enjoy a great deal of autonomy within their own households and receive great respect from family members and perform essential tasks. However, their

lack of access to and control over resources puts them in a precarious situation in the event of stress, as is evidenced in the shorter-term following extreme natural events, and in the longer-term as it relates to 'development' practices (Bolin et al., 1998). Flanagan (2001) notes that for example in Nomal, in the Naltar Valley, women are responsible for much of the weeding. The introduction of fertilizers and pesticides - the decision to use them made, almost certainly, by men - has particular consequences for women. The introduction of these chemicals has eased the workload of women by reducing the amount of weeding required; and yet it also poses a significant health risk. The application of fertilizer is usually done without face masks or gloves. The consequences of fertilizer and pesticide application in Nomal also has wider health implications as the chemicals may enter the water supply and affect downstream users. Women for example are more closely involved in food production. Thus the increased use of chemical fertilisers makes them much more exposed to the risks associated with these materials than it does men.

The gender divide is most obvious in the public domain: education, political decisions and development initiatives (Herbers, 1997). Women generally lack a say in political matters, a situation exacerbated by modernization. Modernization may serve to widen the dichotomy between the public, male domain, and simultaneously contract the private, female domain.

Figure 3.5 Women from Darkot spend much of the summer working in the summer pastures, such as the ones at Dulung Bar, where they tend the animals and prepare and store food. (photo courtesy of Shauna Flanagan, Dulung Bar, Yasin Valley, July 2000)

3.4.3 Health and Population

The basic health needs of the community are met by a small clinic located in Darkot, which services a number of outlying villages, as well as the summer pasture areas. Funding for the clinic, including wages and the cost of medicines and supplies, are provided by Aga Khan Health Services. The main health care worker is supported by two lady health visitors (LHV) based in Yasin. According to conversations with the community health worker, the main problems in Darkot stem from respiratory infections and gastro-intestinal ailments. Colds and chronic bronchial infections are the most common illnesses (N.A. Khan, personal communication, 2000). Tuberculosis is less common (Giles, 1984).

The design and use of houses, particularly during the winter months, has been

assessed as a contributing factor to the high rates of bronchitis and other respiratory ailments (Giles, 1984). A small central fire, despite the small opening in the roof, greatly contaminates the air within the home with respiratory irritants such as sulphur dioxide and soot. Animals and people live in close proximity to one another, again particularly during the winter months.

Polio vaccinations take place once a year. The clinic is also working to educate people about the transmission of diseases, and the need to maintain a clean home environment. Children and the elderly are among the most vulnerable to disease.

Malnutrition is also a significant health concern in the Yasin Valley (Nagra, 1997). According to Nagra (1997) the Yasin Valley and Astor have the highest incidence of malnutrition in the Northern Areas, and in both of the valleys there was a much higher incidence of malnutrition among women than men (Nagra, 1997: 565).

3.5 Features of Agriculture in the Karakoram

> *The terms of the dialogue between cultural heritage and local environment are complex. They are set by the interplay of local topography, flora and fauna, and climate with the cultural repertoire drawn on by the inhabitants of a particular area - the patterns of technology, organization, and ideology introduced by them.*
>
> - John W. Cole and Eric R. Wolf, The Hidden Frontier (1974)

Agricultural production is central to the mixed mountain economy that characterises communities in many mountain regions. The complex interactions involved in lowland agriculture between seeds, micro-climate, nutrients, and moisture availability are - in the mountains - further complicated by the need to integrate the vertical dimension. In mountain regions all over the world, a mixed system of agriculture has develoed, well suited for living with this added dimension (Netting, 1994; MacDonald,

1994, 1998; Rhoades and Thompson, 1975; Groetzbach, 1988).

Rhoades (1986) suggests the main features of a "highland life-style" are common to nearly all the world's major mountain regions. Agriculturally, this combines in a carefully regulated manner, both herding and cultivation using different altitudinal zones for different purposes. Permanent villages are often surrounded by rock-walled fields, corrals and kitchen gardens. Zones immediately above are used for hay-making or the cultivation of hardy grains or tubers; alpine pastures are reserved for pasturing. Verticality is visibly incorporated into agricultural production through the practices of transhumance and the diverse elevations at which crops are sown in order to make the best use of small changes in temperature and orientation. The viability of this system of production has been amply demonstrated over the millennia (Brush, 1988; Cole and Wolf, 1974; Jodha, 1998).

One of the primary activities of village life is agricultural production. In turn, it has been suggested that this mixed economy is oriented primarily towards averting risk. The ways in which agricultural practices have been adapted for this environment, the ways in which risks are averted through those practices, and the fact that losses - when they are incurred - are more likely to be the loss of productive land than material goods add further weight to its relevance as a field of inquiry relevant to this study. It also needs to be shown that the traditional pattern of production and resource management is well adapted to this environment. The 'modernization' of agriculture - as it is promoted by certain agencies - circumvents or overlooks these techniques in order to maximize production and produce marketable (cash) crops, exposing inhabitants to novel risks.

The challenges of high mountain agriculture have been well documented elsewhere (Brush, 1988; Cole and Wolf, 1974; Butz, 1987; Whiteman, 1985; 1988; Kreutzmann, 1994; Ives and Messerli, 1981, 1989; Haigh, 1982, 1984; Valdiya, 1985; Messerli et al., 1988; MacDonald, 1989, 1994, 1998; Moldenhauer et al., 1991; Gardner, 1997), and my purpose here to discuss the general characteristics of Karakoram agronomy before discussing in detail agricultural production in the Yasin Valley and Darkot.

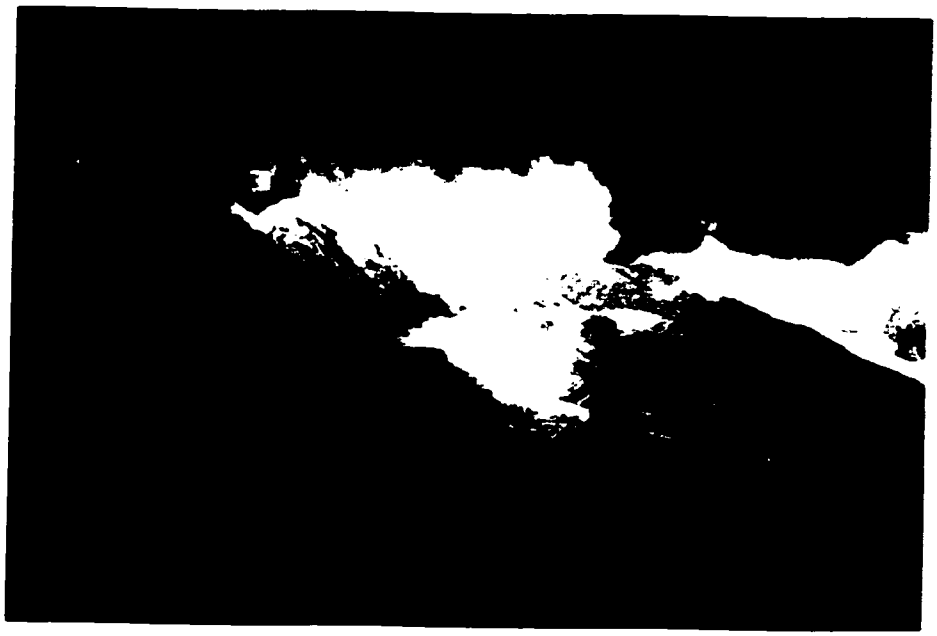


Figure 3.6 Snow and melting ice from surrounding peaks are essential for agricultural production in this semi-arid region.

The main constraints on agricultural production in the Karakoram are water supply, inputs of solar radiation and temperature. Most Karakoram villages display a similar spatial organization of water supply. Cultivation occurs mainly below 3000m but depends on a water supply from above 4000m. This is due to an altitudinal gradient of precipitation which leaves most valley floors below 3000m with annual precipitation

rates of less than 150mm (Butz and Hewitt, 1986; Butz, 1987). Conversely, the zone of maximum precipitation in high glaciated basins above 5000m receives annual precipitation in the order of 1000-2000mm (Wake, 1987). This altitudinal effect means that the majority of precipitation in the region serves to nourish large valley glaciers which release it in a usable form, below the level of local cultivation. The dryness of valley floors and inhabited areas leads to classification of these "barren mountains" as semi-arid or arid.

Cultivation in this environment depends entirely on gravity-fed irrigation. The green cultivated fields are often referred to as "oases" (Whiteman, 1985; Kreutzmann, 1988). As Stephens (1953) writes:

> there seems to be no reason why [oases] should not also mean clefts of verdure amidst sterile towering wastes of enormous rock. I can think of no better word for the startling, delightful little places, fruitful and green, which the traveler finds strung at intervals of ten miles or so along these arid Karakoram gorges (155).

The water from melting snow and ice is transported via complex networks of channels to fields (Butz, 1987; Kreutzmann, 2000; Stoeber, 2000). Farmers apply the water using small furrows or channels between fields. In order to support this infrastructure, there are often complex social structures to allocate water resources, maintain existing channels, and plan and construct new ones (Butz, 1987; Stoeber, 2000). Management of meltwater resources is particularly important because flow varies from year to year, independent of any long term climate change. This one of the most significant hazards for many communities (Butz, 1987), particularly those in which the only available water comes from snow melt rather than glacial melt (Staley, 1982; Hewitt, 1988).

Together with the extensive use of irrigation, it is the abundance of solar radiation

which makes agricultural production viable in the Karakoram. Radiation is an important factor in agricultural climate because it influences photosynthetic potential. It also relates directly to temperature, evaporation and water balance. The entire Upper Indus Basin receives extremely high incident radiation due to infrequent cloud cover and thin atmosphere. The mountain rain shadow reduces cloud cover, except in the highest mountain ridges, especially in summer. Many valley stations receive up to 70% of potential sunshine hours (Whiteman, 1985: 20).

The interactions of slope and aspect also combine to produce a mosaic of micro-environments (Whiteman, 1985: 19). Incident radiation is modified by the shading effect of topography. Shade is not an agricultural constraint where temperatures are high, but it can be important at the upper limits of single and double cropping zones. Because steeply sloping land is not generally cultivated, and only flat (terraces) or slightly sloping lands (fans) are, there is an abundance of sunshine.

Aspect is also an important consideration. Soils warm more quickly on south facing slopes, and permit early planting in the spring; and the southerly aspect is more favorable in terms of heat availability for crop production. Southerly aspect also means higher rates of evapotranspiration, placing stress on the water supply required for plant growth (Whiteman, 1988). North facing slopes are generally cooler. The snow often stays on them longer in the spring and in some cases can delay planting. This has happened on occasion in Darkot.

3.5.1 Yasin Agriculture

The Yasin Valley (2160m in the south, 2760m in the north) is located in the

transitional zone of the Hindukush and Karakoram. While double cropping is generally practised throughout the Karakoram up to elevations of 2400m, the Yasin Valley is one of several exceptions, and only a single crop is harvested annually. The influence of local conditions, including the prevalence of solar radiation, is the main constraint on agriculture. Much of the valley is paralleled by peaks over 4000m. Jacobsen (1998) has shown that this limits the amount of direct solar radiation during the summer months. Whiteman (1985) also makes reference to topographical shading as a factor in Yasin village.

Temperatures - particularly in Darkot - remain cool for the duration of the growing season; this may be due to the influence of several large glaciers across from the village, and at the head of the valley. Moisture is also a limiting factor, as elsewhere in the Karakoram, but farmers did not indicate that were there an abundance of it, two crops would be possible.

Staple *kharif* crops include wheat, maize and barley. All crops - including an assortment of fruits and vegetables - are grown with the aid of glacier-fed irrigation. Factors limiting the growth of these and other crops include the available inputs of solar radiation, the limited availability of soil and water, an arid climate, and the regular occurrence of natural catastrophe (Hughes, 1984: 32). Average annual precipitation in the valley bottom averages only a little more than 100mm (Hughes, 1984; Herbers, 1998).

Family holdings are small, consisting of 1-1.5 ha of land. In addition to land, livestock (sheep, goats, cattle) are kept in communal high pastures in the summer and

stall fed in the winter. Dairy products as well as meat are important food items, and manure is used as fertilizer. Some livestock products and dry apricots, walnuts and potatoes are sold locally or in the Gilgit bazaar.

Early European visitors characterized the Yasin Valley as being heavily forested, though little forest remains. Trees do however provide an important source of wood for construction and fuel wood.

3.5.2 Darkot Agriculture

Like many villages in the Karakoram the village economy in Darkot has traditionally been based upon subsistence agricultural production (Dittrich, 1997). This is being increasingly supplemented by cash income (Stoeber, 2000), remittances from family members working downcountry (Karachi, Lahore, Islamabad) or in one of Gulf States and a mixed economy that is more closely integrated with local and national markets. In this section, I look more closely at agricultural production in the community. Darkot is located at 2760m asl and growing conditions are influenced by the proximity of several large glaciers. Temperatures in Darkot remain cool for much of the year and place strict limitations on the length of the growing season. Below is Whiteman's (1985) temperature data for Yasin village. If anything, temperatures would be cooler in Darkot due to the increase in elevation and the presence of several large glaciers across from the village.

Figure 3.7 Small family plots are an important component of agricultural production in Darkot.

When the first crops are planted in early May, the snow has only recently melted off the local fields. Fields tend to be small, less than 0.5 ha on average.

The primary crop in the village is wheat, which is planted in the middle of May, and then harvested towards the end of August. The largest fields are planted with wheat, which is often intercropped with *mokakk* (a member of the pea family)- a nitrogen fixing legume - resulting in increased yields (Whiteman, 1985). The two are harvested, and often milled together (fig. 3.6). The wheat is usually ground into flour, and then used for making *chappathis*, a dietary staple in much of the region.

Barley is the second most plentiful crop grown. It is planted in early May and harvested in mid-August. Barley is also often sown along with a nitrogen fixing plant, in this case a type of lentil. The barley is used mainly as animal fodder during the winter. Other crops grown on this scale include potatoes and lentils. Only one crop can be grown each year in the short (May-August) growing season. Throughout much of the

Karakoram, double cropping is possible up to about 2400m, and so the Yasin Valley (at 2150m) is an exception. According to Whiteman (1985) this is mainly due to topographical shading and unusually cloudy spring weather that delays planting and keeps temperatures cool.

Figure 3.8 Crops ripening in late-August (Photo: H. Kreutzmann)

Small enclosed plots are an additional feature of agricultural production. A variety of vegetables including onions, turnip, lettuce, spinach, carrots and potatoes, are grown in small family gardens close to the home, to supplement the diet.

Figure 3.9 Peas are often planted with the barley to fix nitrogen in the soil.

Additional constraints on agricultural production exist, including the availability of moisture, inputs of solar radiation and the quality of soils in certain areas. Water in Darkot comes from the network of irrigation channels that draw glacial melt water from the Darkot River, the nival zone at the head of the Yasin Valley and other smaller basins in tributary valleys. This flow is supplemented - and in some places replaced - by small, localised melt water streams and natural springs. A number of people I spoke to reported moisture deficits as a growing problem for agriculture in the village. Anecdotal evidence gathered during interviews with residents points to increasingly drier summers over the last twenty years. During that same period I was told that less snow fell in the winter as well. Mean annual precipitation is important to the long term viability of the community, because of its dependence on valley glaciers which supply much of the melt water for the agriculture. In the absence of data on the mass balances of the local glaciers it is difficult

to corroborate long-term weather patterns. Interestingly however, Miele (1992) reports similar findings for Yasin, but noted that precipitation at Gilgit has doubled over the last century.

The net result of drier summers is that some fields are simply not planted or else they are abandoned part-way through the growing season in favour of fields located elsewhere, closer to a guaranteed water supply. In the absence of rain, several farmers reported using more animal fertilizer to capture and retain moisture.

The village of Darkot is variously sited on alluvial fans, glacial outwash plains, and the floodplain of the Darkot River. The quality of the soil in the village varies. The lower, and relatively unpopulated, portion of the community is located on the floodplain of the Darkot River. Growing conditions here are excellent, combining rich soil and an abundance of moisture. Much of this land however was buried by the debris-flow of 1978. The only comparable growing conditions are in Gasum, also located on a floodplain. The remaining fields in the community are located on alluvial fans, with soils of varying quality. In areas that have been reclaimed following debris flows at Khalung Bar and Hashtic Bar, the soil is very rocky, and must be cleared annually. The large piles of stones scattered about are evidence of the labour intensive, springtime chore of clearing the soil of stones pushed up by the previous crop, and the frost heaves of winter.

The short growing season makes it imperative that crops are planted on time. One year avalanched snow deposited on fields in Moshuting did not melt until late June, delaying spring planting until July. The crop was barely ready in time. The short window of opportunity available for spring sowing also means that the young shoots are

susceptible and extremely vulnerable in the event of a late frost. One way these risks are minimized is through diversity: diversity in the location of fields, time of planting, crop and soil types, avert some degrees of risk, acting as safeguards against pestilence, disaster, and drought (MacDonald, 1994, 1998).

The primary use for land in the village is for cropped fields (see Figure 3.--). A portion of land has also been set aside for grazing. This is a large humocky field, with a small spring in the middle, and a small creek along one side, and very boggy. I was told by my assistant Inayat, that it was unsuitable for agriculture.

Livestock husbandry throughout the Karakoram, and mountain areas in general, is based on the practice of transhumance (Rhoades, 1986; Groetzbach, 1998; Cole and Wolf, 1974). In the late spring/early summer, livestock are herded up to high altitude pastures where they remain until the fall. While there they require little supplemental feeding. During the winter, livestock are herded in and around villages and a substantial proportion of their nutrient requirements are met by stall-feeding. In Darkot this typically consists of wheat straw and wild grass (AKRSP/ICMOD, 2000).

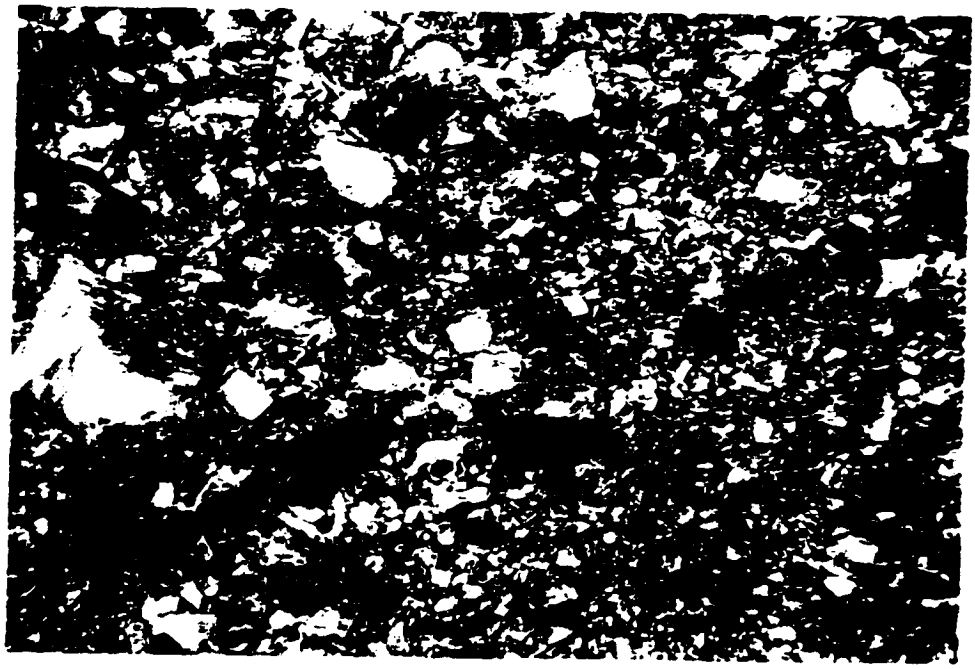


Figure 3.10 Transhumance is a characteristic feature of agriculture throughout the Karakoram.

Hughes (1984) suggests that because cultivable land was a scarce resource, animals were kept away from fields in order to minimise the likelihood of damage being done to crops. A similar practice was observed in the Alps by Cole and Wolf (1974). In order to save grasses near the village and on the lower slopes for winter use, a pattern evolved whereby animals are taken to permanent high summer pastures and the grass on lower slopes is then cut and used for stall feeding (Cole and Wolf, 1974: 125). Stone fences are topped by brambles or sticks making it difficult for goats - the most likely potential culprits - to get into fields. The pattern of transhumance that has evolved in Darkot is more closely related to the small amount of land available for pasture in the village. The village pasture is reserved for cattle and *dzo*. At least one summer pasture is used on a daily basis for grazing sheep and goats, which are able to make good use of the short grass and shrubs at higher elevations. Cattle range freely at other summer pastures.

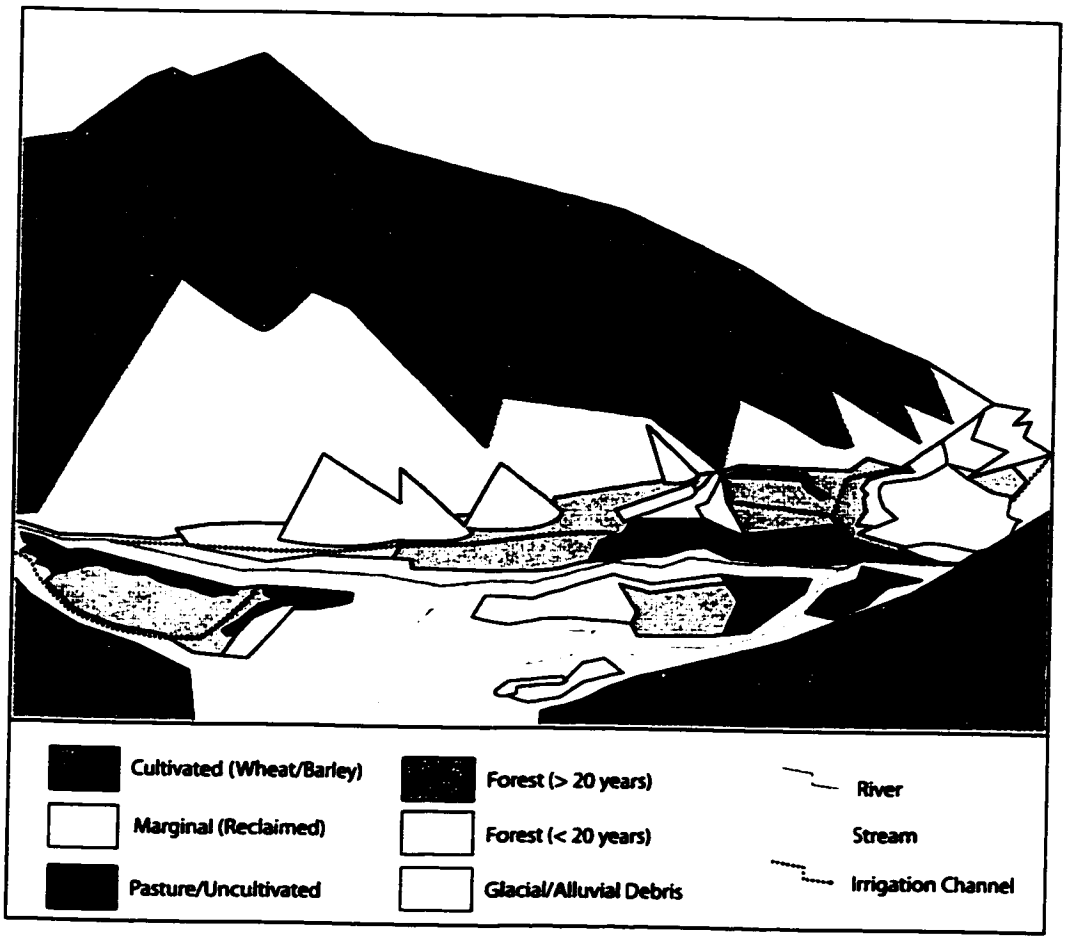


Figure 3.11 Land Use in Darkot (N. Cradock-Henry)

Animals in Darkot are owned by households, but often the local community or several households will share amongst themselves the responsibility for pastoral activities. One or two members of the local community (Gasum, Darkot, Khalung) - generally one of the men or several young children - will take the entire group of animals up to graze one day, the next day someone else will, and so on. In this way, each individual has opportunity to work in their fields, or for paid employment on the road construction crew, for example. Other households travel with their animals and spend the entire summer at the pastures in semi-permanent dwellings. Children sometimes returned

to the village to sell milk, butter and cheese.

Commonly owned animals in Darkot include: dzo (a cross between yak and cow), yak, cattle, sheep, oxen, and goats. These animals are an integral component of the agricultural system in the village. Yak, dzo and oxen are used for ploughing fields, cattle and goats for their milk, and sheep and goats for their wool (sheep and goats). Donkeys are also commonly used for carrying firewood, timber for construction, and other heavy loads. Animal dung is also a valuable source of fertilizer and fuel (Whiteman, 1985).

Recent development literature suggests that throughout the Northern Areas livestock herds are getting larger and their composition is changing, with an increasing number of cattle in the mix (AKRSP/ICMOD, 2000). This has been attributed mainly to population growth and the tendency of families to keep a minimum number of animals for their livelihood and as a capital asset in case of emergency (Streefland et al., 1979). A recent survey of 50 households in Darkot conducted by the AKRSP (2000) provides an overview of animals held. *Table 3.2* identifies the average number of animals per household in the village.

Species	*No.*	*%*
Cattle	4.9	28.5
Yaks and Crossbreeds	0.1	0.6
Goats	9.5	55.2
Sheep	2.7	15.7

Table 3.2 Average Number of Animals/Household (Darkot)

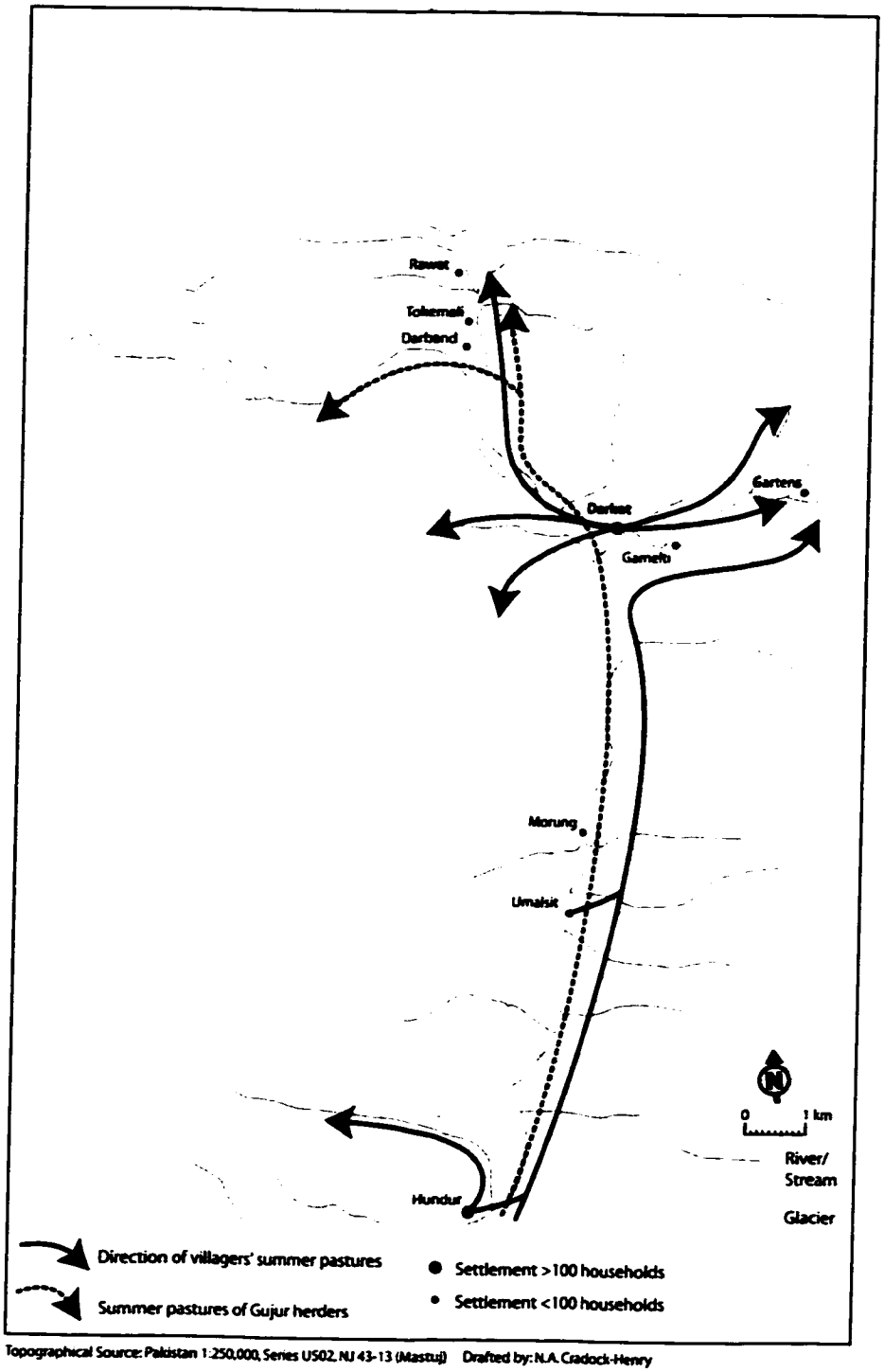
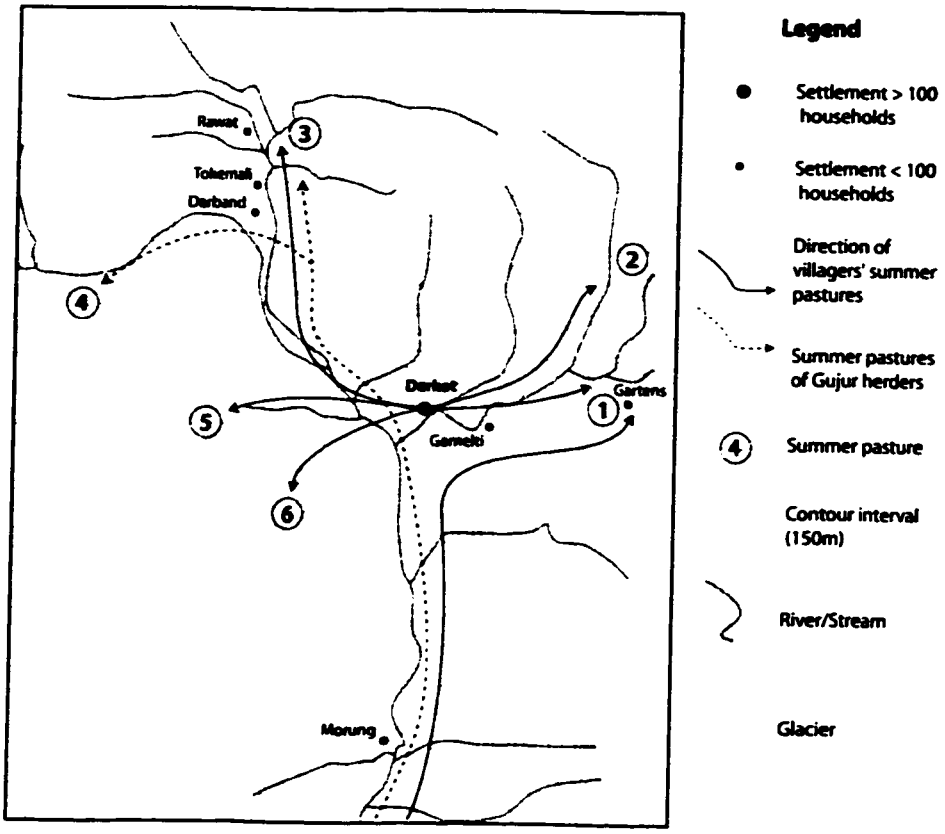


Figure 3.12 Pastures in the Upper Yasin Valley (N. Cradock-Henry)



(1) *Gartens* (3200m+) Following the large debris flow in 1978, a significant number of Darkot households moved here permanently. The upper reaches of the valley are used by Gujar herders. There is permanent and seasonal settlement in Gartens.

(2) *Suaray* (3165m) Small pasture used only occasionally by Darkot households. Seasonal settlement, no cultivation.

(3) *Gekushi Bar* (3270m) This area is used by Gujar herders in the spring after having wintered in Taus. In early June, the Gujar move up the *Dulung Bar* and the pastures are used by Darkot villagers. The area is also used for fuelwood collection and cultivation during the summer. In October, the Gujar return here until moving further down the Yasin Valley in November or December. A road is currently being built from Darkot to the village of Darband.

(4) *Dulung Bar* (3426m-3550m) The *Dulung Bar* is used by Darkot households for wood collection as well as pastures. There is some cultivation in the lower part of the valley. The pastures are permanently settled from late-June until October. The upper Dulung is used by Gujar herders.

(5) *Ghamu Bar* (3405) There are small cultivated areas in the valley, as well as some seasonal settlement. Pastures located at *Thambasakish* (3505m). The lower portions of this glaciated valley are used for wood collection and daily herding.

(6) Kharogil (3650m) A small grassy area 2 hours walk from Darkot. No permanent settlement or cultivation, used on a daily basis for grazing and for fuel wood collection.

Figure 3.13 Summer Pastures at Darkot (N. Cradock-Henry)

Rangeland resources of the Northern Areas have been categorised - somewhat arbitrarily - into three different altitudinal levels: foothills (<1,500masl), dry temperate range (1,500 to 3,000masl) and alpine pastures (>3,000masl) (AKRSP/ICIMOD, 2000:4). These divisions however vary greatly from valley to valley. For example, according to Iturrizaga (1997) and Butz (1991), in Shimshal cropping ranges from 2800m up to 3000m, and the alpine pastures do not begin until 4200-4300m. By the above measure though, the village of Darkot is located in the upper margin of the dry temperate zone, while all of the villages pastures can be considered alpine. Nearly all of the summer pastures currently utilised by villagers from Darkot are located in tributary valleys, with the exception of Darband, further up the Yasin Valley, at the foot of the Darkot Pass. Most of the pastures are located within a 2-3 hour walk of the village, and all have access to running water.

The preceding maps show the location of the various summer pastures used by the community. There are no enforced rules regarding access to summer pastures and their resources (firewood, dung for fuel and fertiliser), but instead patterns loosely based on clan and history. For example people from the community of Khalung generally use the pastures at Ghamu Bar and Dulung Bar, while people from Moshuting usually go to Thambasakish. Some of the pastures are semi-permanent (Darband, Rawat, Tokemali, Dulung Bar), occupied by several households during the summer months, and others are utilised on a daily basis (Ghamu Bar, Thambasakish), herds driven up in the morning and brought down again at night. Some small fields are also utilized by members of the community in these tributary valleys. The main constraints to further planting at higher

elevations are the same that affect the community lower down: the availability of land, moisture, temperature and inputs of solar radiation. Planting crops in diverse locations, and at a range of altitudes is a risk aversion strategy employed by households: if the crops fail in the village because of a lack of water, at least the family has crops sown elsewhere. Alternatively, it may indicate the pressing need to develop new sources of food. It was also clear that this resource was not available to all families (see Chapter 5). The highest fields I came across were several hectares of wheat sown at 2,900masl. The farmer I spoke with said that planting wheat at this elevation, on this aspect was too risky an undertaking in most years because the snow stayed so long, making for a prohibitively short growing season. However, because there had been very little snow during the 1999-2000 winter, he had been able to plant one hectare in the late spring which when I saw them in June, were coming along well.

Figure 3.15 These fields were located at 2900m, about 2 hours walk from Darkot.

Forest products are also an important part of the village economy. Wood is the most important source of fuel and is also used in house construction. In some cases the leaves and tender shoots are used for animal fodder, and branches for the construction of fences. One of the often mentioned goals of the new road (see also 3.4 Modernization) was that it would enable people to access trees at the head of the valley for timber and fuel wood more easily. According to the father of my assistant, Sultan estimated that in the course of the winter he and his family used as much as 9,500 kilograms of wood for heating and cooking, a figure closely corresponding to those derived by Clemens and Nusser (1997). The wood is collected between April and November by women, men and children.

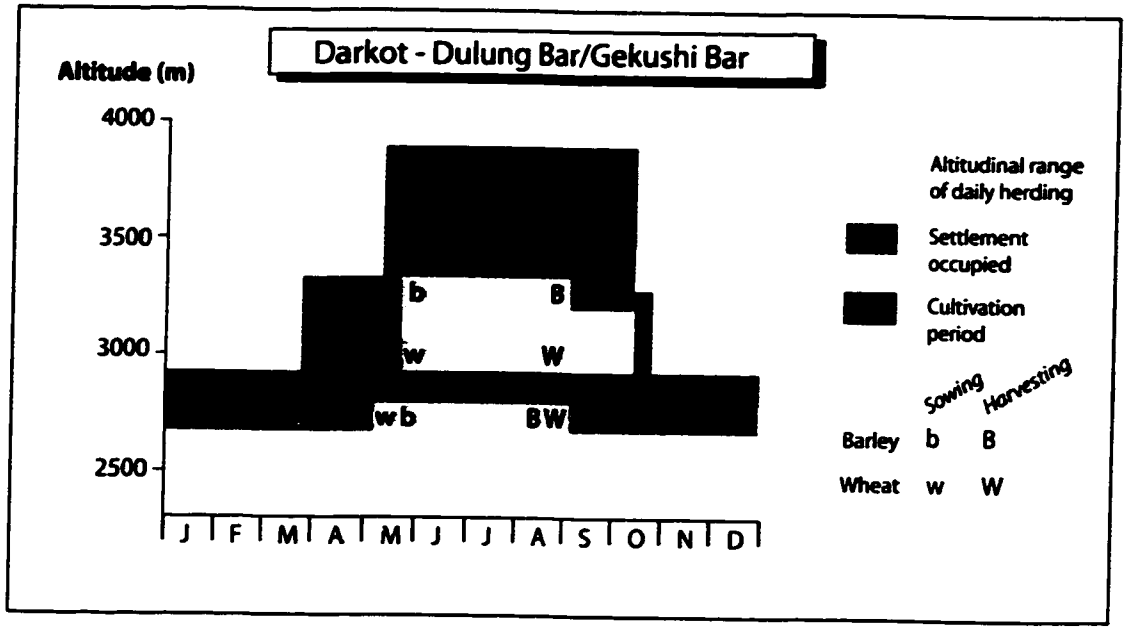


Figure 3.16 Schematic Representation of Agricultural Production in Darkot (N. Cradock-Henry)

3.5.3 Agriculture and Risk Aversion

The system of agricultural production that has evolved in the Karakoram is well

adapted to this particular environment (MacDonald, 1994, 1998). One of the most important features of local resource strategies, for the purposes of this research, is the way risks are minimized or averted. Far from being "irrational", mountain agriculturalists' techniques are well-adapted to their particular environment, displaying the characteristics of a "mixed mountain farming system", the general diversity of which is oriented towards risk reduction (Rhoades, 1986). A number of other techniques have been identified by researchers as 'risk averting', including field dispersal, delayed planting, intercropping, terracing and irrigation flow routing; diversity in the types of animals kept by households; and household labour strategies. These are covered in detail by Bohle and Adhikari (1998), Bjoness (1986), Johnson, et al. (1982), and MacDonald (1994, 1998), upon which the following is based.

A practice common to nearly all highland regions is the cultivation of small, dispersed fields, which in this setting is an adaptive technique (Rhoades, 1986). If maximizing yields and efficiency were the goals, a more likely solution might be to lump these fields together into a single unit. However, scattered fields reduce the risk of total crop failure. Because of the practice of planting a range of crops and varieties in different localities and at varying altitudes, a poor yield in one part of the valley does not imply a loss of the entire crop. Mountain farmers opt for diversification. If frost, hail, or an avalanche destroys the crops at one level it may effect only one part of a family's many holdings. According to Orlove and Guillet (1985), "the scattering of fields... provides a lower risk of total crop loss than would a pattern having all fields and meadows in a single area" (7).

Diversity is also evident in the surface arrangement of cropped lands, which displays risk-mediating characteristics. Terraced fields are often edged with grassed slopes and this contributes to a heterogeneous cropping landscape (Altieri, 1983); the banks acts as barriers or buffers, inhibiting the mobility of herbivores and reducing the impact of pest infestations (Vandermeer, 1989). This may not, however, be solely a risk-mediating characteristic. Banks also retain soil and reduce terrace erosion and the grass is a source of winter fodder (Ahmad, 1991; Thomas and Biamah, 1991). Similarly, leaving stubble on the fields inhibits aeolian erosion but also accomodates free grazing and contributes to the nutrient cycle (MacDonald, 1994).

Figure 3.16 Small dispersed fields are characteristic of much highland agriculture.

Another widely practiced risk averting strategy is delayed or staggered planting. In Askole in the Upper Braldu Valley, MacDonald (1994) notes that villagers commonly grow early-maturing buckwheat as a secondary, rotational crop to wheat. Planting takes place one month after the wheat has been sown. By this time the chance of a late frost

has passed, and the success (or lack thereof) of the first crop can be better appreciated. This flexibility enables farmers to respond more effectively to changing or merely fickle environmental conditions (MacDonald, 1998).

Intercropping - the deliberate, simultaneous growing of different species (polycultural) or varieties (polyvarietal) in the same field - is another adaptive and risk averting technique (Vandermeer, 1989; Altieri, 1991). In Darkot for example, wheat is often planted with mokakk and barley with peas, both of which fix nitrogen in the soil, improving yields (Whiteman, 1985), and meeting one of Vandermeer's (1989) criteria for practising intercropping. Polycultural intercropping also reduces labour requirements and minimizes the risk of total crop loss (Vandermeer, 1989; MacDonald, 1998).

Whiteman (1988) notes another advantage of intercropping, and that is to take advantage of particular microclimates. In the Nepal Himalaya, crop patterns within the field are sometimes refined to take advantage of the slightest variations in growing conditions. Within the same field the earlier maturing barley is sown in a one metre strip in the shaded portion, and the longer maturing and preferred wheat in the rest of the terrace (60).

Polyvarietal plantings, planting several varieties within the same plot, again, serves to disperse the risk of total crop failure and works to ensure an adquate food supply. Polyvarietal plantings within specific monocultures, increase genetic diversity and tend to mitigate the risks and hazards entailed in monoculture farming (Morren and Hyndman, 1987). The onset of specific diseases and disease carrying spores can be slowed, by polyvarietal planting for example, and local environmental conditions can be

modified so that they are less favourable to the spread of certain diseases (Altieri, 1987; Vandermeer, 1989). MacDonald (1998) also notes an additional benefit of polyvarietal planting; because pests and diseases are often variety specific, their diffusion within plots can be inhibited by the distribution of several varieties (304). Rhoades (1986) notes that mixtures of many varieties of native crop are grown "as a way to 'spread out' risks, as each variety responds differently to disease, insects or climate," and that "farmers guard against total crop loss by maintaining variety". While not every agricultural technique is a deliberate risk-averting practice, it may be done for instance to improve yields, the traditional system of agriculture and resource management serves to minimise potential losses and distribute risk among households.

Controlling slope topography to minimize erosion and the loss of soil and areable land, is another characteristic feature of Karakoram agriculture. Terraces control surface water flow, restrict gullying, stabilise slopes and reduce the potential for additional land loss (Johnson et al., 1982; Haigh, 1984). The benefits of slope stabilization are important. The problems of hillside erosion and mass movements pose a significant risk to mountain and hillslope agriculture and have been well documented (Ives and Messerli, 1981, 1989; Haigh, 1982, 1984; Valdiya, 1985; Messerli et al., 1988; MacDonald, 1989; Moldenhauer et al., 1991; Gardner, 1997). Mountain communities have developed strategies to minimize the degree and damaging effects of erosion, and to reclaim land damaged by mass wasting (MacDonald, 1998). MacDonald (1998) makes an important point, that "while actual damage usually occurs quite rapidly, response is a long-term, ongoing process of adjustment rather than immediate reaction" (307). Chapter 5 will

discuss this process of adjustment in more detail in Darkot, where recovery from mass-wasting events two-decades ago, is still going on.

The actual techniques of reclamation demonstrate an intricate knowledge of local environmental conditions and represent the accumulated practical knowledge of centuries of habitation in this specific setting. MacDonald (1998) outlines the process of reclaiming land following a damaging event. First terrace walls are (re)constructed. Stone walls are built in a series up the slope and essentially act as check dams to pond water and collect deposited sediment. If soil is available in the immediate vicintiy it is used to till in the area behind the walls. In any case, the area behind terrace walls is flooded during regular irrigation cyclings and, over time, a base of fine grained alluvium accumulates. This is complemented with the seasonal addition of manure. Once an incipient soil base has accumulated, grass and weeds are permitted to colonize the terrace. They build soil strength, improves the nutrient status of the soil and are allowed to grow for at least three years prior to planting a crop on the reclaimed terrace. By local estimates, the time from beginning the reclamation effort to recropping a suitable field is approximately eight years.

In addition to those specific response characteristics discussed above, continual efforts to maintain and repair terraces and degraded land can be interpreted as an "everyday" passive approach to risk management and the protection of vulnerable land. While farmers may differ in their commitment to protecting such land, community norms and sanctions tend to enforce property standards so that no one household is disadvantaged by the self-interested actions of another.

Diversification is also evident in the livestock component of the local mountain economy. By rearing a mix of animals, farmers are able to procure a variety of livestock products with differing nutritional and utilitarian value. They are also able to limit the risk of the total loss of a significant economic asset due to illness or disease. MacDonald (1998) notes that animals often represent a convertible asset during periods of crisis or low food supply. Animals represent a form of investment and the household maintains a low measure of risk through diversification. Diverse herd composition also permits the exploitation of several altitudinal ecological niches on both a daily and seasonal basis. Closely related to this is the role of spatially dispersed pastures. If all village livestock were concentrated in one pasture near the village, a situation of overgrazing would result and the carrying capacity of that pasture would soon be exceeded (Metz, 1990). The spatial regulation of grazing which disperses livestock also serves to disperse the effects of grazing, protect vulnerable areas, and secure a regenerative food supply (Brower, 1990). This spatial separation of livestock species also acts to minimize the impact of any particular hazardous event such as a landslide, rockfall or predation by wildlife. Much like field fragmentation, farmers protect their investment by spreading it over a wide geographical area with differing ecological conditions.

Figure 3.17 The extensive use of terraces minimizes erosion and makes planting on steep slopes possible.

The ability to protect this investment and equitably reduce risk among all village households is also a function of the communal ownership of pasture lands. While cropped land is privately owned by individual households, grazing land is held as a village commons. This diversification of tenure reduces the vulnerability of village households by providing equitable access to all, and contributes to the maintenance of the village as a viable unit by eliminating the potential dominance of vested or outside interests (cf. Rhoades and Thompson, 1975; Netting, 1994).

A final important strategy of risk management are cooperative work groups, discussed in detail by MacDonald (1996). Everyday field work is the responsibility of individual households, however a variety of normatively appropriate labour arrangements permit some households to overcome the limits and constraints placed on their ability to respond to hazard by a lack of labour. They provide the ability to overcome seasonal

bottlenecks for the village as a whole and periodic bottlenecks for individual households (MacDonald, 1996). At the village level, communal work groups are responsible for the maintenance and protection of common property and village resources. All village households are expected to contribute either labour power or material support to these groups (MacDonald, 1996; Netting, 1994). In contrast, voluntary work groups operate in an ad hoc fashion and come together as they are required by any specific household. These exist apart from and supplement the labour of communal labour groups. During the course of the field season, I was invited to witness one such voluntary work group donate their time and resources to the construction of a house for a man in the community who was partially crippled, and unable to do much of the work himself. Voluntary groups, suggests MacDonald (1996, 1998) focus strictly on repairs to household lands or buildings. Generally, when a project such as repairing or replacing a roof is anticipated, a household head will ask for assistance from friends and neighbors, and individual households will offer assistance based on the expectation that the same help will be available to them when they require it. No specific account of obligations is kept. In the case of more regular work groups, however, a form of balanced reciprocity endures and work is organized so that any enduring debt is avoided (MacDonald, 1994).

The importance of these co-operative groups, both communal and voluntary, should not be overlooked in a consideration of hazard response. It is these groups which permit a rapid response to environmental fluctuations. Stoeber (2000) gives the example of the village of Sultanabad in the Yasin Valley. On the night of 26th/27th of June 1990, torrential rains fell on parts of the Yasin Valley during a thunderstorm prompting several

large mudflows that originated in the relics of the lateral moraines along the slopes above the Yasin Villages. The village of Sultanabad was particularly effected by these events, which - apart from destroying farmsteads and submerging fields and roads - affected the villages two main canals at several points, filling them with boulders, stones and mud along a distance of from one to one and a half kilometres. The water flow was totally interrupted, and over 350 households suffered.

The following morning the tahsil administration in Yasin village was informed and immediate help was promised. The president of the village organization of Sultanabad also asked for the support of other village organizations. The request was made public at prayer times at the mosques and jama'at khanas. Working groups were arranged, and arrived with shovels and pickaxes and arranged for an equitable distribution of the work. Giram groups (composed of several households) took care of the workers on its own canal section, hard work for the women who had to prepare the meals. The water flow on the lower section resumed five days later and six days later on the upper section. Though the irrigation continued at once where the rotation cycle was interrupted, even this relatively short period of water deficiency led to a marked decrease in production (Stoeber, 2000: 86).

The importance of this relative self-sufficiency in times of crisis cannot be overlooked. Even if outside agencies were in a position to help, they would find it extremely difficult due to a dependency on roadways and communication routes both of which are commonly the first victims of geophysical hazards in the Karakoram (Ambrayseys et al., 1975; Hewitt, 1976, 1982, 1984; Stack, 1982; Dev, 1983; Davis,

1984; Nash et al., 1985; Hughes and Nash, 1986; Vuichard and Zimmerman, 1987).

The diversity of labour arrangements also extends to livestock management. Specifically, by forming collective village herds and relying on formal, village-regulated, and informal, privately negotiated, herding arrangements, farmers are able to minimize commitments of time and resources required by their stock. Not only do such arrangements lessen the labour burden on any particular household, but they build and strengthen social ties among those households which participate in a stock group. It is these social ties, developed through 'stock associateship' which can act as a hedge mechanism and increase a household's recuperative power through the activation of reciprocity claims in the event of, or in anticipation of, a stock loss or subsistence crisis (Watts, 1983: 118).

Taken as a whole, traditional systems of resource management and agricultural techniques practised throughout the Karakoram, are well suited to risk aversion. Despite some representations of traditional agriculture as 'static', as having reached the limits of its potential and requiring external intervention (see Mitchell, 1995). These adaptive strategies have demonstrated their effectiveness not only through their longevity, but also their use - in one form or another - throughout the world's highland regions. Changes asssociated with modernization (the development of new social and political groups and processes, the formation of new infrastructure, the re-allocation of resources, and changes in traditional or historic patterns of resource management, trade and movement) tend to disrupt these historic patterns and systems and in so doing create new forms of vulnerability. Within a modernizing society not only are the benefits

redistributed but so are the risks. In the following section I look at modernization in the Northern Areas: representations of mountain peoples and the discourse of development, 'paths' to modernization (in particular, road construction and the AKRSP), and social, economic and agricultural transformation with respect to risk.

3.6 Modernization

How one approaches the subject of modernization, development and risk in mountain regions depends significantly upon prevailing 'views' of mountain people or those seen to be inhabiting marginal or peripheral regions. For instance, mountain regions are often portrayed as marginal, 'backward' or fringe areas; their inhabitants as savage, reckless, and ignorant, a portrayal that is evident not only in the colonial literature of the 19th century, but some of the more recent work in the 20th (see Butz, 1998 for a critique of this). Why this is so, is subject to debate, but one argument is that the perpetuation of such myth, makes metropolitan or downcountry intervention somehow more justifiable. The mountain regions of Northern Pakistan have by no means been excluded from these portrayals, and in the following section I shall briefly outline their place in the national and international imagination. I will then discuss modernization in the Northern Areas, in particular the efforts of the AKRSP and road construction, which often act as instruments for change, prompting (or promoting) economic, social and agrarian transformation. Finally I will outline recent and ongoing development projects in the community of Darkot.

3.6.1 Mountain Imaginings

The cultures and people of Northern Pakistan have existed largely upon their own

resources and as distinct communities for up to two millennia. Beginning in the early 19th century various Western interests mapped and explored the area for scientific and strategic purposes (Hewitt, 1989; Keay, 1996). So began the practice of rendering, or portraying, the region for a modern audience. As travelers of various stripes - surveyors, pundits, explorers and administrators - began to take an interest in the strategic value of the mountain passes; and as painters and poets sought out the sublime, an image of the area was developed, an image that broadly conforms to Said's (1977) notions of 'Orientalism': the 'Orient' as exotic, backward, and occupying a certain place (and position) in the popular imagination. Similarly, in the writings and addresses of these predominantly male colonial authors, there is established a portrait of the reprehensible and irresponsible mountain dweller (Vigne, 1844; Shaw, 1871; Drew, 1875; Visser-Hooft, 1926; Schomberg, 1936), incapable of managing their environment.

It has been suggested that this discourse has been carried into contemporary mountain scholarship, resulting in the conceptualization of local mountain systems and practices as static and resistant to change; as largely anachronistic (Butz,1996; MacDonald, 1998). Inhabited mountain regions are portrayed accordingly as "isolated, temporally stationary, refuge areas" (MacDonald, 1998: 288). In any case, as Hewitt (1992) notes

> human agency appears, at best, as unconcious, an ignorant or helpless accomplice. This is especially easy with remoter mountain lands and cultures. Whether treated critically or romantically they commonly emerge as prisoners of an overwhelming environment, backward in economy; archaic, conservative, and superstitious in culture; having a geography but no history, incapable of effectively adapting to their setting or knowing their way to improvement (Hewitt, 1992: 57).

This portrayal of mountain peoples by outsiders, be they academic, economic, military or development oriented, is not done without an agenda (Tobias, 1986). Butz (1998) suggests that it is sometimes done to justify metropolitan interests, and almost always has the effect of justifying those interests. If mountain people are thought to be incapable of managing their environment, it makes intervention - managing it for them - not only appear justifiable, but as necessary! Butz (1998) gives the example of Shimshal. The people of Shimshal, he writes, are portrayed as being incapable of managing such a fragile and dynamic environment, and so the responsibility must inevitably (or fatalistically) fall upon outsiders, to save the Shimshalis from themselves.

Another example comes from Stellrecht (1998) who refers to literature - government and otherwise - in which the Northern Areas are portrayed as being isolated, and in (desperate) need of being opened up and more fully integrated with lowland economies. "Such sentiments are characteristic of the lowlands, where it assumed that a state of openness can be achieved in the mountain region by means of technological and political strategies, coupled with modernity, and that this, in turn, would give momentum to change (1998:8)." Change however is rarely examined in advance. Just how "a state of openness... [and] technological and political strategies" will effect risk and traditional mechanisms and strategies for coping with uncertainty remains to be seen.

We must also be aware of the 'development' discourse, which shares with Orientalism (Said, 1978) structural features of colonization (Escobar, 1995). Post-1945, 'development' has functioned as an all-powerful mechanism for the production and maintenance of the Third World. The previous knowledge production system was

replaced by a new one patterned on North American institutions and styles (Escobar, 1989). The "Third World" became targets of new mechanisms of power embodied in endless programs and strategies. All of which repeat the same basic truth, namely that 'development is about paving the way for the achievement of those conditions that characterize rich societies: industrialization, agricultural modernization and urbanization' Escobar, 1995: 214).

Beck (1991) and Winner (1986) have demonstrated the growing risks associated with modernisation on a global scale. The implications of 'development' on vulnerability to extreme natural events are best understood through the examination of daily life, particularly in the context of a small high-mountain agricultural community. This awareness is predicated on the fundamental notion that disasters are inherently social phenomenon which have their roots in social systems or structures (Quarantelli, 1995). In short, disasters are social and political events linked to who we are, how we live, and how we structure and maintain our society. For this reason it is necessary to include a discussion of 'modernization' and its relation to risk. Currently, the Northern Areas of Pakistan is a 'target' for such modernization agendas (Butz, 1991). In particular, through the efforts of the AKRSP, the modernization of agriculture and social and economic tranformation is underway.

3.6.2 Instruments of Modernization: The AKRSP and Road Construction

... the Karakorum Highway has brought about revolutionary changes in the Northern Areas... There is a greater awareness in the people about the economic potential of the region where they had lived in total ignorance and chill penury... The overriding consideration was to bring the inhabitants of the territory, who had for many centuries remained isolated from civilization, into the mainstream of national life... The increasing contact between the people of the area and those living elsewhere, will help to promote

national integration of a kind hitherto unknown to the mountain-locked population.

- Karakorum Highway pamphlet, 1978 (cf. Stellrecht, 1998)

There are several 'vectors' or instruments of modernization that are currently being employed in the Northern Areas. Through the efforts of the AKRSP, agricultural modernization and social and economic change is well underway. Premised on neo-classical economics, the question of 'development' is framed around the question of production and integration into the world economy (Butz, 1991). Road construction is also an important mechanism for change. Mountain communities have been linked for some time; there is, for example, a long history of intra-regional trade (Kreutzmann, 1991). However, the introduction of jeep roads (which are closely related to issues of national security and governance) serve as an effective conduit for modernizing schemes. Roads link communities to an even greater degree with political movements, international tourist activity and local and national markets, indeed integrating them into the global economy, but often disrupting traditional patterns of resource management, trade and movement. The aim of this section is to briefly examine these developments, in light of earlier comments regarding the representation of mountain people by outside interests.

The first agent of modernization I wish to examine is the work of the AKRSP. This non-governmental organization has as its mandate

> to increase the capacity of local people in the program area [intially limited to Giligt] to make use of opportunities to improve their welfare and to overcome the problems facing them. The main focus of the development effort is on income-generating activities, toward meeting the programs stated objective of "a doubling of (rural) per capita incomes over a period of 10 years" (World Bank, 1987: xi, cf. Butz, 1993: 223).

The history, goals, objectives and influence of this organization is discussed in detail by

Butz (1993: 221-254). My intention here is to highlight only briefly the part they play in the Northern Areas.

The history, goals, objectives and influence of this organization is discussed in detail by Butz (1993: 221-254). My intention here is to highlight only briefly the part they play in the Northern Areas.

Butz (1993) suggests that the AKRSP's definition of the problem - and its solution - is premised on several assumptions, that in turn reflect neo-classical economic thinking which has only a tenuous connection to, or relevance for, daily life in a high mountain environment. The problem, as defined by this organization, is one of production. First, farmers fields are too small; second, "the plight of small farmers in northern Pakistan is fundamentally economic: they are not able to exploit economic opportunities" (Butz, 1993: 229) and so social organization in the village needs to be reoriented towards increased cooperation to collectively take advantage of economic opportunities. A third assumption is that the goal of high mountain dwellers is economic maximization, just as it is (or is assumed to be) for the rest of us. In the same way that framing the hazards 'problem' in terms of violent natural extremes leads to a certain solution: nature is malevolent and humans are powerless (or irrational, or uninformed, etc.), therefore we must control nature (McPhee, 1976), representing mountain regions as backward or undeveloped, and then reducing that to a solely economic reference point, points to a solution that has a similarly narrow frame of reference. In any event, the solutions promoted by the AKRSP are economic or managerial ones.

The AKRSP solution is threefold, and includes overcoming the problem of small

scale through the formation of a village organization (VO); which, it is suggested, will be most effective when organized around a productive physical infrastructure (PPI) project (link road, irrigation channel, bridge, protective work); supplemented in turn by training and supplies (Butz, 1993). Again, according to Butz (1993) this reflects the programme's debt to modernization theory by emphasising the integration of communities with the capitalist world economy. Second, there is no way to evaluate the effect VOs - which are accorded a legitimacy that informal, cooperative groups are not - have on social organization in the community. Finally, AKRSP defines sustainable development as primarily economic. "AKRSP's interpretation of sustainable development corresponds with that of contemporary theorists: sustainability is primarily economic with ecological implications. Sustainablity of community as a specific social, cultural and political milieux is of secondary importance" (Butz, 1993: 236).

The second instrument of modernization in the region is road construction. This was given a huge boost in 1978 with the completion of the Karakoram Highway (KKH), linking the lowlands of Pakistan with the Chinese Sinkiang-Uighur Autonomous Region. A number of all-weather jeep roads have penetrated northern valleys both before and since. Construction of a jeep road to the Yasin Valley in the 1960s has facilitated motorized transportation between Darkot and Gilgit, the largest town in the Northern Areas.

Before proceeding, however, to a discussion of road construction in the Yasin, and its effects on Darkot, a brief review of the role of the KKH - the archetype of road projects in the Northern Areas - may help to shed some light on the relationship between

access and modernization.

The KKH runs from Islamabad to Pirali (China). Completed in 1978, it is among the highest motorable roads in the world. Several different reasons for the construction of the highway have been given in the literature. Stellrecht (1998) suggests that the road was built primarily for political reasons: China and Pakistan had been allies since 1963, and a highway was seen as the most efficient means of halting any expansion of the two adjacent allies, India and the Soviet Union, from pursuing their interests in the mountains (81). The route for the road was chosen primarily with those objectives in mind: straying neither too close to the cease fire line, nor too close to the Sino-Soviet or Sino-Afghan borders, and ascending the Hunza Valley where it would remain passable, even in the winter. Kreutzmann (1997, 1998) adopts a somewhat different perspective, suggesting that road networks in the Northern Areas are a revival of historic trade routes between highland and lowland and between nations.

Importantly however, the rhetoric of both modernization and road construction portray the people of the Northern Areas as living in "total ignorance and chill penury" and "isolated from civilization" (Karakoram Highway pamphlet, 1978). External intervention and road construction is then justified on the basis of national unity, security and development. While geopolitics may have been an original determinant in the construction of the road, its effects have touched many other aspects of daily life. Interactions between high- and lowland Pakistan for instance have increased dramatically, and possibly provide a template with which we can better understand the future impacts of road construction on Darkot.

Significant changes have come about in the Northern Areas, many of which it has been shown, are related to the goals of modernization, promoted by the AKRSP and the new linkages associated with road construction (Kreutzmann, 1991).

Figure 3.18 All weather jeep roads now link many valleys to Gilgit and beyond.

3.6.3 Agrarian Transformation

The main impetus behind agrarian transformation throughout the Northern Areas has been the integration of the region into the global market economy through the production of cash crops, promoted by AKRSP programmes. A second and related goal, is the desire for increased crop yields. The perceived outcomes of increased productivity as a result of this agrarian transformation include producing more foodstuffs for the commercial market and generating income, and then feeding the growing population.

A key factor in this has been the accessibility and road infrastucture afforded by

the KKH and other smaller roads and the goals of the AKRSP discussed earlier.

According to Kamal and Nasir (1996) some of the most significant changes associated with the modernization of agriculture have to do with landuse. While the area of land under cultivation in the region has not changed significantly between 1963 and 1983, a reflection of the fact that there is very little land not already utilized, there have been major changes in the types of crops sown. Growing of rice, for example, has virtually ended since it is both a labour intensive and water demanding crop, and has been replaced by cheap, good quality rice from the Punjab, readily imported via the KKH. Pulses, which used to be grown on infertile soil, are now also brought in from the Punjab. The soil they were once grown in is now heavily fertilised and used for maize, fodder and vegetables.

The use of chemical fertilizers also reflects the changing circumstances that have shaped the current rural economy. Whereas animal and human waste products were once used to fertilise fields, several recent changes have promoted the adoption of chemical fertilizers throughout the region. Declines in productivity are a net result of the lower labour inputs due to out-migration, decreasing numbers of livestock, and a corresponding decrease in farm manure. Other contributing factors include the use of flush toilets in some communities, which renders the use of human waste obsolete, and the discontinuation of soil conservation practices such as leaving land fallow. This process is aggravated even further by the abandonment of low-yielding fields that are difficult to reach and the growing trend towards cash crops (apricots, cherries, almonds, figs, potatoes).

Pilardeux (1997) suggests the extensive use of fertilizers however has proven problematic. Significant increases in productivity in cereal cultivation depend on regular agrarian inputs, proper handling, exact timing, a strategy balancing fertilizer and irrigation, and timely substitution with improved seed. However, these conditions are rarely met, owing in part to the irregular availability of fertilizer as well as a lack of dependent seed supply, throughout the Northern Areas.

Now that chemical fertilizers are readily available, their use has risen dramatically. Nearly all of the farmers surveyed by Kamal and Nasir (1996) now employ fertilizers and insecticides in agricultural production (315). In many, but not all cases, mechanization has also increased as tractors replace oxen once used for ploughing and threshing. This not only frees labour for off-farm employment, but encourages the enlargement of fields to make more efficient use of tractors.

Agrarian mechanization has been a growing part of Northern Areas agriculture for the last twenty years, as traditional methods of ploughing and threshing were put aside in favour of farm machinery. The threshing of wheat, for example, which was usually done using harnessed animals in a process extending over several days, is now accomplished in less than an hour. The implementation of the tractor and plough similarly saves on labour (Pilardeux, 1997). In some communities the rental of tractors, threshers and ploughs requires community cooperation by pooling monetary resources and devising a suitable schedule for their use. Tractors are used almost continually at harvest to ensure crops do not spoil. If the machines fail to arrive when planned, farmers must turn to traditional methods of harvesting, to avoid loss.

Despite these initiatives, farm mechanization does not appear to have significantly boosted agricultural production. Machines are used in an attempt to offset the seasonal shortage of labour, which in turn, is associated with roads, economic conditions and opportunities, and migration. These are all factors affecting the rural economy. Farm mechanization has not, therefore, led to an expansion of the irrigated area. On the contrary, farmers often curtail production in locations that are inaccessible - to a tractor - as well as in fields producing low yields. Which makes it about money, not primarily about yields.

With increased mechanization in agricultural production, as well as the reliance on jeep transportation for delivering goods "mountain people have become existentially dependent on permanent access to the lowlands" (Stellrecht, 1998: 83). A dependence on fuel alone necessitates, as Stellrecht suggests, maintenance of the highway, which is financed by lowland centres, and yet it makes farmers vulnerable to increases in shipping costs.

Kreutzmann (1991) points out that an early government survey on production feasability in the Northern Areas and Baltistan (Abdullah, 1972, cf. Kreutzmann, 1991: 731) indicated that the region would never be self-sufficient in food production and should orient agriculture towards the extensive cultivation of cash crops. These crops could then be sold/exchanged in return for cheap grain from the Punjab. This has guided all development strategies since that time.

Modernization programmes, with their emphasis on maximizing production, also contribute to a loss of crop diversity and promote changes in agricultural techniques

oriented away from risk aversion. Roads do not cause change, rather they provide the infrastructure which supports and accelerates certain processes (Kreutzmann, 1991). Allan (1986) in fact, suggests that accessibility be incorporated into a new altitudinal zonation model. There is evidence for significant transformation in communities' social, economic, and agricultural bases and land-use, with the rapid communication and access that comes with road access and increased vehicle traffic.

3.6.4 Social Transformation

Darkot has undergone rapid development both through the community's own initiatives and those of the AKRSP. The AKRSP has been the primary agent for modernization in the Northern Areas since its inception in 1982. Programs in Darkot have included those to do with education, health, agriculture, livestock, forestry and social organization. The role of the government has been minimal, though in the village many expressed their hope that this would change under the new leadership of the country4 .

There are three village organizations in Darkot, which have been responsible for a link road (now under construction) to Gamelti, protective levees on Khalung and Dulung Bar fans and a flour mill. As envisioned by the AKRSP, a village organization is a coalition of "all those residents of a village whose continuing economic interests are best served by organising as an interest group" (cf. Butz, 1991: 232). These VOs must meet regularly and make savings deposits into the VO treasury at each meeting (generally every few weeks). The village organisation is however an economic, as opposed to social, familial, or tribal unit. "Spontaneous" cooperative labour has been an important

strategy in recovering from hazardous events and this may be disrupted by VOs, and secondly because of the infrastructure construction requirement, several VOs in Darkot have chosen structural solutions to avert risk (dams, levees).

Social tranformation is also evident from changes in diet and food supply. Allan (1990) notes that following the construction of the KKH and the central government's provision of subsidized wheat, food scarcity has almost been eliminated in the Hunza Valley. Although, as a result no one starves in Hunza as they used to, it has reinforced wheat consumption instead of encouraging a shift in food production from grain to intensive cultivation of vegetables and increased orchard output. "Household cash is now diverted into useless non-food luxuries such as tea, and into large quantities of the three scourges of the South Asian diet: salt, sugar, and fats" (Allan, 1990: 411). Subsidized wheat creates dependency on the central government, giving it political and economic leverage it wouldn't otherwise have (Allan, 1990). Dittrich (1997) notes a similar transformation has been underway in Darkot since the abolition of the traditional aristocracy in 1972, improved road access and greater range of commodities in village stores.

The spread of schools in the Northern Areas, through the efforts of the Aga Khan foundation, also have a tremendous effect on traditional society, in which knowledge and information were closely related to the needs of daily life. Darkot has an AKRSP Diamond Jubilee school, in addition to the government primary school. Parents must pay Rs160 per month ($4 Cdn.) in order for each child to attend the school. Education is 'available' to all, boys and girls. However, the decision to send children to school rests

with parents, their ability to pay and their priorities. The most obvious incentive for educating children is the potential for off-farm employment in later years. Ismaili families generally choose to educate both boys and girls while Shia families are more likely to educate only boys, because of their strict observation of purdah (S. Flanagan, 2001, personal communication). Those with limited cash resources however are left in the position of having to 'choose' whom to send to school, thereby reducing their chances of escaping poverty in the future. The number of children attending the school has increased in recent years, and a concerted effort has been made to recruit girls. This may be a contributing factor in the shortage of farm labour in the village.

Social transformation has not been limited to these spheres alone. The opportunities for paid employment, particularly with the military which provides a fixed 'retirement' wage and the return of these men to the village seems to have an effect on social order. I am not aware of this having been studied in any detail, but in Darkot several ex-soldiers were financially better off than their neighbors (one owned a new bicycle, the only one in the village; another lived in a new concrete house and a third had started a campsite for trekking parties). Finally, as more men leave to find seasonal paid employment elsewhere, the productive and reproductive roles of women inevitably change as they absorb the burden of displaced labour, reconstituting the traditional division of labour.

3.6.5 Economic Transformation

Since the mid-1960s, the economic system of the Northern Areas has been subject to structural transformation processes (Dittrich, 1997). Indicators include the

substantially declining food subsistence level, especially in cereals, the reinforced shift towards the production of marketable crops, and the increasing dependency on external food supply. Causal factors or 'triggers' include the integration of the high-mountain region into expansive political and economic systems leading to the gradual spread of markets for food, consumer goods, labour and capital as well as the intensification and monetarization of exchange relations. The completion of the KKH in 1978 (together with the regional road network) provided the infrastructure and also served as a catalyst for economic change in the Northern Areas. The road linked the highland region with low-land markets and with already established regional roads. In 1982, the AKRSP was formed with the express goal of capitalisation: transforming the traditional subsistence economy into a market economy. By incorporating agriculture into the market economy, reorienting it toward the production of cash crops, however, an integral part of the adaptive strategy of many households has been subverted. It could be argued that this shift is also an adapative strategy - diversifying the resource base of the household or community to adapt to the new reality. Cash, however, is not a resource accessible to all; it creates new hierarchies, new forms of vulnerability (those with money, those without) and new demands on members of the household, particularly women who must often take up the labour left by men leaving to work downcountry or in the Gulf States. In this section, I review some of these changes as they relate to the region.

The introduction of the cash economy has brought, first of all, new opportunities, particularly for men, in off-farm employment. Incomes are used to supplement the sale of agricultural surplus or specialized commercial products at the market. Nearly all

women remain in more traditional roles but are affected by the changes all the same. Many have an ever-greater responsibility for the traditional subsistence economy, particularly food, domestic and village life, as husbands look for work in Gilgit, downcountry, or overseas. The out-migration of men has in some years led to a seasonal shortage of labour to readily perform traditional male agricultural roles.

Increased mobility as a result of the KKH and other jeep roads, has led to rise in local, regional, national and international trade. Fruit from the Hunza Valley is now sent downcountry, and in return, consumer goods and durables from China, and rice, wheat, and pulses from the Punjab, make their way into Northern Area markets. Men have also taken advantage of this new mobility, going both to urban areas in the plains and even to the Gulf States. In this instance however, the loss of traditional house building skills and the ready availability but often poor quality of concrete have contributed to greater vulnerability to earthquakes in this seismically active region (Hewitt, 1976; Davis, 1984). Many of the newer concrete houses simply collapse in an earthquake; one of the unintentional side-effects of development.

Kreutzmann (1991) indicates that trade between Pakistan and China has increased dramatically with the KKH, but that more importantly the economic distance between low-land and high-land areas has dramatically decreased. This has enabled the government to exercise more effective political control, as well as influence decisions regarding resource management (727). Allan (1990) adds that by importing subsidized wheat to the Hunza Valley, the national government has acquired important leverage in the region. Seasonal migration, common during colonial times, has since been replaced

by longer term absences, which can turn into permanent residence in Gilgit, Islamabad, Karachi or Lahore (Kreutzmann, 1991:731).

Changes that are a direct result of development elsewhere in the Karakoram have yet to make their influence fully felt in Darkot. In one sense, the road is a sort of beachhead. And changes visible in other communities will likely occur here in the future.

3.6.6 Modernization, Development and Darkot

A jeepable road was extended from Gupis to the Yasin Valley in the late 1960s and extended to Darkot in the 1970s. From Gupis there is a partly paved road that leads to Gilgit. The road has served as an impetus for change in the area, in several small ways including easier travel to Gilgit for seasonal labour, and purchase of consumer goods. Four-wheel drive vehicles make the trip to Gilgit 2-3 times a week in summer from both Darkot and neighboring Umalsit, less frequently in winter. At the moment the village is without electricity, and so the demand for certain goods is much lower than in Barkulti, or other communities in Yasin with electricity, which allows for refrigeration and the provision of a greater range of products.

It is difficult to say whether or not the limited modernization that has come to the community has been positive. If surpluses are produced, they can be sold commercially at one of Gilgit's bazaars, and an assortment of foods and household products in turn make their way into village stores.

Figure 3.20 Road construction in Darkot, funded by the AKRSP, is linking the village with communities further up the valley and at the same time easing the access to resources that were once difficult/too distant to exploit.

One indication of the effect of the road is that the number of stores in the village has risen from 1 shop in 1972, to 5 in 1982, and 10 in 1992 (Dittrich, 1997) and to 12 in 2000. Several of these stores were only open for part of the day, and one of them was built only after a recent extension of the road. The owner expressed his hope that further road construction would result in increased traffic and sales. The benefits of the road to store owners (and customers) are that a greater range of foodstuffs and durables (razor blades, soap, pots) from Gilgit are now available for purchase.

It is worth noting here, if only in passing, that the road also makes possible the import of basic foodstuffs (lentils, flour, tea, sugar). Dittrich (1997) suggests that the road has, in part, contributed to the decline in local food production. A similar trend has been observed in the Hunza Valley by Allan (1990) and in Nepal by Bohle and Adhikari

(1998). When villages and households become dependent on imported food however, they are increasingly vulnerable to fluctuations in price and availability, as well as the uncertain ability to earn a wage through off-farm employment, and there is no benefit in that.

The road from Gupis was extended through the village of Darkot in 1994, and a recent grant from the national government of 25 lakh rupees has been put towards extending the road all the way to Gamelti at the head of the valley. A second road is also being constructed up a tributary valley, to link the village of Gartens with Darkot.

The decision to build the first road - the extension to Gamelti - was made in consultation with the members of the community. The money, in the form of a grant, could have been used for any number of projects but it was decided to use it for road construction. The reasons given were that it would enable the community easier access to timber and wood supplies further up the valley, for fodder and construction. Other people indicated a desire to be able to access summer pastures more easily and to collect grass for winter fodder. One important household in the village sees the road as the first step in developing the tourism potential of a small hot spring.

The second road under construction, a short spur from Darkot to the village of Gartens, is funded by a loan from the Aga Khan Rural Support Program (AKRSP). The only other current projects include an irrigation scheme to bring water to Darkot, also funded by the AKRSP. Several systems of levees and retaining walls have been built on the sites of the 1978 and 1981 debris flows with the help of the AKRSP.

3.5 Conclusion

The traditional resource management system that has evolved in the Karakoram, is well adapted to take advantage of the unique opportunities and constraints of this vertically dominated environment. One of these adaptations is the extensive use of irrigation for agriculture. The need for water and terraceable land led to alluvial fans and terraces as the first choices for settlement (Kreutzmann, 1994). Once communities were established, the further use of an innovative mix of agricultural practices (field dispersal, polycultural and polyvarietal planting, terracing, and diversity in animals owned); social organization and the use of several ecological zones, allowed them to flourish. Inhabitants of this region have an intimate awareness of their environment. Slight changes in meltwater regimes or temperatures could be catastrophic and yet the success of this system has been proven over several millennia.

As was shown in the final section of this chapter 'modernization' programmes - particularly those promoted by the AKRSP - seek to re-orient the subsistence economy towards external markets. This process is aided and abetted in part by the construction of new roads, setting in motion changes that undermine traditional patterns of risk aversion. This includes changes in land-use and crop type, the introduction of fertilisers, a change in social organization, and in the economic bases of communities. Many of these changes are not well adapted to highland life, and even the elusive 'benefits' of modernization have not been distributed uniformly. This uneven distribution of benefits is foundational for understanding vulnerability at the household level.

With this context established, it is time to address the hazards themselves. What

are the events and processes that influence daily life in Darkot? How does the community manage those risks? And is modernization changing the quality of risk such that more people are affected and affected differently?

Chapter 4 - The 'Ecology' of Hazards in Darkot

4.1 Introduction

> *At night, after all but myself had retired to rest, a flood of mud, trees, and boulders descended like a thunder clap on our camp... we barely had time to rush up the piles of boulders above the torrent when it was on us, and then occurred such a turmoil of the elements as I shall never cease to look back as one of the most awful of my experiences. The vibration... was such that we feared rocks might be loosened from the cliffs which towered above us... dawn revealed to us a great scene of wreck. Pines of ten feet girth gone; a great boulder as big as a house, under which generations of shepherds had slept, overturned...*
>
> - Tanner, 1891: 407

In the preceding chapters, I have sought to establish a contextual framework for understanding 'risk' at the community level in Darkot, Yasin Valley. Chapter 1 reviewed existing hazards research, and introduced the concept of vulnerability as an heuristic device for studying risk in the community of Darkot. Chapter 2 discussed the landscape characteristics and environmental features of the Karakoram. Among these were steep, desiccated slopes, vast amounts of available sediment, extensive glaciation, and high seismicity. The climate is marked by extreme changes in temperature and availability of moisture. Chapter 3 enlarged this frame of reference to include those aspects of human history and activity, relevant to the discussion, with a focus on adaptation and coping. Particular attention was paid to the nature of agricultural production, for it is the risk of loss of, or damage to, crops, harvests or productive land, that is the most prevalent of household risks. Indeed traditional patterns of resource management were shown to be directed towards risk aversion, and not just production (MacDonald, 1994, 1998). The issue of modernization was also examined because it tends to disrupt traditional methods

of coping, and its benefits are unevenly distributed, heightening exposure to hazards for some while lessening it for others.

The purpose of this chapter is to narrow the focus of discussion to look specifically at Darkot, and to provide an inventory the range of hazardous events and processes that the community is exposed to. To do so is not to give these 'hazards' pride of place in the discussion, but merely as one of the necessary components better understanding the particular "ecology of risk" (MacDonald, 1994) in Darkot. 'Risk' is defined as the overlap between a hazard (or collection of hazardous events or processes), a vulnerable population, mechanisms of coping and adaptation, and intervening conditions of danger. Vulnerability exists in the intersection and mutual-imbrication of natural processes, landscape characteristics and social circumstances at the local level, but is contextualized by events and 'actors' (George, 1976) at the larger scale. Therefore it is necessary to establish the context, including just what are the relevant hazards are for the village of Darkot.

The chapter is based mainly on an provides an inventory of the hazards that were observed or reported by inhabitants in the village of Darkot. It is divided up into four sections. These are geomorphic hazards, which includes mass movements and hydrologic hazards, climatic and biotic hazards and food (in)security and health risks. These are shown below in *Table 4.1*.

Geomorphological Hazards

a.) Mass Movements
- i.) Debris Flows (Khalung Bar, Hashtic Bar, Burum Shung)
- ii.) Avalanches (Moshuting)
- iii.) Rockfall (Gasum)
- iv.) Catastrophic rockslides (prehistoric, Dulung Bar)

b.) Hydrologic
- i.) River floods and soil erosion
- ii.) Risks associated with irrigation and water supply

Climatic and Biotic Hazards

a.) Weather related hazards (short summer, drought, poor snowfall)

b.) Pests (birds, bugs)

Food (in)security and health risks

a.) Food shortages

b.) Malnutrition

c.) Poor health (high infant mortality, chronic infection, etc.)

Table 4.1 Range of hazards recorded in Darkot, Yasin Valley

Mass movements in general, and debris flows in particular, are the most noticeable hazards in the community. Two large debris flows in the last twenty-odd years alone have between them covered tens of hectares of land. As such they are quickly located, measured and marked on a map. Other hazards, for example avalanches, are seasonal and concentrated at times of the year when I was not there. To understand them requires more listening and less calculating. They too, however, are discrete events with a discernible sequence and clear geomorphic patterns. What Moughtin (1984) refers to as "creeping hazards" are more difficult to account for directly. These include climatic

hazards such as a late-frost, soil erosion, drought and water shortage (which can be long- or short-term, extreme or 'creeping'), or the sedimentation of irrigation channels and soil erosion. It is also necessary to make reference to 'chronic' risks that may be so pervasive, so much an accepted part of daily life, that people hardly refer to them as such. These risks include a high rate of infant mortality, chronic bronchial infections (due to the poor air quality in the home) (Giles, 1984), malnourishment (Nagra, 1997) or seasonal food insecurity (Dittrich, 1997) and other things that engaged my notice during the 6 week field season.

Figure 4.1 The village of Darkot is located on a combination of sediment fans, old terraces and floodplains. High local relief, intense precipitation, active weathering and several large glaciers contribute to the prevalence of debris flows, avalanches, flooding and soil erosion throughout the community.

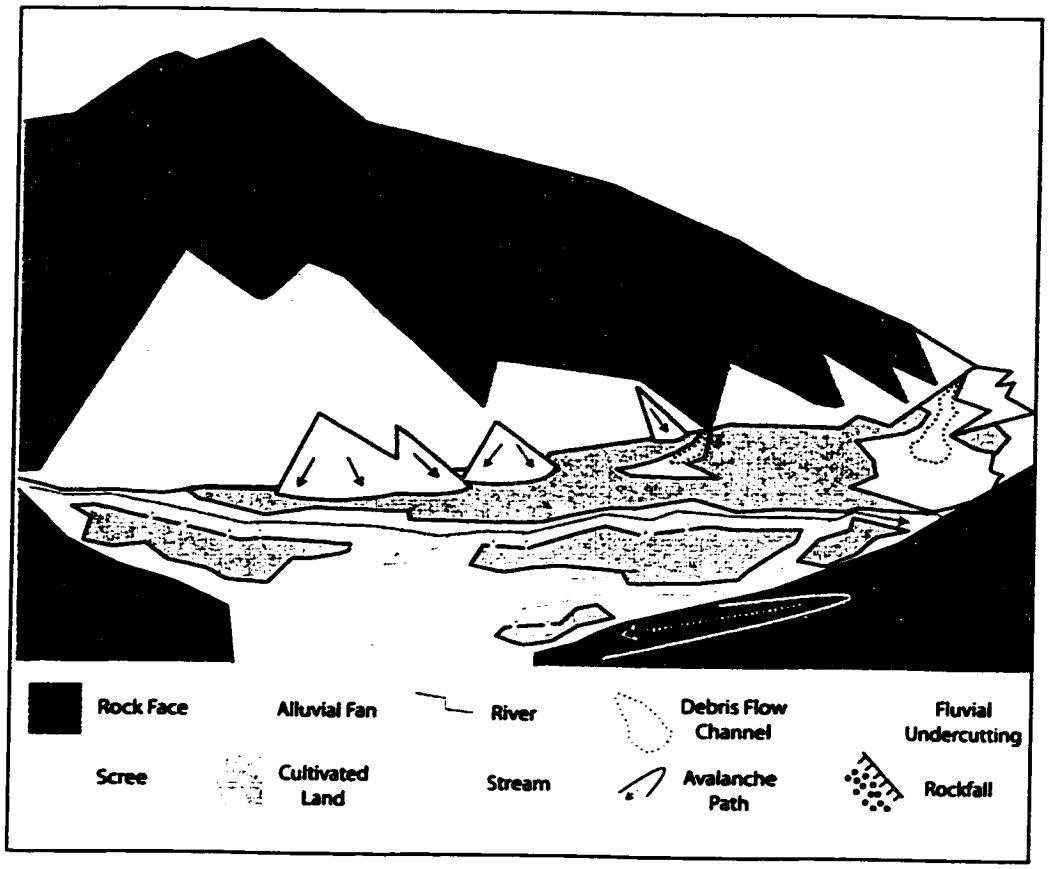


Figure 4.2 Schematic – Graphic Representation of Natural Hazards in the Upper Yasin Valley

Given the time constraints, language and social barriers involved in the course of the field season, I gave most of my attention to debris flows. Not only are these large deposits derived from tributary valleys quickly located, measured, and marked, but they are significant for the large amounts of land that they have rendered almost useless. The loss of productive land and/or the ability to remain largely self-sufficient in food production, was understood by many to be a serious threat to the village's long term viability. Debris flows in particular were regarded among, if the not the most significant factors.

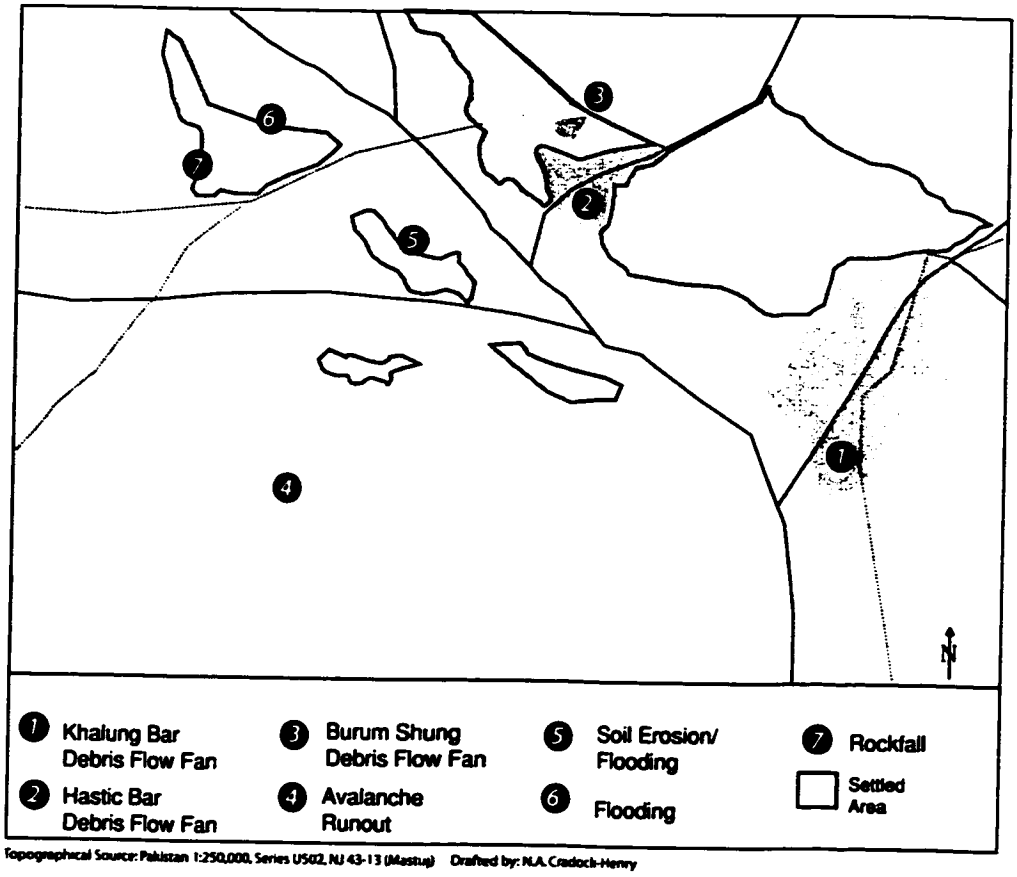


Figure 4.3 Map of 'Natural' Hazards in Darkot

That said, I must make some additional qualifications. First, this is not an exhaustive list of hazards in the Karakoram. Additional hazards, such as those that limited the productivity of land or slowed delivery of irrigation water, have been given less attention in this work than in research conducted elsewhere in the Karakoram. This points to the unique setting of Darkot, although I should be careful to point out the existence of hazards elsewhere in the region, other than the ones I concentrate most of my attention on. Research conducted elsewhere in the area has drawn different conclusions about which hazards are deemed the most pressing. For instance, MacDonald (1989) suggests that in Hopar one of the most significant hazards is the loss of agricultural land

by the retreat of the Bualtar and Barpu Glaciers. Damage to and sedimentation of irrigation channels is a leading cause of damages in other Karakoram communities, referred to by Butz (1987) in Hopar, and Kreutzmann (2000) and Stoeber (2000) in the Yasin Valley. Whiteman (1985, 1991) refers extensively to the risk associated with the weather and the marked variability in temperatures. Said (1997) has identified a range of hazards for the Shigar Valley including landslides, snow avalanches, river floods, torrential rains, short summers and soil erosion. The earthquake hazard in the Karakoram has been described by Hewitt (1976). Debris flows and other mass-movements have received considerable attention elsewhere including Bohle and Pilardeux (1997), Goudie (1981), and Shroeder (1989). Hughes and Nash studied the debris flow dam at Gupis (1986). And Flanagan (2001) examined debris flows at Nomal in the Naltar Valley where it was shown that debris flows played a similarly prominent role in the destruction of farm land. There is a range of hazards common to the region, but not all of them will be as significant in each locale.

Second, I have chosen to discuss what can best be described as 'chronic risks' in the community, which became evident even in the short time I spent there. These risks are pervasive. Possibly they can be referred to as "shadow risks" (Hewitt, 1997) in much the same way that Illich (1991) has referred to women's contributions to labour as 'shadow work', because they are often taken for granted and go unnoticed. A truly ecological understanding of risks in Darkot, must also account for these 'hidden hazards', if only because they effect people's ability to respond and cope with less-frequent, but higher-magnitude geomorphic events.

Finally, while debris flows are a significant hazard, they have a return-time of several decades or more. It is necessary to consider the whole range of hazards that run the spectrum from rare, localised events, to the more frequent, almost ongoing processes that affect, and are in turn effected by, human activity in this mountain region.

4.2 Mass Movements

The desiccated slopes of the Karakoram in the zone of permanent habitation offer little flat or even gently sloping land. Sediment fans - including debris-flow outwash and mud-flow ('alluvial') fans - and stream terraces offer relatively gently sloping surfaces (below ridge top levels), and are often the most readily and heavily exploited sites for human use in mountain areas (Kreutzmann, 1994). Other choices for settlement are on river flats. In addition to being among the few relatively good sites for agriculture, fans are usually situated close to sources of running water. Streams are more readily tapped using local technology that the main rivers running from the glaciers and have areas of forest suitable for the construction of permanent dwellings. Fans are also exposed, however, to a high level of risk from a number of mass wasting/mass movement processes, including debris flows, avalanching snow and rock fall (Derbyshire and Owen, 1990).

Western historical references suggest that the oldest settlements in the Yasin Valley - those recorded by George Hayward in 1870 and by McNair in 1883 - are on old stream terraces and low angle (< 5°) sediment fans (Hughes, 1984). These features are the most easily and often modified for agricultural and residential purposes. Exceptions are where 'old forts' were shown, which were situated on intermediate angled fans,

indicating that the original settlements were related to defensible positions (Hughes, 1984). The risk of occupying low angle fans is acknowledged by the practice of leaving a zone of land unoccupied where outwash debris may be expected to flow. At such places it was noted that dry stone walls are built in an attempt to safely channel any water and debris load/flow (Hughes, 1984).

It is only since 1921 that any villages have been built on intermediate - between 5 and 15° -outwash fans and it is only since the publication of the latest maps (1940s) that farming has spread onto the foot of the high angle scree slopes, the latter surely being the most precarious land form type for agricultural activity.

According to Hughes (1984) there are still a few low angle and intermediate fans in the Yasin Valley that have remained largely devoid of settlements. In recent years, some of these fans have been cleared, and recently taken over by immigrants. Sediment fans in the upper Yasin Valley, including Darkot, are more risky because they are not trenched, whereas many in the Karakoram are, so that debris flows and flood waters pass down the gullies in the fan rather than over the surface.

4.2.1 Debris flows

> *As we approached the Hispar glacier we had to cross the foot of a steep sided valley, where a stream drained some hidden snowy area high above. Just as we reached the brink of the gully we heard a sound like thunder, and saw advancing downward at a great rate, a huge black volume of mingled mud, water and rocks, which filled the whole gully and was making for the river below. The rocks that formed the vanguard of this hideous thing were many of them as large as ten-foot cubes and they were rolled round and round by the mud as though they were pebbles.*
>
> - letter from Baltistan, R.G. Conway, July 1892, R.G.S. Archives

The term debris flow signifies both a geomorphic event and the sedimentary deposit it creates (Jackson, 1987:3). Johnson and Rahn (1971) define it as "the mass movement of granular solids containing relatively small amounts of admixed water and/or air" (169). Debris flows generally consist of coarse-grained inorganic and organic debris that may include boulders up to several meters in diameter and whole logs, meters long. A fine-grained component, made up of soil ranging from clay to gravel and wood mulch, often accompanies the coarse fraction.

Rodine (1975) indicates that water, a source of debris and slopes steep enough to initiate and sustain movement, are the only prerequisites for a debris flow. To initiate a debris flow water must be supplied at a rate in excess of the rate of its drainage away from the debris, so that pore fluid pressure is increased to the point that debris movement can be occur. The flows usually occur in response to major rainstorms, rapid snow melt or both (Hungr, et al., 1987:202). In the Karakoram, water can also be supplied by direct protracted rainfall, rapid ice melt, springs and the melting of ground ice; or by catastrophic events such as jokulhaup (glacier-outburst flood) (Hewitt, 1969, 1993; Bohle

and Pilardeux, 1993; Hughes and Nash, 1984; Iturrizaga, 1997; Said, 1997).

A debris flow event typically consists of several surges of concentrated high-discharge, high-density flow, separated and followed by more diluted 'afterflow', possibly with water flooding. Once initiated, a debris flow usually advances down slope with series of distinct pulses or waves which overtake one another. The snout of an advancing debris flow is commonly described as a low wall of boulders and mud (Conway, 1892; Beaty, 1963; Hughes and Nash, 1984). In longitudinal profile, a debris flow is slug-like with its greatest thickness at its advancing bouldery front. It progressively tapers to a thin tail which eventually merges with the channel deposits.

Debris flows can transfer large amounts of sediment from mountain side to valley bottom in a short period of time - often only a matter of minutes. Many years may be necessary to move an equivalent amount of sediment in the same basin by other means. Debris flows also have the ability to transport large clasts across gentle slopes. Rodine and Johnson (1976) report boulders with volumes upwards of $6m^3$, rafted by debris flows down slopes with inclinations of 5° or less.

Upon leaving tributary valleys debris flows are no longer as confined and so spread out, thinning and draining until they cease to flow. Over the years, a fan-shaped landform is built by successive debris flows at such sites. The term alluvial fan was originally assigned to this landform (Derbyshire and Owen, 1990) but because of the prevalence of coarse debris "sediment fan" is preferred in the Karakoram. Fans can be made up exclusively of debris flow material, or can be built of both fluvial, avalanche and debris flow sediments. Debris flow deposits are distinguished from fluvial fan

sediments by their unstratified structure and poor or absent sorting. They range from clay to boulders in texture and are usually matrix supported. Where they have been recently deposited on the surface of a fan, debris flow deposits are lobate with a surface relief of several centimeters to half a metre or more above the surrounding fan. The upper areas of the fan are frequently marked by levees along the left margin of the passing debris flow snout. Where they are interstratified with other fan sediments, debris flow deposits appear lenticular and sheet-like in transverse and axial fan sections, respectively.

Attempts to insulate lives and property from debris-flow hazards have led to the development of a range of structural defenses, including retaining dams, levees, and concrete channels. These are in use in British Columbia, Japan and the European Alps and have had some degree of success (Jackson, 1987). Along the Howe Sound near Vancouver, BC, for example, expensive homes have been built on the mountain side with little forethought to the possible consequences. Engineered solutions however are costly, and difficult to implement in the mountains of the Karakoram, although the AKRSP has tried. In a small agricultural community such as Darkot, the most viable alternative would be to relocate fields and homes elsewhere; but "elsewhere" in this otherwise steep environment does not exist very often.

4.2.1.1 Debris-flows in the Karakoram

The environmental conditions of the Karakoram are extremely conducive to widespread mass-wasting events (Shroeder, 1990). These includes a high-degree of seismic activity, bare and denuded slopes, extensive intermontane sedimentation including unstable morainic slope materials - remnants of recent glaciation, and the

prevalence of extensive contemporary glaciation (Goudie, 1981). Local relief is also very high in these mountains, often in excess of 3000m and the climate is marked by brief periods of intense precipitation.

Date	Details
June 1998/2000	Two debris flows causes extensive damage in the Hushe Valley. An unknown number of people killed in 1998, and massive destruction associated with the 2000 event.
June 1999	Debris flow destroys a small community on the Ghizer River west of Gilgit. The slide blocked the Ghizer River and several homes and a mosque were flooded by the lake that quickly formed behind the dam. Six families were drowned.
June 1980	Large debris flow near Gupis blocks the Ghizer River. A number of homes and a small village were flooded when a lake formed behind the dam. The size of the dam has been estimated to be 2 x $10^6 m^3$
August 1976	Large debris flow in Nomal, Naltar Valley. 11 persons killed.
	(Sources: Hughes and Nash, 1983; Hewitt 1997; Kreutzmann, 1993)

Table 4.2 Selected Debris Flows in the Karakoram

According to Hewitt (1989) in an overview of Karakoram geomorphology, avalanche deposits and associated meltwater are most often responsible for mud- and debris-flows. Torrential rains, such as those that occurred in September 1992, have also been responsible for a number of other events. Hewitt (1993) and Bohle and Pilardeux (1993) note several large mud- and debris-flows which closed the Karakoram Highway for nearly 2 weeks and were associated with those rains. *Table 4.2* shows a selected range of debris flow events in the region.

Other significant events in the Karakoram include the July 1980 glacier-outburst flood which generated a massive debris flow above the Ghizer River west of Gupis

(Hughes and Nash, 1986). A number of homes and fields were flooded when a lake - 5 km long and up to 30m deep - was formed behind the dam, which persists to this day. When these debris flow dams burst, the downstream results are catastrophic. Drew (1875) recounts the example of one such dam bursting at Atak (Attok) which took the lives of over 500 people, and with them "trees and houses themselves were swept away; every trace of cultivation was effaced; and the tents, the baggage, and the artillery, all were involved in the ruin" (415). Flanagan (2001) has noted the results of a series of debris-flows affecting the village of Nomal in the Naltar Valley. Eleven lives were lost in a slide in August 1976 (including one entire household of 6). Numerous livestock were killed and 9 acres of farmland wiped out. The debris-flow followed a period of heavy rains and formed a large gully which passed directly through the village to the Hunza River. Since this event, homes have been rebuilt elsewhere and some land has been reclaimed by planting fodder and wheat.

4.2.1.2 Khalung Bar

Two of the oldest settlements in the village of Darkot are the communities of Dass and Khatgramm, located on an ancient sediment fan. These were the settlements described by Hayward (1871) and McNair (1883). The fan is referred to locally as either Farangi Bar ("the place of the foreigner"), or as it is marked on the map (US Gov. Series 502, NJ 43-13) Khalung Bar. It was at this site that the largest debris flow to directly effect the village occurred on the evening of July 27, 1978.

Residents recalled severe rains in the days leading up to the event, and it very likely occurred in response to this period of intense precipitation. Whiteman (1985)

makes reference to the glacier that feeds this stream, and suggests that the debris flow may also have been related to an outburst flood. Much of the average annual precipitation of 116mm, falls between June and August. Not only does this promote flashiness in streams in tributary valleys but also slides such as this (Jackson, 1987).

Late in the evening of July 27th, 1978, several hundred thousand tonnes of rock, mud and water tore down the stream bed. Local relief on this particular fan is approximately 1500m, and it is possible that only a few minutes would have been required for the mud and water to reach the valley floor. When the pulsing debris had finally subsided, over 4 km^2 of debris had been deposited on top of crops, canals, and homes (see *Figures 4.4, 4.5* and *4.6*).

Figure 4.4 The upper portion of the Khalung Bar debris flow.

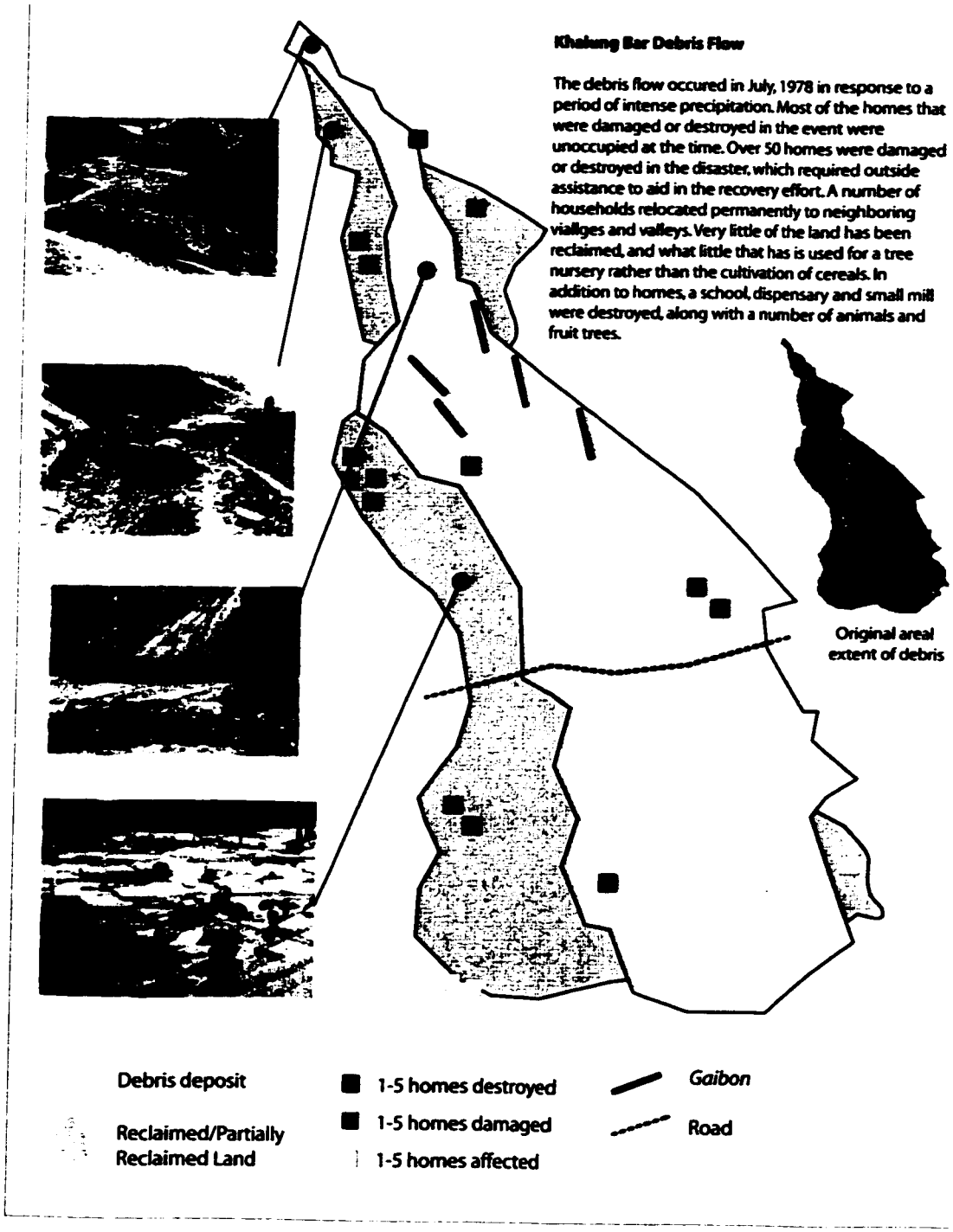


Figure 4.5 Khalung Bar Debris Flow

The majority of damage was done to the original communities of Dass and Khatgram, the oldest settlements in Darkot. The homes, fields and other buildings have been relocated, and much of the fan today remains a barren wasteland. Following the debris-flow in 1978, and as irrigation channels and the road were extended, the community spread out further to the north.

Before the debris flow the surface of the fan had been modified for agricultural use. The small meltwater stream was used to irrigate adjnt fields and power a small flour mill. The risk associated with occupying this and other low angle fans was acknowledged by the practice of leaving a zone of land unoccupied where outwash debris may be expected to flow (Hughes 1984). This is a technique practiced throughout the Karakoram (Moughtin, 1984; Hughes, 1984). In conversations I had with residents several people indicated that prior to 1978 the fan had been active, although the events were of a much smaller magnitude. In place of this non-structural strategy of risk aversion, levees - large piles of boulders held together with wire mesh - now line the channel.

Figure 4.6 Sediment deposits on the Khalung Bar Fan

Occupation of this area entailed a number of modifications to the surface of the fan. In addition to the terraces and canals, there was a mill and several storehouses. A good indication of the relative importance of this area is seen in the number of homes that were destroyed. According to Hughes (1984), 80 homes were destroyed. Kreutzmann (1993) suggests that 1/3 of the village was forced to relocate, a figure which corresponds closely with data collected this summer which indicated 40-45 homes were damaged beyond repair or destroyed. Furthermore, this was the site of a government primary school and a dispensary - both of which were obliterated. The ruins of the school remain on the edge of the slide, a forgotten pile of bricks. Only one home has ever been rebuilt, and that very recently. The owners, however, are still reluctant to move in.

Most of the residents of this small community were engaged in agricultural activities away from their permanent homes when the debris flow struck. In the months

of June to September most villagers live near summer pastures and fields in tributary valleys where animals are tended. Those that were not already up at summer pastures, I was told, left their homes when the small creek on the Khalung Bar fan started to rise. Accordingly, only about 20-30 animals were lost (yak, goats, cattle, *dzo*).

In addition to the loss of homes, animals and other property, was the loss of productive agricultural land. This was, in the longer term, a more serious consequence. One local resident suggested that upwards of 400 *kinar* (approximately 400 ha) of land was lost - this is a fairly good estimation of the total extent of the deposit, which I surveyed to be 4.3 km^2. An additional 9 *kinar* of fruit trees and gardens were also buried under the rock and mud.

Older residents who remembered the event, recalled that their initial concern was for food. Crops were approaching the harvest, and the loss of approximately 100 kg of grain/ha that was normally gathered was devastating. The loss of crops was, and remains, particularly acute for a community that is only able to harvest one crop per year. In this context the importance of transhumance agriculture becomes doubly significant. Because most people had their animals in summer pastures, they were spared. In addition, the practice of planting crops in tributary valleys ensured at least a measure of food, although it was not sufficient. A large number of people - about 20 households - had their fields in Gamelti, a small formerly temporary village above Darkot, and have since chosen to remain there. Others had their fields further up the valley in Darband, at the foot of the Darkot Pass, or in Gasum, on the right bank of the river. In Chapter 5, I shall discuss in more detail the relationship between vulnerability and this event.

4.2.1.3 Hashtic Bar

The second large debris-flow in recent memory to occur in the village was in 1981. The stream channel through which the mud and rock descended is known locally as Hashtic ("backside") Bar. For the most part it is a small melt-water stream used for irrigating the crops in the communities of Heryachim, and the northern ends of Dass and Khatgramm. This area, like the fan at Khalung Bar, is also highly productive agricultural land. A series of transects showed a high level of agricultural diversity in this portion of the village. Low terraces separate fields, the average slope is slightly steeper (>5 °) than elsewhere in the village, and is sited on a combination of historic debris fan, and the toe of a series of large talus cones. The road marks the upper limit of development. The area includes approximately 500 people, and 60 homes.

The debris flow of 1981 - while only slightly smaller than the slide at Khlanung Bar - took most people by surprise. No one I spoke with recalled the stream flooding previously, nor was there a suggestion that the area had been avoided because of an excessive risk. Possibly because there was no history of events and the fact that the stream channel remained very small even during times of peak runoff, no one in the community had been substantially prepared. And, unlike the previous slide, most people were at home when it happened. Fortunately, no lives were lost, and only a few people were injured when the debris tore through their homes.

Seven houses were damaged in the slide. These were pointed out to me during the course of the field-season. Most of them were repaired, only one was completely destroyed. In most cases the debris took out stone walls, and knocked out timber

supports. The low stone fences - often topped with brambles to keep the goats out - were also knocked down along with some terraces. The most severe damage however was to the fields in the community, which were covered with a fine mixture of impenetrable sediments and rock, one metre deep.

It has taken several years for the fields to be restored, and even now I am told they are less productive than they once were. One family has turned one of their rocky patches of formerly productive earth into a campsite for visiting trekking parties. Large piles of stones have been formed along the top of the terraces between fields and on the margins of the cropped area, evidence of the annual spring chore of prying debris from the soil, pushed up by the frost and crops of previous years (see *Figure 4.7*).

Figure 4.7 What little land has been recovered is often marginal.

Development on the fan has been limited since the event occurred in 1981. In 1983 a series of low levees - made out of piles of rocks held together with wire mesh -

were built with the help of the AKRSP. Meant to protect the structures and the fields that it was hoped would be reclaimed, the levees have preserved a narrow channel through which any future debris load can travel. Land reclamation has been prompted, in part, by this "levee effect", right up to the levees themselves.

A total of 3.1 km^2 of land was covered with debris. Since then, almost 1.9km^2 (61%) of that has been reclaimed. This is in marked contrast to the first site. Overall reclamation of land may be related to (a) the confidence that people have in the levees to protect their fields, and their investments of time and labour in recovering that land, and (b) the shortage of available land. Of the two, the latter would appear to be more credible: all of the 0.5 km^2 land put back into production at Khalung Bar, itself a lengthy process, has been within the last 10 years. The combined pressure of the need for food production and the shortage of arable land has meant that risky and marginal areas are being put back under cultivation. In 1990 a new school was constructed very close to the debris-flow channel on top of what appears to be the remains of a much older (>300 years) slide.

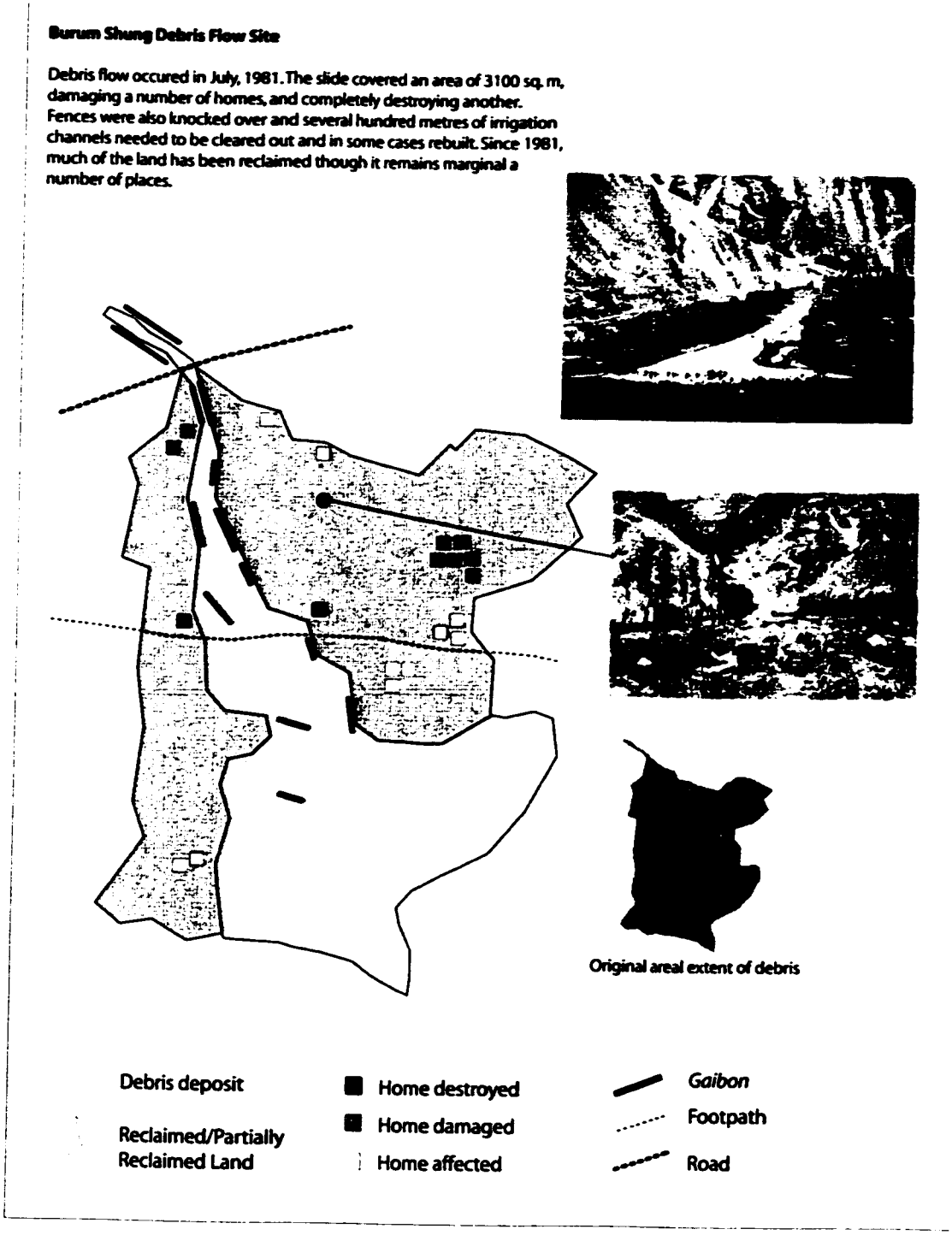


Figure 4.8 Hashtic Bar Debris Flow

4.2.1.4 Nughun

Nughun ("big waterfall") is a small, perennial debris flow site located along the Darkot-Darband jeep road, about 500m north of the Hashtic Bar site. The channel is 2m-3m deep, incised into a spectacular talus cone. It has a sporadic history of occurrence, but remains an ever-present threat for the family on whose land it sometimes descends. The owner said it used to be active every year, sometimes washing away newly planted crops, filling channels with sediment, and burying fields under several feet of debris (fig. 4.9). When that happens, he told me, the family has little choice but to abandon their fields here, and go to Gasum on the other side of the river. In the year that I visited (2000) though, they had been fortunate - to a degree. The absence of rain means the channel poses little danger, but it also means that water for these fields is in short supply. The slope above these fields ranges from 35-40°. Much of the material is fine sediment, or coarse gravels, not very consolidated. During periods of heavy rains, the runoff travels down an incised channel, bringing with it several hundred cubic meters of sediment, which, after crossing the road, winds up in the field shown in *Figure 4.9.*

Figure 4.9 The Nughun debris flow channel regularly floods the fields below.

Several years ago, these fields had just been planted and the entire crop was washed away over the course of several days. A large swath of land has now been abandoned to the vagaries of nature, and allowed to grow over in grass. When the moss comes he says, they go to Gasum where they have other fields. Wheat, barley, and buckwheat were once planted in the original fields. This year, because of the poor snow, and the difficulty in irrigating, the topmost fields were not planted. In such years, he continued, the animals were very important for fertilizer.

4.2.1.5 Burum Shung

The area of Darkot known as Burum Shung ("White rock") is the toe of a large talus cone. There is clear evidence of recent (<50 years) debris-/mud-flow activity, and the fan's inhabitants report it as being the site of several infrequent events over the years. It has only been developed for residential and agricultural purposes in the last 20 odd years. Terraces and irrigation channels have been built, along with 4 permanent homes.

The small fields support crops of wheat and barley, and several apricot trees. The residents expressed their awareness of the risk in occupying the area, but explained that this was outweighed by the need for production: "There is nowhere else for us to go," was a common refrain.

4.2.2 Snow Avalanches

Steep terrain, extreme local relief, and the location of many communities on the exposed valley floor, combine with heavy snowfall at higher elevations to create a significant avalanche hazard in the Karakoram (Shroeder, 1989).

There are two kinds of avalanche. Loose snow avalanches release at a single point and entrain only the top layer or most recently deposited snow (McClung and Schaerer, 1993). Slab avalanches involve a greater volume of snow, travel further, and - owing to the entrainment of the slope regolith - perform more geomorphic work, including the uprooting of trees, the erosion of slopes, and the removal or transport of boulders and debris.

In the Karakoram, both dry and wet slab avalanches pose a threat to life, property, and production. A basic understanding of the formation of avalanches includes knowing the importance of weather, snowpack development, and terrain. As important as an understanding of the factors that contribute to the formation of avalanche hazards [information which is covered in detail by Armstrong and Williams (1986), Keylock (1997), and McClung and Schaerer (1993)] is, it is often more pertinent to a discussion of risk to consider the location, spatial range and temporal distribution of activities, fields, dwellings and transportation routes. This is particularly important in regards to the

Karakoram, where the mountains are sites of permanent habitation as opposed to being backdrops for recreation or used solely for resource extraction (Kariel, 1986). It is vital to consider the unique context of the region, environmental characteristics and landscape features, social practices and techniques, and human vulnerability, in which avalanche activity poses a threat. *Table 4.3* shows just some of the avalanches that occur annually in the Karakoram.

Date	Comments
January 2000	An avalanche struck an army post in Nekron, Neelum Valley, 10 people were killed.
February 1999	An avalanche struck an army post in disputed Kashmir, killing 12.
March 1996	At least 44 people are killed by avalanches in the Neelum Valley.
December 1993	10 soldiers are killed in an avalanche on the Siachen Glacier.
March 1993	Several avalanches kill 100+ people in the Swat Valley. Large number of cattle are also killed, 20+ homes destroyed.
February 1991	25 persons killed in an avalanche in Pakistan occupied Kashmir.
March 1984	Village of Arandu Gol is buried, 50 persons killed.
March 1983	Large avalanche kills 95 persons and injures 300 in Phuban village, Astor Valley.
March 1978	At least 25 people killed in an avalanche that buried the village of Dorr, near Skardu, Baltistan.

Table 4.3 Selected Snow Avalanches in the Northern Areas, Pakistan (Sources: Encyclopedia Britannica Yearbook (1978-2000); Hewitt 1997; Kreutzmann, 1994; New York Times (1978-2000)

The recent development of all-weather roads throughout the Karakoram has increased levels of risk by exposing more people, communication lines, traffic, and trade goods to avalanches. There is now the opportunity to travel throughout the winter with

relative ease. Traditional activities (transhumance, grazing, agriculture) have also expanded into marginal areas, both increasing and exposing people to risks that may not have been present in the original location (de Scally and Gardner, 1994). Another important change is the growth of tourism, which involves the development of hotels and facilities in areas that may once have been avoided and participation in recreational activities by individuals who may have little or no experience in high mountains (Gardner et al., 1997; Gardner, 2001).

In Darkot, avalanches were only cited as being a recurring threat in one community, Moshuting (described in section 4.1) on the west bank of the Darkot River, at the base of the East Ghamu Bar Glacier.

Figure 4.10 The community of Moshuting

The community of Moshuting is situated to the (upslope) left of a significant avalanche runout zone. "Silent witnesses" include the bent trees, large rocks rafted into the village, and the bare, denuded slopes . Immediately above the village is the main

snow accumulation zone. The slope averages 35 degrees, lessening just above the village. The runout (10-15 degrees) itself continues to the glacial outwash plain below. While the avalanching snow itself poses one sort of a hazard - it frequently damages homes, stone walls, and has rafted a number of large boulders into the village and fields - it is the accumulation of heavy, avalanche deposited snow that in the spring poses the most enduring threat.

Avalanches pose the greatest risk in the spring. The community is uninhabited between November and May, so the only risk during the winter months is to property: houses, fences, terraces. In the spring however, fields need to be prepared, crops sown, irrigated and harvested. Fences need to be rebuilt, houses readied for summer occupation and animals brought up to pasture. This is also the time that the avalanche hazard is most pronounced.

Figure 4.11 Avalanche debris that is deposited on the fields delays spring planting and compromises the community's ability to grow sufficient food for the year.

Beginning in March - when the sun warms the snow on the ground and precipitation falls as rain - the bonds which held the snow together weaken, and water percolates through the snowpack to lubricate the surface on which it rests. The result is large slides of heavy, wet, dense snow that - when they are released - entrain large amounts of sediment and rock debris, which is carried down into the village. Immediate damages that were observed and recounted include fences toppled, trees broken and houses damaged or destroyed. Large boulders that have been entrained by this heavy snow dot the community, and one large stone has been converted into the back wall of the very house it demolished. A longer term - and reportedly more serious - effect of these slides was the deposit/accumulation of wet, dense snow on the fields. Villagers reported accumulation of up to 4 meters in winters past, covering the fields and preventing or delaying spring cropping. Elsewhere in the Karakoram this may not be as serious an impediment to agriculture. In a community where only a single crop can be grown in a year however, it is imperative that the crop be successful. The consequences of a failed crop can be disastrous.

In 1997, a particularly heavy year for snowfall, avalanched snow remained on the fields until July. The fields were sown, but it was too late, and they were destroyed by frost before they had matured. With no other fields under cultivation, some members of the community were forced to spend the winter downcountry looking for work, while the rest made do with a meager stored surplus.

Avalanches do occur in other parts of the village, especially on the steep talus slopes and access paths to high pastures, but they were never mentioned as being a

particular problem. There is little travel to and from high pastures or to the communties at further up the valley. Avalanche problems may become more prevalent in the future as road construction continues to integrate once self-sufficient communities and avalanches disrupt regular transportation.

It has been noted elsewhere in the Northern Areas that avalanches are not interpreted as a solely destructive force, but that there are some benefits associated with them. De Scally and Gardner (1994) report that avalanche activity in the Kaghan Valley provides significant resources for the local population. Timber uprooted at higher elevations by avalanches is collected in the valley bottom for fuel wood, organic debris transported into runouts builds the organic component of agricultural soils, and so runouts become prime locations for the cultivation of corn and potatoes. The authors also recount instances of avalanches being purposely used to transport cut logs from high elevation forests. Trees are cut in the fall and left at the top of the runout zone. Other benefits include the use of melting avalanche snow for irrigation. High density snow is manually quarried and trucked out of the valley to the plains for refrigeration; and larger avalanche snow deposits provide relatively easy access between the valley bottom, village and high pastures (de Scally and Gardner, 1994: 207). In the context of the Kaghan Valley, this is understandable. There is a much higher percentage of forest cover, two crops can be grown each year, the village is well connected by road and is at the center of a burgeoning tourist industry. Residents of Darkot, on the other hand, did not relate avalanching snow with any particular benefits. In one case, a large rock deposited in the village was also used in construction, but no other immediate benefits

were mentioned.

4.2.3 Rockfall

The nature of geologic material in and around Darkot, and the extremes in temperature, often cause fracturing and flaking in the rock formations above the community of Gasum, a summer community on the west bank of the Darkot River. Most of the damages associated with this process are limited to destroying sections of fence. The large rocks have also reportedly caused limited damage to crops and fields. A transition area between the base of the rock face and fields has been established, placing property and built structures out of the way of falling rock. In Moshuting, large boulders fall infrequently, and damages are limited to knocking over fences.

4.3 Erosion and Flooding

While not every case of flooding and soil erosion is dramatic these processes do pose a serious threat to the long-term viability of agriculture in at least one community in Darkot. Soil erosion in this valley is a seasonal event related to melting snows in the spring and glacial melting in the summer. Moughtin (1984) who looked at hazards in the village of Barkulti, also in the Yasin Valley, writes that "such events produce the greatest fear because subsequent loss of livestock and damage to the land and foodstocks could result in famine". This view can be challenged however. Not only in Darkot was there a much more resigned view of the risk posed by soil erosion, but food shortages have to do with a much broader range of factors than environmental conditions or loss.

Below the glaciers of the Ghamu Bar Massif lies the small (<10 homes) seasonal settlement of Ashtanimakhduring on the west bank of the Darkot River. According to

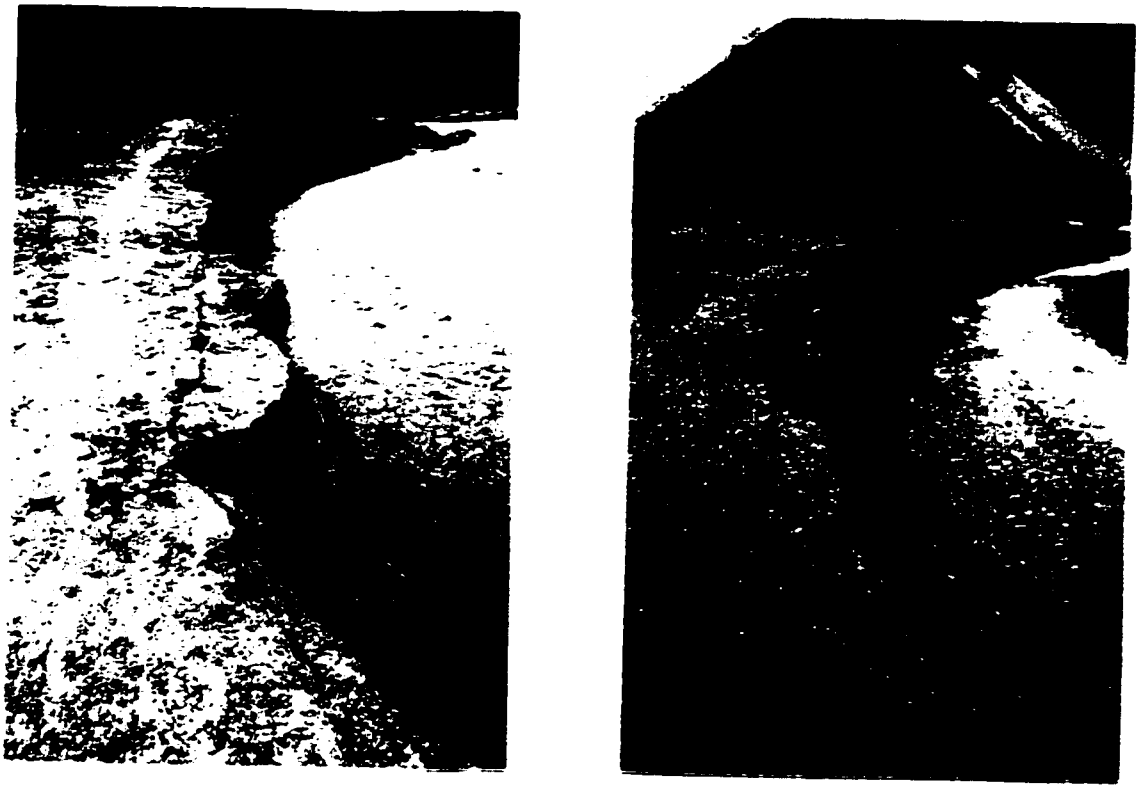
local residents this area, along with tributary valleys and the remainder of the Yasin, was densely forested, as recently as the late 1960s. Still evident are some small stands of willow, juniper, and poplar, but nowhere near the number reported by the first European visitors. Drew (1871), in reference to the site of Hayward's murder, wrote that "[t]he position of the camp helped their design: it was at a little distance from the village, in a small garden at the edge of a thick pine forest" (16). Sir Henry Newbolt, in his account of Hayward's demise, paints a picture of "straggling hamlets half hidden among the willow groves" (cf. Keay, 1996: 331). Schomberg (1934) refers to "the fields and houses of Darkot with its very broad river bed covered with abundant trees" (318). Finally, the English explorer Wilfrid Thesiger who came this way in 1953, said that the local residents called the area around Darkot a 'jungle', where ibex and birds (that he says were hunted for food) were plentiful (Thesiger, 1998: 59). A map prepared by Huzita (1965) shows the village nestled amongst a dense stand of poplars. Some of the local residents of this community pointed out to me where the tree cover once extended: from the right bank of the river, to a place 40 metres beyond, where one willow still stands.

In conversations with local residents I was told that as recently as thirty or forty years ago, all of the land on the west bank of the river had once been forested. Immigration and natural population growth had taken some toll on the forest, used for construction and firewood. The reason that was given most often though was that the land had belonged to the *mir* of Yasin until his title was abolished in 1972. It was not clear whether or not the forest had been 'protected' or destroyed deliberately. Hughes (1984) writes that:

> Willow, poplar, and walnut are the predominant tree types now grown on the terraces. It was reported that many of the tributary valleys were once tree covered but are now totally denuded because of the timber demand for building and for fuel. The last area to have had a natural vegetation is called the 'Jungle', located just to the south of Darkot. Until a few years ago this consisted of 150 ha. of dense willows but is now just a mass of tree stumps and rotting roots. The area is still occasionally scavenged for the odd bit of usable firewood (Hughes, 1984: 258).

Once the trees had been cut, their roots no longer held the soil in place. Glacial meltwater and the waters of the Darkot river then began to slowly erode away at the unprotected river banks. Now the river undulates back and forth, especially during the peak runoff months between June and August, eroding the river banks which soon collapse taking fields with them.

One farmer told me that his house was washed away several years ago. The bank it had been built on collapsed into the river during the spring runoff. He was forced to relocate several hundred meters further back from the river, clearing stones, digging new canals, and establishing another home which - he fears - in another decade will need to be moved again, but to where? "Sixteen *kinar* of land we have lost here", I was told, "four here, three there, five here" - he pointed, and listed the losses one by one. He now plants nothing within 50 meters of the riverbank for fear that it will be washed away. Already huge cracks had appeared in the earth, and several more meters eroded away before the end of my field season there. A photograph of the area taken by David Nash in 1981 clearly shows several cropped hectares of land, land which when compared to recent photos (July, 2000), appears to have disappeared.



June 16, 2000 July 21, 2000

Figure 4.12 With the loss of forest cover the river has broadened its reach and avulses back and forth from one month to the next, exacerbating an already pronounced erosion problem. (Photos: N. Cradock-Henry)

One of Sultan's neighbors continues to plant right up to the river bank. "Land is scarce", I was told, "What else is one to do?" There is a limited amount of soil here. Most of the land on this side of the river consists of rounded stones and sands left behind by the retreating ice. These are not very good for growing anything in, and the terraces where the crops are now planted will soon be gone.

In addition to the problem of soil erosion, localised flooding is also a problem, in particular for the community of Gasum. While the floods do not directly threaten any property or agriculture, they are responsible for slowly undermining the river bank above the community, and threaten one of the last groves of trees. Hughes (1984) reports that

floods have affected the village in the past, but gives no further details, and no one I spoke with recalled a destructive flood in the community in recent memory.

Figure 4.13 In a related problem, once the fields are abandoned, natural ground cover does not return quickly enough to protect the surface material from periodic intense precipitation. Gullying occurs, and the banks are further weakened. Compare this with a neighboring field, still cropped right up to the river's edge.

4.4 Irrigation Water and Risk

Another closely related feature of water supply in Darkot and many other communities in the region, is the central importance of irrigation, and the assurance of an adequate supply of water for crops. Butz (1989) suggests that there are several obstacles to the optimum provision of water for irrigation, the general features of which apply to Darkot as well. These are: poor accessibility of water to fields, uncertainties in the availability of water (timing), problems with water quality, and vulnerability to slope failure above channels, and in the channel walls (80). In the following section, I would like to briefly discuss these water supply/irrigation hazards, in a general overview and as they pertain to Darkot.

The problem of poor accessibility is resolved mainly through the use of irrigation channels (Butz, 1989; Kreutzmann, 1988). The longest channels are those which deliver

meltwater from the nival zone to the community. At the village level, smaller channels and furrows link fields to the main channels. Channels are intricate constructions. The slope of the channel must be such as to minimize erosion and sedimentation, while maintaining a regular discharge, and often having to deal with slope instability on the route.

Accessibility is also managed through the strict control of water. In Askole for example farmers are granted the right to water their fields on a three day cycle (MacDonald, 1994). In Hopar irrigating is done every ten to fifteen days (Butz, 1989), a pattern followed in much of the Karakoram (Whiteman, 1985). Access must be limited, especially in those communities, such as Hopar, in which the only source of water is from melting snow in the basin above the village. Low snowfall during the winter can mean water shortages in the summer. Darkot is fortunate in this regard. It relies only partially on snowmelt, and mainly on meltwater from one of several surrounding glaciers, spring water or water drawn from the river. In most years, the risk of crop failure due to inadequate moisture is minimal. Long term changes in glacier mass balance resulting from decreased snowfall could possibly have an effect on the community's ability to water its fields. Any such changes however would take several years to become evident. Snowfall does, however, effect glacial runoff, and thus irrigation water, in other ways.

Inconsistency in timing due to winter snowfall characteristics and summer melting conditions is also problematic. For instance, if the bulk of winter snowfall occurs early on, it will settle and accumulate a thin dusting of debris. The consequent decrease in albedo may cause peak melting before peak irrigation need. On the other hand, if

major snowfalls occur toward spring, melting will be inhibited by relatively greater albedo (Meier, 1973; Young, 1977). In basins where fresh snow covers perennial snow and ice, low seasonal coverage can cause earlier and higher summer melt. If certain conditions combine, villages may recieve most of their irrigation before or after peak irrigation demand! (Butz, 1987)

The two problems identified by Butz (1987) and related to water quality, are the high sediment load and the low temperature of meltwater. Meltwater irrigation systems are often subject to high sediment loads (Whiteman, 1985). Darkot is no exception and there is a high sediment load resulting from steep slopes, unstable terrain, avalanche activity and the predominance of glacial meltwater. Sediment must be trapped above the cultivated area or else it can clog channels, damage water mills, choke seedlings and raise terraces (Butz, 1987). This is most often accomplished through detailed channel construction. A channel slope of three degrees is understood to minimise erosion and sedimentation (Butz, 1987). Some sediment is acceptable as a matter of course both to replenish non-organic soil constituents, and to prevent saturation through channel walls (Butz, 1987). Sediment can be cleared from channels without too much disruption if necessary.

The second problem associated with water quality is that the temperature of meltwater is often only a few degrees above zero when it enters the channel, and has only warmed to between four and seven degrees by the time it reaches the field. Unless the water can be warmed significantly, its application can lower soil temperatures and decrease growing season (Butz, 1987).

The geophysical hazards described earlier threaten productive agricultural land, and in some cases built structures. These events also threaten water supply and the community runs the risk of crop failure when irrigation channels are damaged or destroyed. Large events such as debris flows are rare, but when they do occur, it is imperative that water flow is restored quickly. In Sultanabad, in the Yasin Valley, Stoeber (2000) writes that when a debris flow covered several kilometers of irrigation channel in 1991, the entire community - and even some people from other villages in the valley - came to clear the sediment out. Water flow was restored several days later and the crops survived. "Reconstructing or rerouting sections of buried or damaged channel is the largest single task villagers face in their efforts to maintain a consistent supply of water to cultivated lands" (Butz, 1987: 98).

Smaller, more frequent events that can threaten the continuous flow of water include the erosion of channel beds from rapid flow; downwasting of channel banks due to overflow; and the fracture of channel walls from seismic activity or the sedimentation of channel walls caused by extended periods of flow (Butz, 1987). Channel design minimized many of these stresses. Vulnerable sections are patrolled regularly so that flow can be diverted at the first signs of potential danger. Small sections of channel can be cleared easily, and in some cases the channel will be rerouted. The use of dynamite in road construction can also damage channels, or promote small sand/rock slides. One channel in Darkot was abandoned after repeated small rockslides during road construction disrupted the regular flow of water.

4.5 Climatic and Biotic Hazards

Weather has an important effect on life in Darkot. Risks associated with it range from long term climate change, which could have an effect on water supply; to the torrential rains that prompted the debris flows described earlier.

Darkot is located on the arid floor of the Yasin Valley. Hughes (1984) reports that the 30-year average precipitation at Gupis - the closest meteorological station - was 116.78 mm/year, and that this could be expected to decrease slightly as one traveled northwards. More recent data on Darkot collected by Jacobsen (1997) suggests an annual rainfall of less than 150mm, in this context the importance of irrigation meltwater is evident.

Darkot, like nearly all of the villages in Yasin, relies on snow- and glacial-meltwater for irrigating its crops. An intricate network of canals, together with shared responsibilities for maintenance, ensure a ready supply of water for most of the village's needs. A number of people however reported that there was less precipitation falling over the winter months, and that summers were getting drier. Last year so little snow fell that crops were sown in April, a month earlier than normal. Inadequate water supply could be a problem in the future. Because the meltwater channels are gravity powered, insufficient snowfall in some basins, can lead to shortages for particular areas during the dry summer months.

Figure 4.14 An infestation of aphids was ruining this year's crop.

There are only a few biotic pests. Birds, blight and bugs affect some fields, but one of the advantages of diversification is that the risk of losing all of one's harvest is minimized (Rhoades, 1986). I spoke with one farmer whose field of potatoes had been virtually decimated in the spring. The problem was an infestation of aphids. The plants were struggling, and he feared the entire crop would be lost (fig. 4.16). I was told however that his fields elsewhere were doing well.

4.6 Food (in)security and health hazards

The question of household food security in mountain regions has recieved a considerable amount of attention in recent years (Allan, 1990; Dittrich, 1997; Bohle and Adhikari, 1998). Possibly this is because mountain areas are in the midst of a transition alluded to earlier, shifting from a mainly subsistence oriented agro-pastoral economy to one in which there is an increasing reliance on external markets to provide food.

According to Allan (1990), in the Northern Areas, vulnerability to food shortages has been almost eliminated in the well connected Hunza Valley. The reasons for this have been adressed earlier, but can be summarized as the addition of an infrastructure (roads) that makes the import of subsidized wheat feasible, and the abolition of the mir-dom, which has given people greater control over irrigation water resources (Allan, 1990). It is important to note however that this is only true for those households with money, that there are still a substantial number of poor in Hunza who lack either land or cash or both. Concurrent with a rapidly capitalizing economy, money becomes an important hazard mitigating resource. Those with access to cash are better able to weather shortages and price increases, not so the poor.

In the Yasin Valley inhabitants' vulnerability to food shortages remains high (Dittrich, 1997). In a recent study by Nagra (1997) the Yasin Valley had the highest incidence of malnutrition in the Northern Areas and females were represented in a much greater number than males (Nagra, 1997: 565). Tranforming processes such as declining food subsistence levels, especially in cereals, a reinforced shift towards the production of marketable cash crops, and the increasing dependency on external food supply are one aspect of the problem. Another is the recurrence of natural hazard events and a growing population.

4.7 Conclusion

The range of hazards that effect the community of Darkot spans the entire continuum of frequency/magnitude. High-magnitude events such as debris flows catch our attention because of their size and visible impacts. The effect of seasonal events such

as avalanches are also evident: large boulders scattered about the community. At the other end of the spectrum though are those events/processes that impinge slowly: the hazards associated with daily life. These creeping hazards are evident in the slow loss of land and forest cover in the community. And there are other hazards which affect human activity directly and constantly such as the sedimentation of irrigation channels, or delayed snowmelt. Chronic risks such as poor health, malnourishment or food shortages, while they may not be defined villagers as 'hazards' they still impinge on their quality of life and make them less able to respond and cope with extreme physical events.

The previous several chapters have sought to establish an 'ecology' of risk in Darkot (MacDonald, 1994). I have sought to delineate the links between environmental characteristics and landscape features, human activity - including adaptations and coping mechanisms, and specific environmental and social hazards.

In the final analysis however, any work that seeks to deal with risks and hazards must also account for people's vulnerability. To what extent do the activities, practices, and social and economic considerations of life influence vulnerability? And is this exacerbated by recent changes in mountain regions?

Chapter 5 - Risk, Vulnerability and Everyday Life

5.1 Introduction

As previous chapters have sought to demonstrate, Darkot is situated in a dynamic environment in which extreme natural events can be expected as part of daily life. These events are, for the most part, rooted in ongoing environmental conditions. There can be little doubt that human activity has altered the ecological landscape but there is often only a tenuous relationship between environmental conditions and the magnitude of losses in an extreme event or an increase in the occurrence of those events. A commonly cited example is deforestation in the Himalaya. The argument was that high rates of population growth, combined with few alternative sources of fuel led to rapid deforestation in the highland region (Eckholm, 1975). Deforestation in turn, it was suggested, resulted in unusually high rates of erosion and an increase in the occurrence of and magnitude of floods, landslides and soil erosion (Eckholm, 1975; Karan and Iijima, 1985; Ives and Messerli, 1989). Short-sighted peasant farmers were blamed for losses from cyclones in Bangladesh, seen as collaborators and yet they were also victims. Instead of grand theories, great care must be taken in attributing cause to risk from natural hazards in this context (Gardner, et al., 1997). As this chapter (and previous ones) have sought to illustrate changes in human vulnerability to environmental hazards, for example, through increased exposure to damaging events or the undermining of traditional coping adaptations, is implicated more often in the formation and realization of calamity than is environmental change or the event itself. Changes in land use, social structure, agricultural production and transportation all play key roles in the manufacture of risk.

Environmental conditions are still a factor, and must not be overlooked, but not to the exclusion of other socially and economically generated processes (Brookfield, 1999).

As previous chapters have also sought to demonstrate, the practices, agricultural techniques and settlement patterns, in short, the traditional system of resource management that is practiced in this region, is well adapted to the environment - socially, economically, and environmentally. The basis of this is *almwirtschrift*, the use of different ecotopes and a range of elevations. Agricultural production, I suggested (cf. MacDonald, 1994, 1998) was oriented towards risk aversion through the use of small and dispersed fields, a variety of cropping techniques, a diverse pastoral economy and through various forms of social organization. Alternatively, 'modernization', however, with its focus on capitalization has tended to disrupt the traditional subsistence economy, undermining traditional responses to risk to the overemphasis of capitalization and increasing production.

In order to survive in a relatively harsh and unpredictable environment, the households of Darkot have evolved, through trial and error, a considerable capacity to absorb environmental extremes and fluctuations, and maintain reasonably secure livelihoods. The traditional subsistence economy that characterized the community for the last several centuries, was well-adapted - both socially and culturally - to a range of natural events. This is not to suggest that were no risks associated with such a subsistence economy. Hunza, for example only recently has overcome the problem of chronic food shortages (Allan, 1990), and there are extensive accounts of floods, glacier surges and outburst floods, mudflows, rockfalls, earthquakes, droughts and famine that

have constrained settlement patterns in these mountains for centuries prior (Kreutzmann, 1994; Abbott, 1848; Baird Smith, 1842; Becher, 1859; Burnes, 1828; Davis, 2000; Drew, 1875; Falconer, 1842). To a large extent, however, these risks were much more effectively averted than they appear to be today.

There are several aims to this chapter. The first is to first re-examine what is meant by vulnerability and how it is formed. Vulnerability was reviewed and defined in Chapter 1, but in order to connect it to the previous chapters, it must be shown to be influenced by social, economic, political and environmental forces that converge on and become evident in, the activities and practices of daily life. What are the factors that have contributed to vulnerability in Darkot? Many of the contributing factors can be applied in varying degrees throughout the Karakoram: changes associated with modernization schemes for example are common to many communities and households as is population growth. The regular occurrence of extreme events is also common to the entire area. My concern here is not with developing a grand theory that can be applied across the region and which can account for regional changes. Rather my interest is with local changes in land use, population, resource management, social and economic change that have influenced risk and vulnerability. Processes at a larger scale may contribute to these changes, but to use isolated examples to infer a regional basis for risk would be misleading (Gardner, 2001). Here the work of Watts (1993), Watts and Bohle (1993) and Blaikie et al. (1994), Cannon (1997) and Wisner (1998) on the causal structures of vulnerability and the progression from root causes to unsafe conditions, are useful analytical tools that may help to identify processes that have contributed to vulnerability

in Darkot.

A second aim of the chapter is to use the disaster 'pressure and release model' (Blaikie et al., 1997) as a way to account for the progression from root causes to unsafe conditions in Darkot. Models have a way of reducing an otherwise complex situation to one or two variables and so I have some reservations about doing this, but it is a useful device to show the way in which risk is realized in this collusion and imbrication of interconnected processes of hazards, environment, vulnerability and coping. In this chapter I wish to account for the interplay and mutual imbrication of hazard events, vulnerability, coping mechanisms and intervening conditions at the level of the everyday, to elaborate on what has been referred to as an 'ecology of risk' (MacDonald, 1994). Blaikie et al.'s model - while by no means perfect - does provide a useful template to further establish a basis for risk in the community.

Finally I wish to answer the question of how risk is expressed, managed and averted in Darkot? What are the impacts of hazardous events? How are chronic risks such as food insecurity managed? The purpose of the third portion of the chapter is to analyze risk within the context established by preceding chapters. I have chosen here to rely on the stories of people and households in the community that have had first-hand experience with 'risk'. These are households that have been displaced by extreme natural events, whose normal adaptive techniques have been strained, who for one reason or another are marginalised or vulnerable to a much greater extent than their neighbors, who are exposed to a greater degree of risk than others. This is not an exhaustive catalogue of testimony, but the examples I draw on will contribute first of all, to a greater

understanding of risk in the region, and secondly, reveal risk as it is experienced by the households of the community in their daily lives, as opposed to "a grandiose technocratic rationalizing... of absolute control of the accidental" (Castel, 1991: 289).

I begin the chapter with a brief review of the concept of vulnerability. I do not seek to locate my work solely within this narrow frame of reference, however. As previous chapters have shown, risk is made up of several different elements, of which vulnerability is only a part.

5.2 Vulnerability

In recent years, the question of vulnerability has broadened the scope of hazards research. As a concept it has the potential to reorient a field of study with tremendous potential for both theoretical and practical contributions (Habermas, 1973), and as such is both intriguing and exciting. As a concept, however, it rests on very little in the way of theory. Instead, it is used to refer to any number of different scenarios or cases, without ever moving beyond empirical definitions. Vulnerability has instead come to mean a number of different things. Liverman (1989) for example identifies dozens of authors using this term and related ones (marginality, resilience, susceptibility, adaptability, fragility, risk). For some authors, it is enough to be aware of it, and make passing reference to it, while others have been criticized for using it indiscriminately, to the extent that environmental conditions have been overlooked (Brookfield, 1999). As a concept, however, vulnerability does not rest on well developed theory (Watts, 1983; Wisner, 1993), nor is it associated with any widely accepted indicator or methods of measurement.

Watts and Bohle (1993) have made some attempts towards establishing a causal structure of vulnerability as it relates to hunger and famine. Their work can also be used to at least account for, in a preliminary way, vulnerability in Darkot. The first part of this review will address their work. In the second half of this section, I will turn my attention to the causal factors in Darkot that may help us to understand better the manufacture of vulnerability and its contribution to risk.

> It is a truism of sorts to say that it is mainly the poor that suffer from [disasters]. But not all poor people are equally vulnerable... indeed it is not necessarily the poorest who face the greatest risk... there is a multiplicity of factors that codetermine whether an individual will [suffer] (Watts and Bohle, 1993).

How we might account for that multiplicity of factors is the first part of what I wish to address here; what those factors are, is the second.

5.2.1 Causal Structure of Vulnerability

> *Vulnerability is a multilayered and multi-dimensional social space1 defined by the determinate political, economic and institutional capabilities of people in specific places at specific times.*
>
> - M.J. Watts and H.G. Bohle, *The Space of Vulnerability* (1993: 46)

Vulnerability has been defined in a number of different ways (Liverman, 1989). As Chapter 1 showed, many of them begin with the specific empirical forms which they assume (cf. Watts and Bohle, 1993: 45). Vulnerability is thus defined as "the risk that large sections of the population are deprived of entitlements" (Sen, 1991: 37) or "the degree to which different classes of society are differentially at risk" (Susman et al., 1984).

Chambers (1989), however, starts from the properties of the system which give

rise to vulnerability, rather than the forms they assume. For Chambers (1989), vulnerability is

> the exposure to contingencies and stress, and difficulty coping with them. Vulnerability has thus two sides: an external side of risks [hazards], shocks and stress to which an individual or household is subject; and an internal side which is defenselessness, meaning a lack of means to cope with damaging loss (1).

I should point out here that I do not wholly agree with Chambers' (1989) idea of defenselessness. As Chapter 3 sought to show, the inhabitants of Darkot do have a number of ways of averting risks, they are not defenseless, rather their defense mechanisms have been, in many cases subverted and in some cases, overwhelmed.

Chambers does point, however, to three coordinates of vulnerability:

the risk of exposure to hazards, stress, or shock;

2.) the risk of inadequate capacities to cope with hazards, stress or shock; and

3.) the risk of severe consequences of, and the attendant risks of slow or limited poverty (resiliency) from, hazards, crises, and shocks.

Vulnerability is synonymous with the defenselessness of people and their lack of resources to cope with externally and internally produced risks and shock, and it has three dimensions: "The risk of exposure to crises, stress and shocks; the risk of inadequate capacities to cope with crises, stress and shocks; and the risk of severe consequences" (Watts and Bohle, 1993: 118).

From this vantage point, the most vulnerable individuals, groups, classes and regions are those most exposed to perturbations, who possess the most limited coping capability, who suffer most from crisis impact and who are endowed with the most

circumscribed capacity for recovery. Vulnerability can, in other words, be defined in terms of exposure, capacity and potentiality.

Watts and Bohle (1993) use these coordinates to propose a theoretical framework, a causal structure of vulnerability, that I would like to review here. Any such framework they suggest, must be able to map historically and socially specific realms of choice and constraint - the degrees of freedom, they call it - which determine exposure, capacity and potentiality (46). Although the authors are concerned with accounting for hunger, their ideas can be used to point in the direction of a 'social space of vulnerability' that we might use to better understand the interplay between risk and vulnerability in Darkot.

Their use of the term social vulnerability designates an attempt to disaggregate poverty and to emphasize the relational positions of individuals, households and social groups in the context of a specific society (Bohle 1992, 1993, 1994; Watts and Bohle, 1993). Watts and Bohle (1993) draw on three theoretical bases (entitlement, political economy, empowerment), to form a tripartite structure, in which each side of the triangle is represented by one of the theoretical legs. As they understand it, vulnerability is a cumulative process of long-term transformations and short-term events triggered by economic, political, social and cultural processes, possibly deteriorating as a result of unstable ecological conditions, which, taken together, have a negative impact on the well being (security) of a population.

Bohle (1993), breaks this down further into two main types of vulnerability. First is the vulnerability to short-term 'conjectural crisis' in which the declining command over food, one's own labour and monetary income is due to sudden entitlements failure. An

example of this would be declining production-based entitlements due to price increases. A second type of vulnerability is associated with a long-term 'structural crisis', involving the underlying socio-economic and political structures and relations that catalyze conjectural crises (e.g. unequal socio-economic structures, unjust access to means of production, systems of surplus appropriation and exploitation, and other conflicts influencing social relations between gender, groups and classes).

Dittrich (1997) in his study of food security, suggests that in the peripheral and marginal Yasin Valley, the population groups most vulnerable to food (and other) crises will be those which are structurally underprivileged in terms of assets: power, status and food security. These same elements, as will be shown, can be related to the broader context of environmental hazards. The most vulnerable households then are ones which are highly exposed, be it to dangerous processes or short-term market perturbations. Their coping strategies are undermined, and they are excluded from social participation and not integrated within a social security network.

A second way to visualize the formation of vulnerability, or, more accurately, the progression of forces that result in calamity, is Blaikie, et al.'s (1994) disaster "pressure release model".

5.2.2 Disaster "Pressure and Release" Model

In this section I wish to review the disaster "pressure and release model" (Blaikie et al., 1994). This model will help to serve as a tool to account for the formation of vulnerability in Darkot. I should point out here that there is a danger in using a model to represent reality. Reality, particularly when dealing with 'risk' is more complex than any

model could ever hope to account for (Mitchell, 1990). My purpose in using it here is simply as an illustrative guide to show how vulnerable conditions are formed and how when they intersect or overlap with a hazard event, disaster occurs. In Blaikie et al.'s model, the pressure of unsafe conditions 'pushes' one way and a hazard event the other; a vulnerable population is caught in the middle of a sort of 'nutcracker'. From this discussion, I will try to illustrate through anecdotal evidence, the expression of risk in Darkot in daily life.

As a final note of introduction, the term 'disaster' has often been used to refer to an event of a certain magnitude (e.g. 100 people killed, 1000 injured, $1 million in damages). This diverts attention however from the ongoing crisis that characterizes daily life for many of the world's most vulnerable people. Interpreting disaster in such terms also promotes it as a 'spectacular' event, one that erupts unexpectedly, reinforcing the dominant view of risks and hazards that this type of work seeks to challenge - directly or indirectly. My occasional use of the term reflects this concern that in some places, disaster is a chronic condition, prefigured by history.

The 'pressure and release' model is a useful device to examine hazards in the Karakoram. D'Souza (1984), Davis (1984) and Coburn, et al. (1984) looked at the relationship between hazards and settlement patterns in the Karakoram. They suggest that until the late 1960s or early 1970s, the *baipash* was the most predominant type of housing. Walls were made of stone masonry, with timber bands at regular intervals. The roof was a series of interlocking timber beams, covered with packed earth for insulation. These buildings were locally specific, and more importantly, were reasonably well

adapted to a seismically active environment (Coburn, et al., 1984). From the late-1960s on, however, there was a subsequent shift towards the increased use of unreinforced concrete in construction. Walls were not attached properly to the roof and few people had experience working with steel reinforcements. Additionally, most buildings continued to be located on steep slopes because nearly all arable land here is required for agriculture. The result was a highly dangerous situation, precipitated by several (seemingly) unrelated factors.

The complex interaction referred to above was the outcome of a shortage of traditional building materials, which promoted the use of concrete in construction. There was reduced concern about building safety which took less precedence to other issues affecting risks of a chronic, daily nature and finally, new buildings were not constructed using aseismic (earthquake proofed) building techniques.

The shortage of materials and skills was related to several 'dynamic pressures'. Population growth had contributed to the loss of forest cover. Slope materials are already unstable (glacial till, moraine, alluvial soil) and road construction had encouraged the legal and illegal harvesting of wood. Carpenters and other skilled tradespeople traveled south on the KKH to Gilgit, Lahore, Islamabad and Karachi, or to the Gulf States to work. This out migration of labour was encouraged by the government of Pakistan: workers remitted foreign currency to family at home, which in turn could be used to reduce balance of payments deficits.

The road meanwhile, was used to import concrete, which was considered 'modern' and more appealing (Coburn et al., 1984). The construction of the road was

linked to the war with India, a military alliance with China and increased political control in the Northern Areas. The progression from global scale root causes to dynamic pressures to unsafe conditions, while at times tenuous, is probable. When a moderate earthquake struck the mountains of Indus Kohistan in December 1974, the losses were inordinately large (Hewitt, 1976). Thousands of people were killed many times that injured.

As this section has sought to elucidate, risk must be thought of not only in terms of a hazard, but also the extent to which populations, groups and households are vulnerable to damaging events. For Watts and Bohle (1993) this is a 'social space of vulnerability', whereas Blaikie, et al. (1994) see vulnerability as the culmination of a progression of pressures that lead to unsafe conditions.

Blaikie et al. (1994); Wisner (1993) and Cannon (1997) address the problem from an expanded "political economy/political ecology" perspective to address not only class, but social relations, and their influence on the conditions of everyday life. In the following section I wish to demonstrate the transition from root causes to unsafe conditions in the Yasin Valley. The final section of this chapter will examine this through stories of daily life.

5.3 Introduction: 'History, social relations and prefiguring calamity'

In this section I wish to propose a tentative framework for understanding risks, hazards, and vulnerability in Darkot. This framework is based on Blaikie, et al.'s (1994) 'pressure and release' model.

I want to stress that this a tentative framework, and that I do even this with some

trepidation. Unlike a 'disaster', 'vulnerability' is not a discrete event, bounded by time and space, with a clear beginning and end. Often vulnerability is instead rooted in history. Oliver-Smith (1986a, 1994) for example, suggests that the Yungay disaster in Peru was an event "500-years in the making" . He refers here to the fact that it is difficult, if not impossible, to understand Yungay without knowing about the Spanish Conquest of South America, the introduction of a whole new social structure, the fact that a completely ahistorical style of architecture was introduced, or that the indigenous peoples have been systematically marginalised both before and since the event. There is then a need to incorporate a historical or temporal dimension into the assessment of vulnerability. There is however, little in terms of a historical time line available for Darkot or the Yasin Valley. Anything prior to the last hundred years is conjecture, but historical conditions have an important influence on assessing vulnerability today.

Second, given the language barrier and the short amount of time available for the fieldwork component of this research, it was difficult to assess the importance of social structures, kin networks, modernization, and the range of resources that individual households are able to command. I understand now, more than ever, that if I wish to adequately account for 'risk' in Darkot, that these variables must be considered in greater detail. That said, here is my analysis of risk and vulnerability in the community of Darkot, Yasin Valley, Northern Areas, Pakistan.

Vulnerability in Darkot is best understood by being contextualized by changes in root causes and dynamic pressures, that are expressed in unsafe conditions in daily life. Vulnerability in the community is thus predicated on instability in the national political

economy and within the peripheral political economy of the Northern Areas.

The extent to which the local population is vulnerable to extreme events, and households within that population, appears to have been increasing in recent years. While vulnerability has increased, it is also important to note that traditional methods of coping have been undermined. Modernization has facilititated the out migration of labour, social organization appears to have changed through the village organization (VO) programmes, household command over a broad range of resources has increased for some but decreased for many others. In Darkot, several households for example, indicated that a member of the family ran a store in Gilgit, or worked in Karachi, or was being trained as a veterinarian in Islamabad. Access to these resources however is not uniform.

In seeking to account for the social construction of vulnerability, several factors are implicated. Root causes include chronic instability in the political economy already mentioned. This instability is channeled into dynamic pressures at the valley level, and includes high rates of population growth, out migration, high levels of dependence on external food supply, and the steady erosion of the subsistence economy through modernization programme and road infrastructure.

The Yasin Valley is considered peripheral and marginal within the Northern Areas economy (Nagra, 1997; Dittrich, 1997). The population has among the highest rates of malnourishment in the Northern Areas (Nagra, 1997). Land available for converting to agriculture has remained stagnant (Hughes, 1984), while the population continues to grow. In Darkot, there is some evidence to indicate extensive deforestation in tributary valleys, most often attributed to population growth and changes in the feudal system of

tenure.

5.3.1 History, Social Relations and the prefiguring of calamity

Root Causes/Underlying Factors

In order to account for the formation of vulnerability to hazard events in Darkot, it is useful to first identify some of the broader, underlying root causes for vulnerability in the national context. It will be demonstrated that these underlying processes ultimately impinge on livelihood security for people in Darkot.

Pakistan first of all has a political economy prone to crisis. This is the result of an unstable political system and disparate socio-economic structures. Frequent changes in governments and their varying political programmes, along with high expenditure for military purposes, debt repayment and for subsidies, as well as the recently implemented structural adjustment programme of the IMF and World Bank, have hindered the implementation of long-term development. Pakistan is characterized, nationally, by high population growth. The country depends on the import and export of a narrow range of commodities, and is exposed - to a high degree - to perturbations in world markets. Extreme natural events - floods, droughts, earthquakes, and in the mountain regions, a range of mass movement events - are common. Together these constitute a set of underlying root causes, characterized by instability, inequality and vulnerability. These processes are channeled to some degree, by the spatially peripheral characteristics of the Northern Areas, and in turn, the Yasin Valley.

Within Pakistan, the Northern Areas represent a spatially peripheral and economically marginal region. The indicators of this are as follows:

- the regional lack of power and rights in the national political economy,
- deficits in the regional apparatus and social infrastructure,
- a per capita income that is below the national average,
- very low literacy rates and a low health standard,
- high migration rates, and
- a high degree of dependence on external food supplies (Dittrich, 1997)

To demonstrate how root causes are channeled into dynamic pressures, it is useful to look briefly at the events of September 1990. Between September 1990 and November 1992 food prices in lowland Pakistan increased by more than 20% (Dittrich, 1997: 36). The price increase was the result of a combination of factors including unstable political conditions following the upheaval of the first Bhutto government, the suspension of US aid, a temporary breakdown in the food distribution system, the 'Gulf Wars' and the revaluation of the US$ against the rupee. This shift in price was amplified in relation to food purchased in the Northern Areas. To blame were higher transportation costs, and more intermediaries - each of whom exacted their profit - required to deliver the food to northern markets.

In the Yasin Valley, exchange rates between external food items and local farm products grew further apart, and the wages paid for non-farm wage labour dropped. According to Dittrich (1997), between November 1989 and November 1992, farmers received about 40% less wheat flour or cooking oil for one kg of walnuts (38). The value of dry apricots fell by one-third for wheat flour, and by one-half for cooking oil (Dittrich, 1997: 38). And, while wages for skilled labour increased comparably with food prices,

wages for unskilled labour declined (Dittrich, 1997: 39). The most vulnerable families in Yasin, says Dittrich (1997), made up for this shortfall by obtaining food on credit or generating cash through the sale of animals. In this way, decisions made in a Geneva office, by a Washington bureaucrat or an Islamabad bank have a significant effect in a peripheral mountain valley.

Dynamic Pressures

The root causes identified above (instability in the political economy, high rates of population growth, etc.) are channeled into dynamic pressures in the Yasin Valley, and contribute to the formation of vulnerability in Darkot. The valley is characterized by high levels of dependence on external food supplies and reduced subsistence. An additional dynamic pressure is the process of moneterization, commercialization and the modernization of agriculture - all of which are differentially distributed throughout the valley.

It should be noted that the total population of Yasin has risen dramatically in the last century. If neighboring Barkulti is any indication - the community there had grown from 1,000 persons at the time of the 1931 census, to approximately 2,500 in 1980, while the total population of Yasin had risen from 8,000 to 20,000 in the same period (D'Souza, 1984:293) - a similar rise in population in Darkot would have put great strains on the environment, particularly as large amounts of wood are needed for construction and fuel.

Unsafe Conditions

I have already indicated the regular occurrence of natural hazards in the village of Darkot (Chapter 4). Vulnerability at the village level is difficult to pick out. In fact, as a

community, it appears to have been relatively successful in its adaptive strategies. At the household level however, a different picture emerges. Hazard events have exposed certain households to disproportionate levels of risk.

The following conditions are evident in Darkot:

1.) The amount of land that can be readily converted for agriculture is limited. Hughes (1984) suggests that there has been little change in the amount of land available for cultivation since the 1930s and in Darkot, there have been - as was noted earlier - significant losses. Inhabitants have few choices: resume farming exposed fields after a hazard event, noting that it takes at least 3-4 years to reestablish suitable growing conditions, or find new land to cultivate, land which is likely to be of marginal quality and in an exposed location, or emigrate.

2. Population growth within the valley, and very likely within the community itself, has been high. If neighboring Barkulti is any indication - the community there had grown from 1,000 persons at the time of the 1931 census, to approximately 2,500 in 1980, while the total population of Yasin had risen from 8,000 to 20,000 in the same period (D'Souza, 1984:293) - a similar rise in population in Darkot would have put great strains on the environment particularly as large amounts of wood are needed for construction and fuel. Several people indicated that population growth and deforestation contributed to the two large debris flows to affect the community in the last twenty years. There was also a strong correlation reported between the loss of forest cover and the loss of agricultural land to riverine erosion. There have been significant changes in intervening conditions.

3. Traditional methods and practices of coping are slowly being undermined by the growth of the market economy and capitalization. Increasingly, households are caught between the 'scissors' of the growing market and the eroding subsistent economy. There is less labour per household available for contributing to agriculture, and yet the opportunities to earn a replacement wage are few, and competition for those jobs intense. More often than not, the burden of displaced labour falls on women (Hewitt, 1997). Some households have been able to take advantage of this opportunity (jeep owners, skilled workers, influential households), but most have not.

4. When hazard events occur, those people who are able to respond effectively are those who command the widest range of resources or entitlements. There is very little evidence to suggest that there has been a quantitative change in the frequency of such events in Darkot. However, the ability of some people to respond effectively to them, does appear to be increasingly compromised, as will be shown in the following section.

5. Finally, the question of social organization cannot be overlooked. The traditional system of resource management is such that 'risks' are distributed among all of the households in the community. MacDonald (1998) writes that in Askole, field dispersal also had the added effect of offsetting inequality. He writes, "All village households own a number of disparate plots scattered across the surface of the terrace fan, and these collective holdings holdings of dispersed fields act to ensure that no individual household has disproportionate land holdings, concentrated on good land near the village, or, conversely, on poorer quality marginal land" (MacDonald, 1998: 298).

It remains to be seen what the cumulative effect of village organizations will be

on this traditional way of organizing community life, based as it is on an economic relationship; however, it may very well work to exclude those who have little to give.

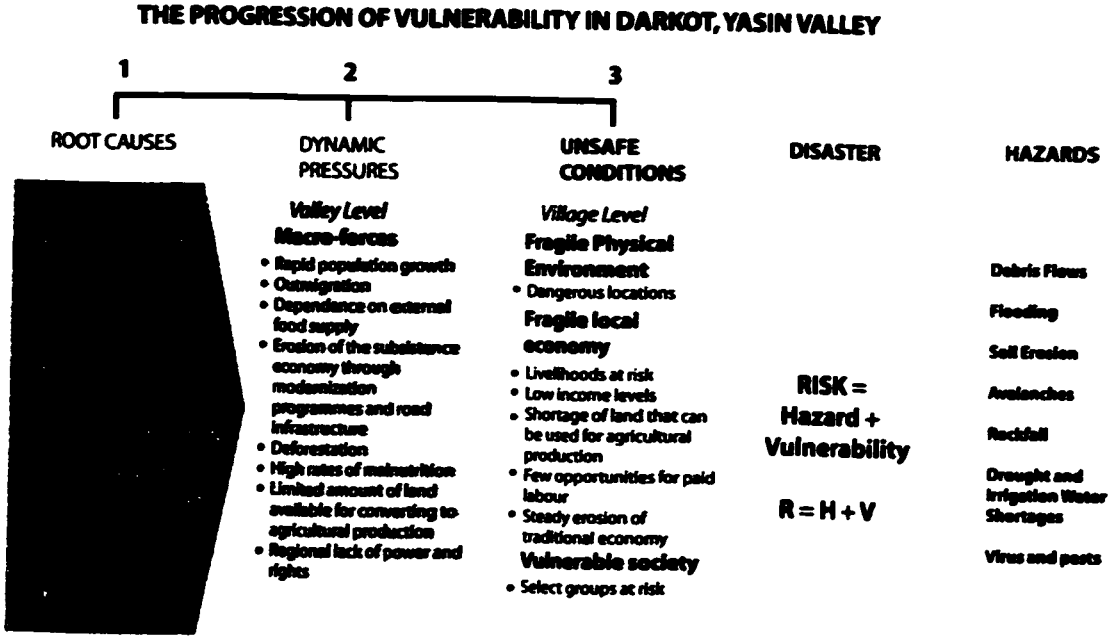


Figure 5.1 The Progression of Vulnerability in Darkot

5.4 Testimony, Vulnerability and Daily Life

Hazard events, far from being 'abnormal' or aberrations in an otherwise stable existence, are best understood within the contexts of daily life. Much of the work that I undertook in Darkot was trying to understand how the various households within the community managed loss, how they were able to cope with damaging events, what their strategies were for avoiding or mitigating future losses, and what the repercussions were of the debris flows of 1978 and 1981 in particular. In this section, I present some of the stories that emerged from my time in the community as a way of illustrating the changes in social, economic and environmental conditions related to vulnerability at the household level.

In 1978, the Khalung Bar debris flow tore through the westernmost settlement in Darkot, forcing a number of households to relocate. Almost one-third of the village, at that time consisting of 100-150 households, moved permanently to their summer pastures or fields. Here, temporary summer dwellings, a small, round stone wall with a conical roof of twigs and sticks, were quickly replaced by a *baipash*, adequate facilities for keeping animals over the winter needed to be constructed, and the remaining crops salvaged. Because the debris flow occurred in July, there was little time.

The community of Gasum, overlooking the debris flow deposit, is now home to many of these households. None of them have ever moved back down to Darkot. I was told that a couple have since left, and settled elsewhere in the Yasin Valley or in the neighboring Thui Valley with relatives.

The community of Moshuting (refer to Fig. 4.4) is located on the west bank of the Darkot River, at the foot of the Ghamu Bar Glacier, 2705m asl. The settlement consists of eleven households, approximately 90 people, who - since the debris flow in 1978 washed their fields away - have been forced to subsist on several hectares of land. The narrow strip of cultivated land is little more than sediment washed out of the peaks towering above the small settlement. The men refer to themselves as being of the Badalay tribe, descendants of two brothers from neighboring Chitral, who settled here over 300 years ago. They had since formed a small, closely knit network of kin in the community of Khatgramm.

Their lands were kept within the tribe, and divided up among sons as they married and began their own households. Until 1978, the tribe's homes in Darkot were all close

together on the fan at Khalung Bar, and they utilized the land in Moshuting - where they now live - only occasionally, every other year, and only for barley. The soil was too poor to try to grow anything else.

That, of course, all changed the summer of 1978. "We did not plant crops here [in Moshuting] that year", community members told me. Several of the men of the tribe were away for the summer months, looking for work down country. The fields are also located a forty minute walk from the village proper, on the other side of the river. There were no homes there, and the amount of labour required could not be spared. "We had only the fields we planted in Khatgramm and when they were gone, we lost everything". Eight homes belonging to the tribe were demolished and several meters of sediment was deposited on top of their once productive fields. The clay and rock quickly hardened into an impenetrable surface.

It was not clear whether they had an extended network of households elsewhere, but they had no choice but to move out to the other side of the river, permanently. The tribe still owns a small plot of land in Darkot proper. One dozen people spend the winter crammed into one of 4 *baipash*. The rest of the year (May-October), they are here, coaxing as much food out of the rocky soil as they can.

The land here is only marginally productive. Several of the men left for Gilgit a few years ago looking for work, and they remit cash to their families left behind. The homes that they have built are frequently damaged by avalanche activity (see 4.2.1.5) Large boulders are rafted into the village every spring. Often fences and homes need to be rebuilt or repaired.

The fields are north facing. Avalanched snow stays on the fields as late as June some years, and delays planting. The bottom portion of their fields are being washed away by glacial meltwater. There are only a few young men left here year round and they told me there is too much work for them. The incentive to join the others in building the road, which pays 100 Rs. a day ($2 Cdn), is clearly great.

This is one of the more extreme examples of vulnerability in Darkot. At the collective level their entitlements are very insecure. They have little in the way of productive land, nowhere near enough to support the small community, and at the same time, there are few wage-earning opportunities in Darkot. Without the dispersed agricultural base that is so generally effective in managing risks, and with very few sources of income, their livelihoods are insecure at best. Moreover, they have been given little choice but to settle in an exposed location.

It is also important to note that they are both marginalised within the greater community and peripheral to it. The modest collection of homes is far from the village proper where they still have some productive land and where they must go to tend to it; they are also far from the clinic and from any of the small shops. Politically and socially they appear to have little influence, which erodes even more their opportunities to reverse some of these changes or develop a more secure livelihood. They have no village organization and none of the capital needed to begin one. When the new government gave the community a grant of 25 lakh rupees, the inhabitants of Moshuting asked if some of the money could be used to build some low walls to protect their fields from erosion. The decision was made instead to extend the road through Darkot to the head of

the valley at Darband. Many people indicated that this decision was largely influenced by a 'powerful' family and the need to exploit resources (wood and fodder in particular) at the head of the valley.

The benefits of the road will, it seems, in the end benefit only a small minority: the family that owns the store on the side of the new road (who encouraged it in the first place) and the owners of the only jeep in the village. The same family also hopes to develop the tourism potential of a small hotspring near Darband. Some additional benefits clearly will accrue to other local inhabitants - ease of travel between the two communities and summer pastures and of course, an abundance of wood. It is also clear however that the benefits are negligible at best for the people of Moshuting.

Some of the residents had wished to see the money spent on levees to protect their fields from flooding and erosion, or hoped that maybe they would be provided with some form of compensation so they could settle elsewhere. It takes several years to clear a small plot of land and begin harvesting a decent crop in this coarse and rocky soil.

Over the course of the summer, several people were asked for their opinion on the construction the of a new road. The village had been given 25 *lakh* rupees from the national government, and had decided to use the money to build a road further up the valley to Darband. "The road is a good thing", one man said, "Some people wanted to use the money to protect their fields... but the road is good for everyone. We can go to get wood, to get food for our animals... it will be better here with the road."

Others whose fields are also threatened by erosion were not so sanguine about the need for the road, nor for the changes it had wrought in their small community. Many of

the older residents in Moshuting considered the road unwelcome. "We need a bridge more than a road", one man told me, "only one or two people have jeeps... it is a waste of money." Another expressed concern that the money could have been used to build walls to try to protect some of their fields. "The young men are getting paid to work on the road crew, and they do not tend their fields... it is more work for us [the old men, women and young children] and when we can grow no food we must buy it. But we have no money."

The above comments are indicative of the transition period associated with the enforced shift to modernization. This transition, however, is complicated somewhat by the lag between the growth of the market economy (and more importantly opportunities for paid employment) and the erosion of the subsistence economy. According to Sen's influential entitlement thesis (Sen, 1989) vulnerability - in particular to food shortages - is a risk often associated with the threat of large-scale entitlement deprivation (Sen, 1990: 37). According to Watts and Bohle (1993) these shifts are framed as being a function of market perturbations, with a particular emphasis on rural land, labour and commodity markets (Watts and Bohle, 1993). Persons at risk in these imperfect fluctuating markets, and who suffer from various forms of price scissors (Swift, 1989; Bernstein et al., 1990) are, collectively, the most vulnerable social groups.

In the Northern Areas, this process is clearly underway. Vulnerability, say Watts and Bohle, emerges in "the historical epoch during and after the appearance of a class of wage labourers and prior to the development of a social security system" (Watts and Bohle, 1993: 119). Compounding this are high rates of population growth and a limited

amount of arable land (which has remained almost stagnant), as well as differences in the accessibility (Allan, 1990). Between these two economies are individual households that often struggle to maintain a traditionally diversified economic base.

A couple of kilometers away, on the other side of the vast outwash plain of the Ghamu Bar glaciers, I spoke with another couple whose lives had been similarly effected by events two decades ago. Zumrat had been raised here in Darkot, and his wife was from Barkulti, a neighboring village to the south. They too once had a home and fields in Khatgramm, but unlike the people now in Moshuting, they had nowhere else to go.

Their small home is surrounded by a dry stone fence. Indeed that seems to be all there is out on this side of the river: lots and lots of rocks. At one time, the glaciers of the Ghamu Bar massif covered almost this entire portion of the valley. Now they have retreated, leaving a vast expanse of round stones, and very little soil (see *fig. 4.5*). "Every year", they told me, "we must pick the rocks from the field, plant the seeds, and then pick the rocks from the field". It took them 3 years to clear the land of stones, another 5 before the first successful harvest was coaxed from the ground. In order to survive they sold some of their animals and every winter Zumrat went to Gilgit, Lahore and Islamabad looking for scarce work in construction. During the summer, work is occasionally available as a porter, but competition for such jobs is intense.

With much of the best - or in some cases only - land already utilized for agriculture, agriculturalists and pastoralists have to make do with whatever they can find. Among the alternatives are (a) relocating permanently to summer fields (which are often in another village or neighboring valley), (b) trying to reclaim the land that was lost, at

the cost of great inputs of labour or (c) trying to develop new land. The problem with trying to develop new land however is that only the most marginal and high risk land is not already used! A corollary of that is related to the outmigration of male labour. There is some land that would possibly be suitable for agriculture at the head of the valley, about an hour's walk from Darkot, and indeed some of it is already used: by the Gujar in the early spring and by Darkot villagers from the early summer months onward. However, in order to stabilize the slopes, not only terraces but irrigation channels would need to be constructed, requiring vast amounts of male labour. The terrace walls need to built, soil needs to be brought in, an organic base needs to be cultivated over a period of several years and few men are available (or willing) to make such a risky investment, and one that shows no productive gains until several years after the terrace is completed. Additionally, the new fields would very likely require the construction of a new series of irrigation channels. Even extending an existing channel requires a tremendous amount of work, the channels often needing to be blasted or hewn out of the solid rock. It is not simply then a matter of a shortage of land, but also of the labour required to make it productive. In Darkot, a number of households are trapped in a cycle of vulnerability: unable to produce enough food from the land at their disposal, male members of the household leave to find work in one of the large cities and send remittances home. The remaining family members must address the shortfall of labour and are vulnerable to fluctuations in commodity prices, which can be rise or fall quite severely. But with the men gone, the household is unable to expand - even if the opportunity were available - their resource base!

In Darkot, a small percentage of the land that was covered as a result of the Khalung Bar debris flow has since been recovered. For example, a women's co-operative has started a small garden on the lowest reaches of the fan where only the finest sediment was deposited and the AKRSP field officer stationed in Gupis - and who is originally from Darkot - has encouraged one of the village organizations to start a small tree nursery, which they hope will bring a forest of willows and poplars for future use. Small rectangles marked with piles of stones delineate the approximate boundaries of fields belonging to owners who hope that one day they will have the confidence to use the land again. A circle of stones, marked in the center by an 'X' I am told is where the government helicopter landed after the debris flow. It has not returned since. Only one house was ever rebuilt and it remains empty.

At the top of the fan, where upwards of 4 cu. m. of debris was deposited, one household is stubbornly trying to reclaim their fields (see *fig. 4.6*). The men carry soil down the hill from fields in Gartens and deposit it on top of the debris. This is the first year they have tried to plant crops here, and when I visited, they were coming up well in the rocky soil. "Next year this will need to be cleared again", he told me as his wife and three young children sat on their haunches sifting through the soil for stones. The family lost six *kinar* of fields here in 1978, but they are not able to grow enough in Gartens, and so they are taking another chance on this plot of land. "We will not move back here", the man continued, gesturing toward the boarded up house at the top of the rise, "but we need more food". "Most people are afraid to move back here", he said, "that is why they plant trees instead of wheat", pointing at the seedlings planted at the bottom of the fan.

To survive the first time, they had to sell their animals to buy grain, and they do not wish to have to do that again.

Debris flows, avalanches and rockfall such as those described above are among the more 'extreme' events, and undeniably, have had material effects on the community that last well beyond the duration of the actual event. Other hazards, what D'Souza (1984) calls 'creeping hazards' are also present throughout the community, acting as a limit on development, agriculture and spatial settlement. These processes are limited in their effects, and pose a threat to only a small subset of people within the village. It is not possible to suggest - as have some other authors who have done work elsewhere in the Yasin - that inhabitants are much more concerned about these high frequency, short duration or seasonal natural events, such as soil erosion, that have an immediate and localised impact and threaten the viability of agricultural production or transhumance practices (D'Souza, 1984; Hughes, 1984).

Soil erosion is most pronounced in the area known locally as Ashtanimakhduring. There are other, smaller plots of land which are also at risk. Much of this low-lying land however belongs to one of the better off families in the village, who have been able to protect it by building small levees along the river.

One man here told me that the family's house was washed away several years ago. The bank it had been built on collapsed into the river during the spring runoff. They had to relocate their household several hundred meters further back from the river, clear stones, dig new canals, and establish another home which - they feared - in another decade will need to be moved again, but to where? The amount of available land has

remained stagnant, while the population has grown and increased pressure has been put on what land they do have. "Sixteen *kinar* of land people have lost here", I was told, "four here, three there, five here" - pointing, the losses were listed one by one. The household now plants nothing within 50 meters of the riverbank for fear that it will be washed away. Already huge cracks had appeared in the earth and several more meters of land had been washed away before the end of my field season there.

One of the household's neighbors continues to plant right up to the river bank. "Land is scarce", Imran said, "What else can we do?" There is a limited amount of soil here already, most of the land on this side of the river consists of rounded stones and sands left behind by the retreating ice. These are not very good for growing anything and the terraces where the crops are now planted will soon be gone.

Communities that are at risk from (low-frequency) extreme events also vary in their ability to cope with loss, recover, and withstand future events. The experience of Darkot, for example, stands in contrast to the community of Sultanabad, 15 km to the south. Stoeber (2000) points out that when a debris flow struck the community there in 1990, the entire social apparatus was galvanized into action. One to one and a half kilometers of canal were filled with debris and/or damaged, effecting 350 households. Three irrigation channels had been destroyed, and several others filled with fine sediment, that hardened in the sun and needed to be chipped out manually soon after. The morning after the event, the community administration in Yasin village - the largest community in the valley - was informed and promised to send help; village organizations elsewhere in Yasin mobilized and recruited work groups armed with pickaxes and shovels. The entire

administrative bureaucracy, from households, to village organizations, offical/unofficial local (village) representatives, to religious leaders, and the civil and police administrations, between them, managed to restore the flow of water only six days later, though even such a short period of water deficiency resulted in a marked decrease in production (Stoeber, 2000: 86). The response to an event of similar magnitude in Darkot, only a few kilometers away, was quite different.

In Darkot the response of the community and government administration to the event was revealing. According to residents, every family was given a blanket and some grain by government officials. No other compensation was made, and the land was almost entirely abandoned. Additionally, each household - in short order - needed to construct new dwellings before winter. Several new canals needed to be constructed in order to preserve what remained of the year's rapidly maturing crops. There is no record of any assistance from outside the community. Within the community the response was to leave. Those who had lost fields or homes left, many relocating permanently to summer pastures in Gamelti and Gartens or at the head of the valley at Darband, Rawat and Tokemali. No effort was made to reestablish the community on the site of the Khalung Bar debris flow, and only recently have people begun to reclaim small portions of the land and then as a last resort.

5.5 Conclusion

Typically, societies with long tenure and low stable population numbers have developed adaptive strategies over generations to reduce risk from natural hazards in mountain areas (Gardner, et al., 1997; MacDonald, 1998). In Darkot, the root causes of

vulnerability appear to be closely related to recent changes taking place not only in the Yasin Valley but throughout the Northern Areas. Changes to the human ecology of the area brought about by the influences of new people, land uses and ideas, for instance, may change the balance and lead to increased risk or vulnerability (MacDonald, 1994). Examples of this include: growth of primary resource extraction such as forestry or mining, the development of strategic transportation corridors through mountain areas, modernization of agricultural activities as for example, orchardry and horticulture, and the development and growth of tourism (Gardner, et al., 1997; Gardner, 1997; Eisbacher, 1988).

In Darkot, many of these changes are closely related to modernization, but also to the abolition of the 'feudal' system. Land that was vested in a monarch enjoyed some protection. Population growth has intensified the pressure on already scarce land resources and there is a shortage of labour necessary to develop new cultivated areas. There has been a steady decline in food entitlements. As households have become reliant on the provisions of the market, they have been exposed to sudden price increases, the availability (or lack) of paid employment, and women have been forced to shoulder the burden of displaced labour. The introduction of a regional transportation corridor has made possible greater range of commodities, trade and migration of labour (Dittrich, 1997). These changes have created a 'social space of vulnerability' that is differentially distributed throughout the village. Spatially peripheral households have access to fewer resources, lack the close kin networks and receive few of the benefits of modernization.

From the available evidence, the following picture emerges. Darkot has

remained relatively secure for the last century. While population growth in the Yasin Valley has been high, there is some evidence to suggest that there has also been widespread emigration to the neighboring Ishkoman Valley (Kreutzmann, 1994). From the time of its initial settlement until the 1930s, there was an expansion of surface area under cultivation. Hughes (1984) indicates, that the limit for cropped land peaked at this time and has remained stable and in some communities has been decreasing. During this time, hazards were known and expected. This fact is attested to by historical accounts and the adoption of a wide range of risk averting techniques in agriculture and social organization.

Since the 1930s, the valley has undergone a series of changes. This includes the creation of the nation of Pakistan in 1947, the increasing importance of the Northern Areas militarily and politically and the ongoing war with India over Kashmir. It also includes the abolition in 1972 of the feudal system. Furthermore, high rates of population growth and possibly immigration have met with the limits to the expansion of agricultural land, the erosion of the traditional economy, and the impacts of modernization. Households affected by hazard events find their entitlements and range of options limited economically (work is needed to buy food because not enough food is grown), socially (command of financial resources is required to receive the 'benefits' of village organization), politically (the Northern Areas has little say in the national arena) and spatially (households have little choice but to settle in exposed locations, following a disaster).

What is less clear, but certainly important, is the extent to which economic and

social change has made, and continues to make the residents of the community more or less vulnerable, and able to respond with the flexibility and creativity necessary to flourish. This is, for the time being, a question of the social upheaval, environmental and technological changes associated with rapid economic development and social change.

The construction of roads throughout the Northern Areas, and to Darkot in particular, did not cause these changes/developments in the community. But the road did/does act as the infrastructure that supported/s and accelerated/s certain processes. These include the extension of low-land administrative control as a result of Pakistan's independence, interaction with commercial markets, and the implementation of community and AKRSP development initiatives. These have all resulted in significant changes in the life and conditions of work for the community. Women clearly remain in more traditional roles and have an ever greater responsibility for the traditional subsistence economy as men look for paid off-farm work (Hewitt, 1999), although the links between this and women's vulnerability to hazards needs to be looked at in more detail.

As this chapter has sought to show, the community's link to the cities of Pakistan, and through them, to the economic, political, and recreational interests of distant, industrial nations are increasing and strengthening, and as they do, the likelihood of repercussions being felt in Darkot from events far removed in time and space, becomes increasingly likely. Vulnerability at the community and household level it appears, is becoming globalized.

Chapter 6 - Conclusions

6.1 Summary

> *His face is turned toward the past. Where we perceive a chain of events, he sees one single catastrophe which keeps piling wreckage upon wreckage and hurls it in front of his feet. The angel would like to stay, awaken the dead, and make whole what has been smashed. But a storm is blowing from Paradise; it has got caught in his wings with such violence that the angel can no longer close them. The storm irresistibly propels him into the future to which his back is turned, while the pile of debris before him grows skyward. This storm is what we call progress.*
>
> - Walter Benjamin, *Illuminations* (1968)

In this thesis I have suggested that 'risk' is best understood as a series of overlapping concerns, including a hazardous or damaging event, vulnerability, methods of coping with or adapting to changing a changing natural environment and intervening conditions which exacerbate or lessen damage. The village of Darkot in the Yasin Valley, Northern Pakistan was used as an example. The village has borne the effects of several hazardous events and processes. These have included large debris-flows, avalanches, ongoing soil erosion, flooding and rockfall, as well as those associated with irrigation water. 'Chronic' risks were also identified, such as food shortage and poor health, risks that may be so pervasive that they are not even acknowledged as such. The community has however been able to manage, in a variety of ways, the risks associated with inhabiting this mountain region. For several hundred years it appears that the community was largely self-sustaining. The population in the entire Yasin Valley was relatively low, and what little land was available for agricultural production was soon utilized. Flexible modes of agricultural production were adopted, local food production was sufficient - there is for example no record of debilitating famine in Yasin as there

was for instance in the Hunza Valley - and this would undoubtedly have been complemented by intra-regional trade. Natural hazards associated with this mountainous environment were clearly understood and prepared for. As Chapter 3 demonstrated, one of the ends towards which the local economy was directed, was 'risk aversion'. Through the use of, for example, small dispersed fields in a variety of ecological zones, delayed planting, and diverse agricultural production, risks were effectively distributed throughout the various households in the community. The risk of occupying sediment fans was acknowledged by leaving a strip of fallow land parallel to the channel where debris might flow. Areas that were more exposed to frequent extreme events were either avoided, or only used occasionally. The distribution of risk was both spatial and social.

The village - and the Northern Areas in general - are in transition. Arguably the processes at work have merely accelerated in recent years. There is a long history of intra-regional and international trade networks, since the time of the Silk Road. The Northern Areas have also been of strategic importance. However, there has been several new processes at work which differ significantly in scope from earlier changes. These, as Chapter 3 showed, include the work of the AKRSP, road construction, and economic and social change, which I referred to under the heading of modernization. Taken together, these agents have strengthened the ties between low-land and highland regions, increasing to the susceptibility of Northern Area communities to changes at the national and international scale. These perturbations are essentially 'channeled' into increasingly unsafe conditions in the Yasin Valley. The model developed by Blaikie et al. (1994) showed how changes in national and regional policy, economic conditions, and security,

influence people's vulnerability at the local - or community - level. The example of Darkot was used to illustrate this idea, and it was shown that changing 'risks' and people's vulnerability was broadly influenced by national and even international processes. I suggested that one way to account for this was through the use of the 'Disaster Pressure Release' model (Blaikie et al.) and Beck's (1991) 'risk society' thesis. I argued that that changing risks are less a product of 'natural' hazards - debris flows, avalanches, flooding and soil erosion - than of changing social and economic conditions and that changes in traditional patterns of resource management, coping and adaptation have an underlying influence in vulnerability.

The effectiveness of traditional resource management systems and their resilience to damaging events arises out of a shared world view that does not separate ecology or resources from the wider social, political, and economic organization of the community. This wider organization serves to reinforce social ideals and norms based on religious faith and traditional ecological knowledge held by a community (Kates, 1980). Thus the sustainability of the system is largely dependent on a common world view or value system related to resource use and its manifestation in social mechanisms.

The expanding extension (intrusion?) of lowland interests into mountain lands for administrative control, strategic military purposes, development and recreational uses has had serious consequences on traditional resource management systems and their resilience to damaging events (Kates, 1980). The introduction of the cash economy, access to commercial resources and markets, and opportunities for off-farm employment, particularly for men, have brought about many changes as these small communities are

slowly integrated into the larger global market economy (Thomas-Slayter and Bhatt, 1994). Most importantly, as far as this thesis is concerned, is the effect this has on community unity and access to resources, the foundation for the traditional resource management system and its resilience to external perturbations.

The consequences of development, similar to damaging events, affect the community unequally and have generally served to increase the vulnerability and diminish the range of adjustments available to already vulnerable groups. This was demonstrated in relation to gender as new technology for growing cash crops and the out-migration of men for employment has diminished women's already scant control and responsibility over resources and their own activities, while at the same time increasing their workload. Also discussed was the unequal access of farmers to agrarian innovations and children to education. These examples illustrate that it is primarily those members of the community having plentiful resources who are able to adopt new techniques and skills, thereby improving their situation, while the situation of those already lacking resources worsens.

The rapid rate of change resulting from development is detrimental, at least in the short-term, to the ability of villagers, and the village community to respond to damaging events, both due to increased reliance on external markets (reduced self-sufficiency) and the partial breakdown of traditional socio-cultural systems.

'Modernization' programmes must begin to adequately account for the changes that they incur, particularly as the relate to risk and changes in people's vulnerability to hazardous events. Traditional patterns of resource management have been largely

successful. Communities have developed effective techniques for averting, absorbing and distributing loss. This appears to be changing however.

One of the earliest critiques of the dominant interpretation of risks and hazards research was premised on the fact that there was no adequate indication that there were marked changes in environmental conditions worldwide. There were not more earthquakes every year, or more hurricanes or floods. The rising losses associated with hazardous events must lie elsewhere it was argued. Changes in vulnerability to damaging events - more people living in exposed areas, more people with fewer means of coping with loss - these were seen as more indicative of real life.

In a similar way, changing risks and the losses associated with them, are in Darkot, less a product of any significant change in environmental conditions, which aside from the loss of some of the valley's original forest cover appears to be negligible, than it is the undermining of traditional patterns of resource management and the integration of the local political economy with that of a wider sphere. 'Modernization' significantly alters traditional patterns of resource management, the ways in which communities and households have absorbed losses and prepared for future events, and it does so blindly, without acknowledging - even cursorily - the consequences.

A note of optimism is required however. The communities of the Northern Areas have demonstrated their resiliency over hundreds of years. It is entirely possible - even probable - that they will manage to continue to change and adapt with the same flexibility that is characteristic of these places. That is my sincere hope. That Darkot, and communities like it, will discover new ways to respond to the risks associated with this

region, that they will recognize the ways in which intervening conditions can exacerbate a damaging event, that hazards will continue to be expected and prepared for and that vulnerability will be effectively redistributed. I hope that 'progress' will not be fatal.

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