Communities, Networks and the State: Continuity and Change among the Kuhl Irrigation Systems of the Western Himalaya

(DRAFT MANUSCRIPT)

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Chapter One

Shocks, Changes and the Kuhls of Kangra

On April 4, 1905 a devastating earthquake struck Kangra Valley. In addition to the tragic loss of life (12,663 deaths were reported[1]), villages were levelled, roads were destroyed and bridges collapsed. The extensive networks of gravity flow irrigation systems, known locally as kuhls, were also severely damaged. The timing of the earthquake, at the beginning of the rice planting season, threatened famine later in the year because kuhls are the only source of irrigation water until the onset of the monsoon in late June; had the summer paddy crop failed, Kangra's relative isolation from the plains to the south would have made famine relief difficult. The British colonial government, aware of the ramifications of interrupted irrigation, mobilized the expertise and labor of soldiers in military engineering units known as Sappers and Miners to rebuild and repair the destroyed irrigation structures. By the third week of April the Chief Secretary of the Punjab Government cabled the Government of India Home Department Secretary that "...Sappers and Miners have commenced work on [the] irrigation heads of Baner stream..." and "A fourth double company of Pioneers [have] arrived Shahpur and will join the Sappers and Miners in repairing the irrigation channels which take out of the Baner in neighborhood of Kangra...".[2] With the help of the British army the irrigation channels were repaired.

Nearly fifty years later, in 1952, a different type of environmental shock struck the kuhl irrigation systems of an adjacent mountain river, the Neugal. During a torrential monsoon downpour a landslide in the narrow canyon headwaters temporarily dammed the Neugal.[3] Eventually the force of the rising waters burst the debris dam sending a wall of water and debris raging down the streambed. The destructive force of the wall of water eroded large areas of fertile agricultural fields, destroyed the cliffside portions and diversion structures of many kuhls, and changed the course of the Neugal. Two kuhls in the middle reaches of the watershed, Patnuhl and Menjha, were among those the flood destroyed. However, Patnuhl Kuhl, just upstream from Menjha Kuhl, was less severely damaged and within a few weeks the irrigators of both were able to repair Patnuhl. For the next three years, until Menjha Kuhl's diversion structure was successfully relocated 50 meters upstream and a new cliffside channel constructed, farmers from Menjha Kuhl received irrigation water from Patnuhl Kuhl.

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[1]Middleton, L. 1919. Final Report of the Third Revised Land Revenue Settlement of the Palampur, Kangra and Nurpur Tehsils of the Kangra District, 1913-1919. Lahore: Government Printing, p.5.

[2]Telegrams no. 239 and 240 dated 23 April 1905. From Chief Secretary to the Gov't of the Punjab, to the Secretary to the Government of India, Home Department. Delhi: National Archives.

[3] See Agarwal et al. (1991) for a discussion of landslide dams in the Himalaya, including their frequency and large contribution to overall erosion and sediment loads.

During the last fifty years changes in the political economy of the region have further challenged the ability of farmers to maintain the integrity of the kuhl systems on which they still depend for summer and winter crop irrigation. While less dramatic than earthquakes and floods, the changes are pervasive. They include increased household engagement with the market economy, primarily in the form of outmigration for employment. Male outmigration has differentiated the interest in and dependence on agriculture among households with or without access to remittance incomes; households with high remittance incomes and low male labor availability at home have resorted to social fallowing in which agricultural terraces are converted to fodder production. , Outmigration has created acute labor shortages for communal tasks, challenging capacities to mobilize adequate labor for annual kuhl repair and maintenance. And it has exacerbated caste and class based inequalities, which stretch the conflict resolution capacities of kuhl regimes. Some kuhl regimes were unable to manage the internal tensions resulting from these changes and shocks. Their channels lie defunct. However, at the cusp of the new millennium, most kuhl channels still brim with water during the crucial pre-monsoon irrigation season and also during the winter wheat growing season. Kuhl regimes demonstrate the potential resiliency of institutions for common property resource management in their ability to maintain their physical and institutional integrity despite these sorts of shocks and transformations.

Key Questions and Explanatory Threads

The extreme set of ecological and social conditions within which the kuhls of Kangra Valley exist challenge the ability of theories of common property resource management to explain their persistence and change. In order to account for the differential patterns of change and persistence among the kuhl regimes of Kangra, three broad, over-arching questions must be addressed. These questions extend the domain of inquiry beyond that which is often considered in the study of systems of common property resource management. The first over-arching question asks what is the role of the state in supporting or not supporting community-based institutions for common property resource management. Answering this requires rethinking the relationship between state and local institutions, and indeed, our understanding of what constitutes the "state" and "local" and how they may mutually constitute and reinforce each other. A second over-arching question concerns the possible roles of exchange (material or symbolic or both) between different community-based resource management systems in enabling their persistence. Exploring this issue requires drawing back from a micro-focus on individual systems of common property resource management to a more landscape-scale perspective in order to first identify and then evaluate the possible effects of exchange between networked resource management systems. A third overarching question focuses on the importance of regionality in terms of how it informs the specific institutional forms, micro-

level social relations, ritual aspects of, and trajectories of change within common property resource management systems. This question forces investigation of the role of culture, informal institutions, and region-specific understandings of community and identity. These over-arching questions incorporate multiple levels of analysis and integrate different analytical perspectives. When woven together, these levels and perspectives create a tapestry whose pattern should correspond to the transformations and rhythms of change observed within individual kuhl regimes.

Four intellectual strands, each representing a different scale and set of relations, must be woven together for the tapestry's pattern to become clear. The last three strands expand the domain of inquiry into less frequented terrain. The first strand is primarily focused on local level social and ecological processes which facilitate or hinder collective action. Here, attention is focused on those social aspects known to affect the likelihood of collective action. These include group size, the extent of internal differentiation within the group, e.g., caste or class differences, the degree of dependence on the resource by group members and the amount of variation between households in terms of dependence on the resource, the ability of the group to exclude outside would-be resource users, and the group's rule-making and dispute arbitration capacities. It also addresses characteristics of the resource involved, including for example whether or not the resource is fugitive, the risk and uncertainty associated with its management, and its productivity or value. The field of common property resource management, drawing on theories of collective action, property, risk management, and institutional economics, has developed a sound foundation for understanding the relationships between these elements and successful collective action.[4] This strand is adept at explaining the emergence of collective action for common property resource management and the institutional forms such management assumes. It is less able to explain the persistence of enduring forms of common property resource management under the conditions of recurring shocks and economic change described above. Doing so requires broadening the scope of inquiry to include the following three strands and then weaving them together.

The second strand concerns the potential for and effects of beneficial exchange and coordination between separate but interdependent community-based natural resource management regimes. This perspective broadens the scope of inquiry horizontally. It points to the possible existence of latent networks of interdependence that link together different irrigation systems within a hydraulically defined landscape unit. In his pioneering research on the subak irrigation systems of Bali, Indonesia, Lansing (1991) has

[4] Some of the many important contributions to the field of common property resource theory include Wade (1988), Berkes (1986), Ostrom (1990), McCay and Acheson (1990), Ostrom, Gardner, and Walker (1994), McKean (1992), Bromley (1992), Seabright (1993), and Agrawal (1996). See Mosse (1997b) for a thoughtful critique of the institutional-economic modeling approach of common property resource theory.

shown how such networks, managed by decentralized, nonhierarchical religious authorities, function to coordinate complex agricultural activities, including irrigation management, over large landscape scales. Can such networks also act as "buffers" to help insulate individual irrigation systems from the destructive effects of recurring floods and earthquakes? Exploring this question involves first identifying the extent to which networks do indeed link individual kuhl systems, and then examining them in light of research on the roles and functions of networks from sociology and political science, particularly organization theory.

The third strand problematizes the categories of "local" and "state" by extending the investigation of kuhls vertically to examine spatial-temporal variations in relations between kuhl regimes and extra-local authorities. This strand shows that contrary to some constructions of "traditional" and "local" which are developed in sharp opposition or contradistinction to state structures, there exists the possibility of constructive state intervention in local resource management regimes, even to the extent that the endurance of some erstwhile local systems of resource management may be due, in part, to infrequent but important state involvement in them. Examining the possibility of this type of interaction requires teasing apart the simple dichotomous opposition between state and society to reveal the complex interconnecting relations the opposition generally masks. It also involves blurring the exaggerated distinction between pre-colonial, colonial, and post-colonial state structures of authority to be able to identify the specific points of, and basis for, interaction between elements of extra-local authority and village-based irrigation management. Only then can the rationale for a mutually beneficial interaction between state authority and local irrigation organization be developed.

The fourth strand grounds the analysis in place and in regional history. That the kuhls are in Kangra is not inconsequential to the forms that formal irrigation organization have assumed, nor to the historical trajectory of change within kuhls. This strand explores the "Kangriness" of kuhls. It identifies the informal social institutions which under gird irrigation organization and within which kuhl regimes are embedded. It addresses regional social formations, patterns of land ownership, and wealth distribution, and shows how they have informed kuhl regimes and in turn how kuhl regimes reinforce them. It also addresses history. Kangra is located on the edge of the main routes which have linked north India with Central Asia for centuries. The proximity "of Kangra to the plains of north India has enabled large numbers of Kangra men, primarily high caste Rajputs and Brahmans, to serve in Afghan, Mughal, Sikh, British, and Indian armies. The ideas, values, norms, and modes of interaction servicemen bring home with them have also influenced the historical patterns of irrigation organization and the trajectories of change which have occurred within them.

Common Property Theory

Telling the stories of the kuhls of Kangra engages with two areas of study that together have implications for our current understanding of community-based resource management in India. The first area of study concerns common property resource management theory, especially as it relates to irrigation management.

Institutions for common property resource (CPR) management and the resource systems they manage persist to a greater extent and for different reasons than prevailing theories lead us to expect. Enduring CPR management systems which contradict the conventional wisdom that people acting in their own self-interest cause resource degradation and declining collective well-being include communal pasture and irrigation management in the Swiss Alps (Netting 1981), communal forest management in Japan (McKean 1986), China (Menzies 1988), and Nepal (Ghimire 1993), and marine tenure in coastal fisheries (Berkes 1987, Cordell and McKean 1986). To account for enduring CPR systems, theories of CPR management explain individual participation in CPR regimes in terms of the costs and benefits of participation, and they explain rules, sanctions and other organizational attributes in terms of the efficiency and security of exchange between individuals within the CPR system (Ostrom, Gardner and Walker 1994, White and Runge 1995).[5] Researchers have demonstrated that the degree of social/economic differentiation within a group of resource users and the extent of their reliance on the commonly-held resource influence the likelihood of collective action for managing the resource (Bardhan 1993b, Oakerson 1986, Olson 1965, Tang 1992, Wade 1988). Current theories predict that environmental change, e.g. market expansion, migration, public sector interventions, privatization initiatives, population growth and technological change, stress CPR systems by increasing the cost of and controls upon individual choices. They postulate that the response of a CPR regime to environmental change depends upon the effects of the change on individual choices and the internal regime structures that regulate them (Ostrom 1990). However, researchers cannot predict why and how a stressed CPR regime will either persist unchanged, transform to endure, or collapse.

Irrigation management systems, a subset of common property resource institutions, provide a fertile field of inquiry for scholars interested in diverse questions ranging from the conditions under which self-organizing forms of collective action are likely to emerge and persist (Tang 1992) to the relationship between irrigation and centralized political authority (Hunt and Hunt 1976, Sidky 1996). While all

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[5] I define CPR systems to include both the institution that manages the resource and the natural resource itself. I define CPR regime to mean the institutional arrangements that have evolved to manage the natural resource system.

[6] Irrigation as a common property resource differs significantly from other commonly managed resources such as grazing lands and forests. Grazing lands and forests are essentially reservoirs of solar energy. The key management challenge concerns how to distribute the benefits of that stored energy to the community of rights

irrigation systems share common tasks associated with water management and the construction, maintenance and operation of the physical structures associated with water use (Uphoff et al. 1985), the organizational forms that have evolved to accomplish those tasks vary widely. They encompass acepahlous systems of "ordered anarchy" (Netting 1974, Leach 1961), self-organized decentralized, non-hierarchical autonomous systems (Martin 1986, Yoder 1986) self-organized hierarchical networks (Lansing 1991, 1993, Spooner 1974), and externally organized hierarchical and centralized systems (Hunt and Hunt 1976, Whitcombe 1972, Wittfogel 1957, Worster 1985). Self-organizing irrigation systems possess many of the characteristics associated with successful common property resource management regimes. These include: 1) well defined user group and resource boundaries, 2) congruence between rules governing resource appropriation and provision, 3) the ability of resource users to modify rules, 4) the existence of monitoring, sanctioning and conflict resolution mechanisms, 5) the political decision making autonomy necessary for local self-organization, and 6) for larger irrigation systems, the organization of management activities into "nested" layers (Ostrom 1990, 1992, Tang 1992). Hardin's (1968) tragedy of the commons model to the contrary, classic examples of self-organizing irrigation management systems which possess these characteristics and have persisted for centuries include the huertas in southeast Spain (Maass and Anderson 1986), Balinese subaks (Geertz 1980, Lansing 1991), and the zanjeras of Illocos Norte in the Philippines (de los Reyes 1980, Lewis 1971).

Privatization and State Control of the Commons in Greater Punjab

Despite the widespread existence of enduring common property resource institutions, their viability has been eroded in many cases by the multiple tensions that accompany large-scale demographic, political and economic changes. This can result in resource degradation and a shift in property rights to either privatization or state control of the resource (Ensminger and Rutten 1991, Feeny et al. 1990, Jodha 1985a, 1985b, Ostrom 1990, Polanyi 1944). The dual processes of increasing privatization and state control of resources that common property theorists predict under conditions of change has occurred throughout the plains and mountains of northwest India during the last two centuries. This area, known as the greater Punjab, included Kangra until it, along with the other Himalayan districts of old Punjab, was merged with neighboring Himachal Pradesh in 1966. From a historical perspective, greater Punjab constitutes the

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holders while simultaneously preserving the productive capacity of the resource. With irrigation, on the other hand, there is no prior reservoir of resource benefits to distribute. Until collective action has been undertaken to provide water for irrigation and other purposes, there is no possibility of anyone benefiting from it. This contrasts with the possibility of an individual who cuts trees from a forest or grazes her animals on uncultivated lands. The possibility of irrigation presupposes the existence of collective action. While the freerider challenge does exist within the context of irrigation, rather than threatening the productivity of the resource base itself as it can within the context of forests, pastures, and fisheries, it reduces the water available to other users without necessarily threatening the future biophysical viability of the resource.

broader regional context in which to situate the analysis of continuity and change of the kuhls of Kangra. Situating the communal irrigation systems of Kangra within their regional context underscores the extent to which their continued persistence contradicts the more general trends of increasing privatization and state control of common property resources in greater Punjab. Explaining this contradiction brings forth illuminating points of contrast between the social, political, and ecological characteristics of the mountains and the plains, irrigation in the hills and irrigation in the plains, and water and other common property resources such as forests or grazing lands. As I will show, it also forces a more nuanced analysis of the complex, intertwined relations between the state and local communities. This is particularly relevant because of the current interest on the part of both the government and non-government organizations in supporting community-based irrigation. The effectiveness of state or private interventions which are not informed by a historical understanding of how these systems formerly operated will be compromised.

Chakravarty-Kaul (1996) has ably traced the dramatic decline in village common lands throughout greater Punjab during this period. She shows how rapid expansions in cultivated areas, particularly after 1860, resulted in dramatic declines in village commons, grazing lands, and the massive displacement of pastoral groups as well as marginal sedentary groups for whom common lands resources met important subsistence needs during periods of scarcity. A complex of factors fuelled this process; these included population growth, fixed assessments between revenue settlements, state-sponsored capital investments in agriculture, expanding markets for commercial agriculture, and improvements in transportation networks such as roads and railroads. Chakravarty-Kaul also addresses the nature and effects of the British colonial administration's involvement in the codification of customary law, particularly the manner in which the settlement process established village communities of landowners who were made jointly responsible for paying the assessed land revenue. In exchange, landowners' secured their private property rights, their shares in the common lands, as well as the authority to expand cultivation into the previously uncultivated common grazing lands. This process occurred throughout Punjab, even in areas such as Kangra, where such communities did not exist prior to British rule. On the plains, and to a lesser extent in the hills, the expansion of private property into the village commons "produced many local conflicts as the claims of farmers clashed with one another, as farm communities claimed the land of pastoralists and forest cultivators, and as the state, zamindars (landlords), tenants, and ryots (owner cultivators), asserted rights to newly cultivated land" (Ludden 1999:192).

The colonial state's intimate involvement in (re)structuring property rights and facilitating the concentration of resources and power among groups which became (and still are) regionally dominant was particularly apparent among the canal colonies of the Punjab. Here the 19th century imperial science of

large-scale irrigation engineering combined with social engineering to create new patterns of state power and community linked together in a joint enterprise to control the environment (Gilmartin 1994). Irrigation pushed agriculture into semi-arid regions previously occupied by nomadic and semi-nomadic groups. Social engineering policies to create productive (and obedient) communities[0] displaced these groups; in their place dominant caste groups were granted large tracts of newly irrigated land at relatively low rents. These same dominant caste groups played critical roles in the military, including supplying large numbers of army recruits (Ludden 1999).

The large scale and dramatic conversion of common lands to irrigated agriculture, and the concomitant consolidation of power among dominant caste groups which occurred on the Punjab plains was not repeated to the same extent in the hill districts of greater Punjab, including Kangra. The reasons for this were varied. To begin with, the potential for expanding the cultivated area was much less in Kangra than for other regions of the Punjab; by the mid-nineteenth century most cultivable areas had already been brought under the plow. Whereas greater Punjab had the largest proportion of uncultivated but cultivable land in 1891 in British India and by the 1920s the area of irrigated agriculture had doubled (Chakravarty-Kaul 1996:22), in Kangra in 1855 the first District Commissioner and settlement officer, G.C. Barnes remarked that "he did not anticipate . . . any reclamation of waste land" and that the cultivable areas "have been long since selected and reclaimed; nothing is left now, but the precipitous sides of hills, frequently encumbered with forest and brushwood" (1855:63). These observations are borne out by an examination of cultivated area in the Neugal basin, where the research for this study was carried out. Between 1851 and 1892 the cultivated area increased eight percent from 6,522 to 7,028 hectares. Between 1892 and 1915, the period of most rapid expansion of cultivated area in greater Punjab, the cultivated area in the Neugal basin actually declined slightly to 6,568 hectares. Not surprisingly, in this agrarian environment grazing lands were quite scarce. Prior to harvest time grazing was confined to the uncultivated areas adjacent to hamlets. After harvest the stubble covered fields became temporary grazing lands let out to nomadic pastoralists, the Gaddis, to graze their herds of sheep and goats. Groups of Gaddis timed their seasonal movements between the high mountain meadows and the low hills to coincide with the crop harvests. Along the routes they travelled twice annually they traded temporary grazing rights for the fertilizer the animals left behind.

Other factors also differentiate Kangra from the plains. Perhaps self-evidently, due to a combination of hilly terrain and little scope for increased cultivation, there was no opportunity in Kangra for large scale canal irrigation systems and the massive state capital investments they entailed. Additionally, in Kangra village communities did not exist as corporate organizations with defensible

entitlements to private cultivated and common uncultivated lands, as they did in many parts of the plains. Instead, hamlets, often single caste, dotted the hilly landscape with little if any sharp demarcation of boundaries between them. Individual families held rights to private cultivated areas; these entitlements were secured through a pattah from the ruling Katoch lineage of hill rajas. Uncultivated areas, to the extent that they existed, were considered the property of the hill chiefs.

The narrative of privatization of the commons powerfully describes transformations on the Punjab plains during the late 19th and early 20th centuries, but has limited salience in the hill and mountain regions. However, the other outcome predicted by common property theorists in response to large scale demographic, political and economic changes - increased state control of the resource - did occur in Kangra with regards to the "precipitous sides of hills, frequently encumbered with forest and brushwood" Barnes referred to in1855. Beginning with Lyall's revision of the first settlement in Kangra in which he attempted to reassert state claims over forest resources which Barnes, thinking that encouraging agricultural intensification was more important than forest conservation, had given to the "village communities" he created in the first settlement 20 years previously, the colonial administration commenced a long term project of securing state control over forest access and utilization in the western Himalaya. The process through which this occurred has been well analyzed (Saberwal 1999, Grover 19XX, Baker 2000, Singh 1998, Tucker 1983, Guha 1989). Forest conservancy entailed many conflicts analogous to those Ludden discusses with regards to the privatization of the commons in the plains. Conflicts over forest access and use occurred between Gaddi pastoralists and the Forest Department, the Forest and Revenue Departments, the Forest Department and the "village community", and landowners and non-landowners. Out of these conflicts emerged shifting alliances such as between Gaddis and the Revenue Department, negotiated concessions by the Forest Department of rights of forest access and use to village communities, and new local institutional arrangements for forest management such as the Village Cooperative Forest Societies which represent early precursors to contemporary community-based forestry programs. Although certainly not uncontested, state control of forest resources in Kangra and other areas in present day Himachal Pradesh increased dramatically during the late 19th and early 20th centuries and continues to this day.

Surrounded by privatized common lands on the plains and state controlled forestlands in the hills, the persistence of community-managed irrigation regimes in Kangra may seem anomalous. In many ways it is. Other self-organized irrigation systems in India subject to rapid political and economic changes have deteriorated and/or collapsed (Hardiman 1995, Sengupta 1980, Gordon 1994, Mosse 1997). Why have the kuhls of Kangra persisted while other self-organized irrigation systems in India have not? And why were

the kuhls not privatized or taken over by the state as happened with other common property resources in greater Punjab? While the answers to these questions are developed in subsequent chapters, this section has served to raise issues, begin the process of situating Kangra as a region within a broad spatial and temporal context, and identify the persistence of kuhl regimes as an interesting topic worthy of further investigation. A full analysis of the patterns of persistence and change within the kuhl irrigation systems of Kangra requires elaboration of the explanatory tapestry described above and its application to information derived from the field research.

Field Research Methods

Field research was conducted in two stages, from December 1990 through November 1991, and from September 1992 through November 1993. The second stage consisted of iterative periods of writing and fieldwork. During both stages, I employed a wide variety of research methods including extensive participant observation, three different formal surveys and one informal survey, informal interviews, and group discussions, with farmers, kohlis (watermasters), elder men, officials within the Irrigation and Public Health (IPH) Department, and district officials. I also made extensive use of colonial documents kept in the District Commissioner's Library and the Revenue Department. These records provide information about land use patterns, irrigation, and the social and historical characteristics of the region. Other secondary data included village level records regarding kuhl management, IPH records of some of the kuhls presently under their management, and studies published by the Himachal Pradesh Agricultural University in Palampur that provided comparative and background information regarding local agricultural and resource management systems. Additionally, there exists a unique historical record of the 715 major kuhls and the more than 2,500 minor kuhls that irrigate Kangra District. First compiled in 1868 and later revised in 1918, the Riwaj-i-Abpashi (Irrigation Customs) is an unusual and detailed compendium of information regarding individual kuhl irrigation systems as well as customary rights and rules governing irrigation. It is discussed more fully in Chapter Four.

I chose District Kangra for this study because it has the most extensive kuhl irrigated area in Himachal Pradesh, almost 32,000 hectares. This is more than twice the kuhl irrigated area of District Mandi, which has the second largest irrigated area in the state.[7] Within District Kangra, Kangra Valley was selected because, as table 3.4 shows, the two tehsils (district subdivisions) that comprise Kangra Valley, Kangra and Palampur, account for most of the irrigated area in the district. Within Kangra Valley, one river basin, that of the Neugal River, was chosen for collecting primary data. I chose a small river

[7]Report of the ICAR Research Review Committee. 1982. Indian Council of Agricultural Research, Krishi Bhawan, New Delhi, p. 9.

basin as the unit of analysis for primary data collection to facilitate examination of inter-kuhl relations, and their possible role in explaining the persistence of kuhl regimes. I chose the Neugal river basin because it has the highest density of kuhl networks in Kangra Valley. I determined kuhl network density by collating the number of kuhls in each basin and the number of villages each kuhl irrigates (Table 1.1). The table shows that of the perennial torrents *(khads)* flowing from the Dhaula Dhar range, the Neugal has one of the densest networks of kuhls.

Table 1.1 The Major Kuhls of Kangra Valley, by Khad, by number of Tikas (hamlets) each Kuhl Irrigates.

Khad	Number of Kuhls by Number of Tikas (hamlets) Irrigated																							Total #
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21-	26-	>30	
Rat hu																								0
Chambi	1																							1
Mahadi	1																							1
Brahal	2	1																						3
Kultah	2	1	2	1																				6
Lindki	1	2	3				1																	7
Kharini	4	3	1																					8
Sansal	1	3	3	1																				8
Dibvar	4	5	3																					12
Binwa	6	1		1			1			1								1						11
Naud	11	4	1																					16
Banoi	12	13	1	1																				17
Ikku	7	1	2		1	3	1	1	1															17
Kuhairi	I5	1	1	1																				18
Khauli	6	2		4		1			1	2			1	1								1		19
Churan	10	8		3																				21
Bhanoon	16	6	1	1																				24
Awah	3	2	1	2	1	2	1	3	2	2	1	1						1			2	1	1	26
Pun	18	2	7																					27
Maul	20	4	3	1																				28
Neugal	8	6		6	1	1		2	1	1				1		1	2				4	1	1	36
Manooni	4	13	7	3	1	3	3	1	2															37
Gaj	22	4	6	2	2	1			1				1		1									40
Baner	20	6	3	3			1	1	1		3	1	1				1					1		42
Mand	25	9	4	2	1		1																	42
Manjhi	16	7	4	5	3	5		1	3	1														45
Drun	30	11	2	2	1																			46
Joegal	28	15	3	2																				48

The fieldwork process proceeded through a series of stages. At the suggestion of Anil K. Gupta, Professor, Indian Institute of Management, Ahmedabad, I invited the kohlis of all the kuhls in the Neugal basin to a midday meal in the district town of Palampur. More than 30 kohlis attended, including a few who managed kuhls for the Irrigation and Public Health Department. This initial meeting provided an opportunity to introduce myself and the purpose of the study, as well as to facilitate discussion between kohlis regarding some of the current issues in kuhl management. This general meeting constituted a precedent for the smaller group meetings I organized periodically throughout the fieldwork to generate group discussion among those present, to present my thoughts about what I had been finding, and to elicit feedback on my work. This proved to be a valuable opportunity to test local responses to my own thinking, and to exchange information between kuhl regimes about management strategies and solutions to common problems.

Throughout the period of fieldwork I used participant observation to familiarize myself with local agricultural and water management practices. This included primary responsibility for paddy production on a small terraced plot, participating in the annual maintenance and repair activities of several kuhls, accompanying kohlis on their nightly patrols of the kuhl's channels to guard against water stealing and to identify potential leaks, attending kuhl committee meetings, and participating in the annual religious ceremonies of three kuhls. Participating in these events provided me the necessary familiarization with both water and agricultural practices requisite for the more formal inquiries I made during the course of fieldwork.

Before surveying could begin, all the kuhl regimes in the basin were first mapped and their flows measured. They were then stratified by flow, length, command area and number of villages irrigated, and classified into three groups: small, medium and large. Two kuhl regimes from each size class were chosen for surveying. Two kuhls managed by the IPH Department were also chosen for surveying. For each kuhl regime three different survey questionnaires were used; a farmer survey, a kohli survey, and a survey for members of the kuhl committee, if present. Knowledge gleaned from informal interviews, meetings and participant observation provided the information base necessary for designing the first iteration of the questionnaires. The questionnaires were pre-tested in three villages and refined further.

I had one research assistant during the survey period, Mr. Rajesh Thakur, who had recently completed a Masters of Science degree in Agricultural Economics at the Himachal Pradesh Agricultural University at Palampur. Together we surveyed a total of 95 male farmers randomly selected from the head, mid, and tail-end sections of each of the six chosen kuhls, as well as the kohlis, and where present,

the elected officers of the kuhl committee.[8] Farmers were selected from different positions within each kuhl in order to identify possible tensions between head- and tail-enders, and to be able to compare the degree of tension across different kuhls.

Each survey took approximately two to three hours to complete. On average we conducted two surveys per day. To facilitate more candid conversations we completed each questionnaire form after the survey. During the farmer survey we asked questions regarding, 1) the farmer's agricultural production systems, 2) sources of income, 3) knowledge of the history of the kuhl(s) whose water the farmer used, and general knowledge of adjacent kuhls, and 4) various aspects of kuhl management including the kohli's work and mode of compensation, the structure and functions of the kuhl committee if present, the organization of kuhl maintenance and repair, water guarding, fines, sanctions and rule enforcement mechanisms, water measurement methods, and conflict management both within and between kuhls.

The kohli's questionnaire included many of the same elements as the farmer's questionnaire, the main difference being that the sections dealing with the kohli's duties and responsibilities, kuhl management, and relations between kuhls were expanded. Similarly the questionnaire for members of the kuhl committee, if one existed, emphasized their rights and responsibilities as committee members, and the structure and functions of the committee. Most surveys ended with a period of general open-ended discussion that often provided useful, qualitative insights into kuhl management.

Throughout the survey period, informal group meetings with farmers were also held. These provided an important forum for further investigating questions that arose during the process of surveying, and for checking the accuracy of the perceptions we formed during the survey period.

At the time of the 1991 Kharif crop harvest, Mr. Thakur and I measured paddy crop yields by harvesting and weighing 20 ten by two meter marked plots distributed from the upstream to the downstream portions of the Neugal Basin. These measurements provide a rough idea of yield differences between different parts of the basin, and a basis for comparison with yields obtained by the Himachal Pradesh Agricultural University in Palampur under more controlled conditions.

Upon returning to District Kangra in late 1992 I spent three months collecting and analyzing secondary data for two time series. The first consisted of tika level primary census data from the 1951 decennial census up to and including the 1991 census, aggregated at the basin level. This information was used to track the changing ratio of the agricultural and non-agricultural labor sectors as an indicator of expanding nonfarm economic opportunities. The second time series consisted of tika level information

[8]Local conceptions of family honor made it impossible for me to interview women other than in informal group discussions. Non-Brahmin and non-Rajput women do engage in agricultural activities (except for plowing and sowing).

regarding cultivated area from 1851 through 1991, also aggregated at the basin level. This information was collected from settlement reports in district archives of the Revenue Department and the District Commissioner's Library. The declines in cultivated area, in combination with expanding wage labor markets, are evidence of the dramatic changes in the economic context of kuhl management. This information is presented and discussed in Chapter Three.

Throughout the second stage of research I continued to collect relevant secondary information including the various records that kohlis and kuhl committee members maintain regarding kuhl management. During this period I also began to write the dissertation on which this book is partly based. While writing I made periodic field visits to confirm questions. This iterative writing process provided a valuable opportunity to discuss my developing ideas with kohlis and others knowledgeable about kuhls, and to solicit their feedback and responses. During the process of writing, it became apparent that the analysis of kuhl regime responses to the changing political economy of water management would have more basis if I used data from a larger number of kuhl regimes. Accordingly, I spent the last two months in the field, with the able assistance of Mr. Jugal Kishore for much of the time, conducting key informant interviews with kohlis, elders and others regarding the nature of the organization of kuhl management, and how and why it had changed, if it had. These interviews were conducted for the remaining twenty-one privately managed kuhls within the Neugal basin that had not been surveyed earlier.

Data Analysis

Data were analyzed at the regional, basin, kuhl, and individual scales of analysis. Analysis of colonial settlement reports combined with published secondary materials and my own observations provided the basis for discussing the historical development of Kangra State, its role in kuhl management, and the cultural context of kuhl regimes. Tika level census data and cultivated area data were aggregated at the basin level to track changes in the area under agricultural production and the ratio of farm to nonfarm employment. The structure, functions and effects of relations between kuhls were determined based on qualitative responses during interviews with kohlis, prior kohlis, and elder farmers.

At the level of individual kuhl regimes, data regarding the management structure, and rules and practices for each kuhl, was assembled from kohli, kuhl committee and sample farmer questionnaires, transferred to summary data sheets, coded, and entered into spreadsheets. Qualitative information, quotes, and researcher observations were included in summary data sheets. Attendance records were collated and analyzed to determine rates of absenteeism, and when possible, how they had changed over time. Account books, records of fines and sanctions, and registers of the minutes of kuhl committee meetings, were

analyzed to determine the trajectory of change in kuhl management over time, as well as differences in management structure between different kuhl regimes.

At the individual level, data from the sample farmer questionnaires was analyzed to determine the effect of position within the kuhl on the relative balance of the benefits and costs of contributing to kuhl maintenance and repair. This information was also used to determine changes in water availability in different sections of a kuhl's command area, and the effect of those changes on cropping practices.

Organization

Chapter two synthesizes what are often disparate strands of theory into an integrated framework which should enable analysis of "local" irrigation management within the broader political, economic, social, and historical context. The purpose of the framework is to provide the basis for analyzing how environmental change affects internal regime stress, how regimes respond to stress, and the impacts of regime response on regime persistence. The first strand concerns how local level factors influence possibilities for effective collective action. Elements to be considered include the effects of social differentiation, rising opportunity costs of labor due to outmigration, returns to labor allocated for kuhl management, and local ecologies, as they differ from kuhl to kuhl. This material will be drawn largely from existing rational choice studies of common property resource management systems. The second strand addresses state-local relations vis a vis kuhl irrigation across pre-colonial, colonial, and post-independence time spans. This strand will combine theories of the state from political science and sociology as currently applied within the field of political ecology with institutionalist and neo-institutionalist perspectives to theorize the basis of state authority, the motivations for state interest and involvement in "local" irrigation management (as well as other natural resources), and effects on the organizational structure of kuhl regimes of increased interaction with a bureaucratic state apparatus. The third strand concerns inter-kuhl coordination and the role of networks in mitigating the destructive effects of environmental shocks. This strand draws on theories of organizational and social networks - their properties, their functions, their "embeddedness", their character and coherence - to illuminate the possible roles of inter-kuhl coordination in buffering individual kuhl regimes from the environmental shocks enumerated above. This strand will incorporate discussion of the role of informal institutions, pervasive norms and cultural idioms, and "community" and its construction in explaining the enduring nature of kuhl regimes. The fourth strand addresses the influence of regionally, of place, and of history, on the character and persistence of kuhl regimes.

Chapter three conveys to the reader a sense of Kangra as a place and of the changes and shocks that have challenged the integrity of kuhl regimes. Thus, it sets the stage for understanding endurance,

transformation, persistence, and demise within kuhl irrigation systems by discussing the setting in dynamic terms. The chapter provides information on climate, topography, agricultural production systems, land ownership patterns, and basic social divisions. It includes discussion of changes in political regimes, recent regional economic change (outmigration, nonfarm employment, remittance income), and population trends. After reviewing the nature of the environmental risks with which kuhl regimes must contend, it concludes with an overview of the annual rhythm of activities associated with kuhl management. This overview addresses the seasonal organization of water management, the institution of kohli (watermaster), the various rules used for determining the who, how and when of kuhl maintenance and repair, the ritual elements of kuhl management, and water distribution and measurement during the summer and winter cropping seasons.

Chapter four addresses pre-colonial and colonial state involvement in irrigation. It analyzes how changing notions of property, subtle shifts in the basis of state authority, codification of irrigation customs, and other policy changes introduced by the British, influenced state roles in irrigation, introduced new arenas for and modes of conflict resolution, and encouraged the expansion of kuhl irrigated areas. I demonstrate that relations between some kuhl regimes and supralocal authorities have been important in maintaining the physical structures of those regimes because supralocal authorities provided necessary but otherwise unavailable resources. State roles in kuhl management have included state sponsorship of kuhl construction, resource inputs for kuhl repair following destructive floods and/or earthquakes, and third party mediation for resolving water disputes. The discussion attends to the continuities as well as the disjunctures between pre-colonial and colonial rule. It identifies the internal rifts and shifting policy priorities within the colonial state which influenced state involvement in irrigation.

Chapter five analyzes how increasing nonfarm employment has differentially affected kuhl regimes and accounts for the diverse array of regime responses to those affects. The first part discusses how increasing nonfarm employment and the resulting labor scarcity/increasing opportunity costs of labor have challenged the integrity of some kuhl regimes. I will show how declining farmer participation in kuhl maintenance and repair activities, the declining authority of the kohli, and increased headend-tailend conflict (especially when exacerbated by pre-existing caste differences and conflict), have resulted from increased nonfarm employment and concomitant declining dependence (for some households) on local agricultural production. The second part of this chapter explains how and why the effects of increasing nonfarm employment vary from kuhl to kuhl, as well as the responses to those effects. The "reliance differentiation" framework which incorporates factors such as social differentiation (caste and class) and dependence on kuhl water (read as value of kuhl water) is presented to account for the different impacts of

nonfarm employment across different kuhls. Integrated with this section will be analysis of the different responses of kuhl regimes to these stresses in terms of the extent to which farmers have formalized their management structure and the extent of state involvement in kuhl management. In this section I argue that formal organizational structures can be a response to internal stress/conflict and are therefore not always an indicator of successful ability to mobilize resources. The last section of this chapter addresses the effects of increased interaction with the post-independence "developmentalist" state on the structure of current kuhl management institutions. Using ideas drawn from the "new institutionalism", this section explicitly incorporates supra-local authority and governance structures as factors that help to understand and explain the trajectory and form of recent changes within kuhl regimes.

Chapter six analyzes the role of interdependence in buffering environmental shocks. In this chapter I map interdependence between individual kuhl systems to identify patterns of network density. This allows exploration of the relationship between network density and instances of inter-kuhl coordination (e.g. water sharing, joint management endeavors, etc.). I argue that interdependence between individual kuhl systems can be a resource that enables exchanges to occur between kuhl regimes. These exchanges can mitigate and buffer the negative consequences of shared dependence on and vulnerability to a capricious and risk prone environment. I describe analogies from other social arenas and show how they constitute mutually reinforcing structures of action for the patterns of exchange between kuhl regimes. This discussion contributes to our understanding of how institutions that share a mutual environmental dependence can manage that dependence through strategies of coordination with each other.

Chapter seven summarizes the study's results and discusses their wider implications. Under conditions of regime interdependence and recurring environmental shocks, the embeddedness of kuhl regimes in broader social relations, cooperative water sharing arrangements between kuhl regimes, and external subsidies that complement local capacities account for the persistence of kuhl regimes. Under conditions of environmental change that reduce dependence on regime benefits for regime members, regime persistence is directly related to the ability to manage internal stress through regime formalization. The degree of stress and corresponding extent and impacts of formalization depend on the regime's physical and social complexity, its interdependence with other regimes, the productive potential of agriculture, the extent of inequality between regime members, and scale.

The scope of the last chapter broadens to consider the more general implications of this study for our understanding of community-based natural resource management institutions and how they respond to both changes and shocks. This includes 1) addressing the importance of moving beyond the state-local dichotomy to understand the nuanced relations that interlink these different levels of governance within the

context of natural resources, 2) the need to consider the role of infrequent but extreme environmental "shocks" and the possible coping strategies that have evolved to mitigate their destructive force, 3) the importance of employing a diachronic perspective, especially for elucidating the meanings and causes of specific institutional change within local resource management organizations, and in some cases for showing continuities across what are sometimes considered discontinuous divides e.g. pre-colonial - colonial, or colonial - post-colonial, and 4) illustrating how enduring formal institutions for natural resource management are generally embedded in informal social institutions and often are themselves part of the process of producing "community" and social capital.

Chapter Two

A Framework for Analyzing CPR Management Regimes

In the previous chapter I proposed that understanding the ability of kuhl regimes to persist despite recurring destructive shocks and unprecedented rates of regional economic change required developing an explanatory tapestry that contained four different strands. The strands are the social and ecological characteristics associated with each kuhl regime which affect the potential for collective action, the possibility for exchange and coordination between separate but interdependent kuhl regimes, the relations obtaining between kuhl regimes and state institutions, and the effects of "regionality", e.g., social formations, historical specificities, and constructions of community, on kuhl regime persistence and change. This chapter engages with each of these strands and presents a theoretical understanding for them. Theories of collective action and institutional change grounded in rational choice and transactions cost approaches are drawn upon to illuminate the relationship between regime persistence and the internal social and ecological attributes of the regime. Analytical approaches to the study of the functions and structures of networks - social and organizational - are used to develop an understanding of the potential role of exchanges between kuhl regimes in promoting regime persistence despite recurring environmental shocks. An approach to understanding state institutions and authority and the nature of the relationship between them and local institutions for resource management is developed to investigate the potential for state involvement to facilitate the persistence of kuhl regimes. Lastly, I investigate the extent to which the embeddedness of kuhl regimes in regional social, political, and historical formations helps to account for regime persistence. These four different strands are then integrated into a coherent explanatory framework from which are derived a set of expectations regarding continuity and change within kuhl regimes under conditions of recurring shocks and regional economic change.

Rational Choice and Transactions Costs

Theories of rational choice and transactions costs constitute the foundation of institutional economics that in turn has been widely employed to explain institutions for common property management. Rational choice theory rests on two assumptions: that individuals make choices that maximize their own benefits or utility, and that collective behavior is best understood as the aggregation of choices made at the individual level. Transactions costs economics (Williamson 1975, North 1986) integrates the basic tenets of neoclassical economics with an approach that acknowledges the informational and organizational costs

that collective action entails and argues that institutions develop to minimize those costs.[1] North (1986) argues that individuals form contracts with each other to specify the terms of exchange. When a number of individual contracts are grouped under a general, overall contract, they constitute an organization. In this view, organizations as group contracts minimize the transaction and production costs that would otherwise be incurred if the exchanges that occur within it were negotiated in the marketplace.

In addition to the assumption that people are rational, self-interested actors, institutional economics emphasizes the costs of measuring the attributes of the goods and services that are exchanged, and the costs of evaluating the performance of individuals contributing to the provision of the good or service. The difficulties associated with measuring these attributes lead to the development of monitoring and enforcement of contracts. North (1986) argues that enforcement costs are reduced to the extent that exchange is personal and repetitive, hence the advantage of the relatively stable, long-term contracts that organizations constitute.

While institutional economics seeks to explain all institutions in terms of transaction costs, Mancur Olson (1965) focuses on the narrower subset of institutions whose purpose is the provision of collective goods. Olson specified the conditions under which rational, self-interested individuals will or will not engage in collective action to provide collective goods. Olson focused on the internal characteristics of the organizing group, the nature of the collective good, and the extent to which selective benefits accrue to group members in order to explain the emergence of sustained collective action.

Ostrom (1990), drawing on Olson and other collective action theorists, analyzes the process of institutional change within common property resource management (CPR) institutions. Defining institutions as nested sets of constitutional, collective choice and operational rules[2], Ostrom conceptualizes institutional change as changes in rules at any one of these three levels. Institutional change will occur when a quorum of franchised members supports a proposed rule change. North argues that the main drivers of institutional change are "fundamental and persistent changes in relative prices" (North,

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[1]See Williamson (1975, 1981) for transactions costs analysis, and Coase (1984) for its roots in institutional economics.

[2] Ciriacy-Wantrap (1969), in a similar vein, refers to institutions as social arrangements "that provide decision rules for adjusting and accommodating, over time, conflicting demands...". Ciriacy-Wantrup and Bishop (1975) also distinguish three levels of decision making rules within an organization. The lowest "operating level" refers to the day-to-day decisions that organizations make regarding inputs, outputs and similar operational activities. Middle or "institutional" level rules regulate decision making on the operational level. Rules affecting the structure of institutions are made at the highest, "policy" level. These include laws or acts specifying how people can create a legitimate, chartered organization that has standing vis a vis government authorities. Conceived of as a nested cluster of decision making levels, decisions made at a higher level affect those at the next lower level. Higher level rules constitute the context of change for lower level rules.

1986:234)[3]. Changes in prices affect an individual's estimation of the benefits and costs of the contract. Because individuals have different objective functions that reflect their own preferences, changes in prices will affect them differently. The tensions created by such changes may lead individuals to attempt to alter the contract, or to leave the organization altogether. An individual will support a rule change when, for that individual, the expected benefits exceed the expected costs as filtered through that individual's own set of norms and alternative opportunities. When the expected costs exceed the expected benefits an individual may choose to no longer contribute towards the provision and management of the common property resource. However, North notes that the free rider problem, and the large number of individuals involved, constitute sources of institutional "stickiness" which may prevent institutional change even when the relative benefits and costs of membership have shifted dramatically.

Individuals evaluate the expected benefits and costs of a proposed rule change according to their own internal norms and opportunity costs. In Kangra, opportunity costs vary substantially among individuals, especially between households with and without nonfarm employment. Alternative opportunities, individual discount rates, and opportunity costs all affect valuation of the kuhl regime's benefits relative to other potential opportunities that are foregone for the sake of participating in the kuhl regime. The fewer the alternative opportunities, the lower the opportunity costs and discount rates, the greater the individual's dependence on kuhl water. Dependence on kuhl water may be conceptualized in two manners. In the narrow sense dependence has to do with the availability of alternate water sources. In addition to substitutability, dependence on kuhl water is also affected by the possibility of participating in the wider economy, thereby reducing dependence on the local resource base altogether.

Because of the difficulty of directly ascertaining expected benefits and costs, Ostrom proposes a set of observable variables that make up these two "summary" variables. Similarly, she suggests the observable factors that determine internal norms and opportunity costs. I will briefly summarize her presentation, through an example of a rule change that has been adopted in some, but not all, kuhl regimes.

Mobilizing labor for channel cleaning has become increasingly difficult in the last two decades due to the expansion of off-farm employment opportunities[4]. Declining dependence on the local resource base for some segments of the population has reduced their interest in contributing labor for the maintenance and repair of kuhl systems. As rates of absenteeism on the days appointed for channel cleaning increase, the farmers who do come have to contribute more and more labor in order to maintain the kuhl. The

[3]In contexts where important factors are not monetized, changing discount rates and opportunity costs convey the same meaning as changes in relative prices.

[4] See Chapter 3 for a detailed analysis of the changing context of kuhl management, including increasing nonfarm employment.

inequalities this introduces can eventually threaten the integrity of the whole kuhl regime. Members of some kuhl regimes have responded to this problem by changing the operational rules that govern resource mobilization. These regimes substituted monetary contributions based on cultivated area for the previous system of contributing one's own labor. The money thus collected is used to hire wage labor to clean and repair the kuhl under the kohli's supervision.

In assessing the expected benefits of shifting from a labor- to a monetary-based system of resource mobilization, Ostrom argues that a kuhl regime member would need to know how the change would effect the quantity, variability, quality, and sustainability of resource flows, and the degree and nature of conflict. Determining the effects of a rule change along these parameters requires information about 1) the size of the user group and the resource system, 2) the variability and current condition of the resource, 3) market values for resource units, 4) past conflict levels, and 5) the present and proposed rules (Ostrom, 1990:196).

In order for a farmer to assess the expected benefits of contributing money instead of labor for kuhl maintenance he would need to know how the change would improve water flow relative to current levels, and how it might reduce conflict between regime members. Both assessments would require knowledge of the past. They require knowledge about water flows when the channels were well maintained, and knowledge of previous conflict levels prior to increased off-farm employment opportunities. Market values for kuhl water do not exist and therefore would not affect the estimation of expected benefits. An important component of anticipating the benefits of the rule change is the belief it would improve water flows and reduce current conflict, i.e. that reduced water flows and increased conflict levels can be ultimately attributed to more people working off the farm. Knowledge of the variables listed in 1-5 above will not enable estimation of the benefits of the rule change until the variables are related to each other within a causal framework. Only then can one predict what might be the outcome of changing the manner of mobilizing resources for kuhl maintenance.

Expected costs can be divided into two categories, the costs of considering a new rule, and the costs of implementing a new rule. The costs entailed in considering whether or not to substitute money for labor are determined by the number of individuals involved, the heterogeneity of their interests, the decision making rules for changing rules, and the asset distribution of the members. The collective action necessary for a successful rule change is negatively related to group size and group heterogeneity; some inequality in asset distribution fosters collective action (Baker, 1998). Ostrom suggests that the nature of the proposed rule, the history of change within the regime, and the autonomy to make and enforce rule changes also affect the costs of considering a rule change (Ostrom, 1990:198-202). These statements lead us to expect that the costs of considering changing to payments for kuhl maintenance will be least in smaller,

homogeneous regimes characterized by some asset inequality that have previously implemented changes, and that have the autonomy to implement further changes.

The costs of implementing a land-based tax for kuhl maintenance include compiling a list of the cultivated area of every regime member, collecting the tax at an annual meeting, maintaining written accounts, and supervising kuhl maintenance using paid labor. An individual deciding whether or not to support the substitution of monetary payments for labor contributions for kuhl maintenance would compare the costs associated with changing and implementing the new rule with the costs of continuing to monitor and enforce the labor-based system.

Internalized social norms and individual discount rates determine how an individual values the expected benefits and the expected costs of a proposed institutional change. They constitute the final of Ostrom's three groups of variables that together determine whether or not a person will support a proposed change. A kuhl regime member for whom improved water flows resulting from the rule change matter little because he has an off-farm job, may nevertheless support the change because it provides an inexpensive way to fulfill a social obligation and avoid negative social sanctions. A regime member with a low discount rate, i.e. one without outside employment, will support the change because of the expected improved water flows. Thus both discount rates and social norms are important determinants of how a farmer will evaluate the expected benefits and costs of the shift to monetary contributions for system maintenance. Shared norms influence decisions when resource users are members of the same community and are involved together in many different activities. Individuals engaged in off-farm economic opportunities have higher opportunity costs for contributing towards the management of the CPR than those dependent on the CPR for critical resource inputs.

Ostrom's formulation of the process of institutional change within CPR regimes provides the basis for generating propositions about the characteristics of regimes that will be more or less able to respond to rapid regional economic changes that alter the opportunity costs and discount rates of regime members. The propositions should differentiate kuhl regimes that have been able to respond to recent economic changes in Kangra from those that have not.

The framework developed so far provides the means to analyze the micro-level processes individuals employ to determine whether or not they will lend their support to institutional changes within a CPR regime. The cumulative impact of such individual decisions will determine whether or not institutional change will occur. However, accounting for the persistence of kuhl regimes entails more than understanding the conditions under which institutional change will occur or not. Other factors, such as the role of extra-local political entities in kuhl management and the importance of the cultural and historical

context of irrigation in Kangra must also be explicitly incorporated into an analytical framework. Doing so is necessary in order to explain why kuhl regimes have assumed the specific organizational structure they have, as opposed to other possible ways of organizing, and for addressing how and why a specific set of alternative opportunities evolved at a particular place and time during periods of institutional change. Of particular importance in situations characterized by recurring environmental shocks, is the potential role of networks of exchange relations that link together different regimes. The emergence of networks of exchange relations between up- and downstream kuhls immediately following an earthquake or flood may influence the ability of individual regimes to persist despite such disruptive shocks. The next strand to be developed in this chapter, sociological and organizational approaches to the study of networks, addresses the possibility that interkuhl networks may enhance the ability of individual kuhl regimes to maintain their integrity despite recurring destructive shocks.

Networks for Managing Environmental Uncertainty

Under conditions of frequent and extensive damage from recurring perturbations, coordination between separate irrigation systems may help mobilize adequate labor to repair the physical system and to guarantee at least minimal water flows during the period of repair. The paucity of work on inter-system coordination following shocks may be related to a lack of conditions necessitating coordination, the fact that ephemeral forms of inter-system coordination are more difficult to observe and analyze than non-ephemeral organization, and the tendency in irrigation studies to concentrate primarily on individual villages or single irrigation systems rather than on the broader patterns of irrigation discernible at the regional or watershed level. An important exception to this is Lansing's (1991) work on the role of religious authority and water temples in coordinating water deliveries, water management, and agricultural cycles across large networks of individual subak irrigation systems in Bali. In a similar vein Ambler (1989) discusses the coordination of crop planting to reduce peak water demands across different irrigation systems. And Mosse (1997b:475) argues that tank irrigation systems in south India comprised interlinked chains or "cascades" associated neither with autonomous "village republics" nor with a centralized hydraulic state, but linked with decentralized or segmentary forms of political organization. Despite the attention these authors have focused on network relations among irrigation systems, the relationship between intersystem coordination and regime persistence has yet to be fully explored.

This section begins the process of developing an analytical view of the role of networks in enabling individual CPR regimes to manage risk and uncertainty. Organizational theory, particularly the branch that concerns relations between organizations, provides one vantage point from which to explore these themes. Employing organizational theory to examine interkuhl networks requires thinking of kuhl regimes

as a type of formal organization. To the extent that the analogy holds true, the insights of organizational theory can be applied to kuhl regimes or other community-based natural resource regimes. However, in focusing on the formal aspects of such regimes, one must not overlook the importance of informal institutions, or what has been termed the "embeddedness" of formal institutions in historically, socially, and politically contingent social relations, contexts, and idioms of expression (Granovetter 1985). While keeping this caveat in mind, this section draws on theories of interorganizational relations, especially resource dependence theory, to explore the possibility that coordination between interconnected kuhl regimes can be an effective strategy for mobilizing resources and buffering environmental shocks.

The underlying assumptions of resource dependence are that organizations depend on their environments for critical resources, and that as these resources become scarce, interorganizational competition for them emerges (Galaskiewicz 1985:282). Organizations survive and prosper to the extent that they successfully compete for resources (Aldrich 1976:420). Uncertainty within this framework is important because to a great extent the nature of uncertainty regarding a critical resource determines the degree to which it constitutes an environmental contingency that the focal organization must manage. A key aspect of the resource dependency model is organizational management of environmental dependence, "organizations seek to manage their environments so as to reduce dependencies and uncertainties" (Aldrich 1976:420). Thompson, following Emerson's (1962) work on power and dependence, argues that an organization's dependence on an element within its task environment is directly related to the organization's need for the resource the element provides and is inversely related to the presence of alternative sources of that element (1967:30).[5] Thompson's work suggests that there are two types of resources on which organizations depend; material and exchange resources. Material resources are the primary inputs such as raw materials or budget allocations which organizations require to survive. Exchange resources are the relationships through which the focal organization obtains the material resources it requires from those organizations in its task environment that control them. The distinction between material and exchange resources builds on a distinction made earlier by Hage (1978) between the environment as a resource provider and environment as a network of organizational relations. Organizations use negotiated arrangements to manage relations with those elements of their environment on which they depend (Thompson 1967:34).

[5]Scharpf (1978:355) extends this line of reasoning to create a 2x2 table with resource substitutability and resource importance as the two axes. He argues that an organization's relationship to an element in its environment will be one of high dependence when substitutability is low and importance is high, low dependence when substitutability and importance are both low or when they are both high, and independence when substitutability is high and importance is low.

Although most kuhl systems are highly dependent on river water as a primary material resource, there are no exchange resources available to the managers of kuhls (other than ritual, see Chapter three) through which they can directly manage the unpredictably of water supply due to floods and earthquakes.[6] Thompson suggests that in order to manage environmental contingencies the focal organization will attempt to gain power by trading on its ability to reduce the constraints and contingencies other organizations face in their task environments (1967:34). While this formulation suggests that exchange resources can be deployed in an indirect manner to reduce an organization's dependence on an element within its task environment, it maintains the theory's focus on a focal organization and dyadic exchanges between it and other organizations. This restricted focus limits the theory's ability to account for interorganizational coordination when all the organizations in an organizational field are subject to the same material resource contingency. Under such conditions no one organization possesses a comparative advantage that it can use as an exchange resource to trade with other organizations and thus reduce the contingencies both organizations face.

In order to account for observed interorganizational coordination among kuhls under conditions of common environmental vulnerability, high environmental dependence, and uncertain resource supply, it appears necessary to shift the level of inquiry from the level of the individual focal organization to the organizational field. This expanded focus enables examination of relations between kuhls, the extent to which a network of interkuhl relations exists, and the degree to which interkuhl networks may help reduce the environmental uncertainties related to periodic but unpredictable environmental shocks.[7] Pfeffer and Salancik use Emery and Trist's (1965) classification of an organization's environment into four categories (placid-randomized, placid-clustered, disturbed-reactive, and turbulent) depending on the nature and source of interdependence between an organization and its environment, to draw a more general distinction

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[6]This statement is true for all kuhls during the hot and dry pre-monsoon season. However, in some areas annual streams that flow during the rainy season are diverted into kuhl channels thus reducing dependence on the perennial water source. Using Scharpf 's 2x2 table this suggests that although the importance of water for kuhls remains high throughout the year, the substitutability of perennial stream water varies depending on the presence of nearby annual streams.

[7]Warfen (1967:404-406) differentiates organizational fields into four categories based on, 1) the degree to which goals are shared among units, 2) the degree to which inter-unit decision making is centralized, 3) the level at which decision making authority resides, 4) the extent to which the units are autonomously structured, 5) the level of commitment to inter-unit leadership relative to unit leadership, and 6) the degree of "collectivity orientation". Of the four types of interorganizational field contexts (unitary, federative, coalitional and social-choice), the "coalitional context" best describes the field of interkuhl relations. Individual kuhls coordinate their interactions in an *ad hoc* manner when and to the extent that their goals overlap, there is no formal organization for interkuhl decision making, authority for interkuhl coordination rests within each kuhl, primarily with the watermaster, most kuhls are autonomous from each other but they do coordinate their labor inputs for joint efforts, although norms govern the relationship between watermasters there is no commitment to a joint form of leadership or management structure, and lastly there is a minimal level of "collectivity orientation" among the irrigators of different kuhls.

between a set of orgamzations which transact with each other and the larger social context within which the set of transacting organizations is embedded (1978:70). Pfeffer and Salancik further specify other properties that characterize the organizational field comprised of interdependent organizations. They suggest that the environment of an organizational field has three main structural characteristics, 1) the degree of interconnectedness between the set of organizations, 2) the degree of resource scarcity (munificence), and 3) the distribution of power and authority among the organizational set (concentration). They argue that under conditions of resource scarcity, relatively high degrees of interconnectedness and low concentrations of power, interdependence between organizations will increase and will produce conflict and uncertainty for individual organizations. Interconnectedness creates problems for organizations because the environment of a particular focal organization becomes increasingly uncertain and unstable as the degree of system interconnectedness increases (1978:69).

The image that Pfeffer and Salancik portray of "organizational environments as loosely coupled networks of clusters of organizations which are themselves more closely interconnected" (1978:70) provides a lens to examine the possible roles and importance of relations between interconnected kuhl systems vis a vis the risk and uncertainty periodic environmental shocks create for individual kuhls. However, in the case of interkuhl relations, their assumption that interorganizational interdependence resulting from increasing interconnectedness is directly related to increasing conflict and uncertainty does not hold. Rather than state the relationship as an assumption, it may be more illuminating to ask, "under what conditions does increasing interdependence resulting from environmental interconnectedness result in more or less uncertainty for an individual organization?" If, under some conditions, interdependence reduces environmental uncertainty, then it becomes important to ask how and why it does. Although Pfeffer and Salancik assume that interdependence leads to conflict, under some conditions interdependence may provide the basis for cooperative interorganizational coordination.

Astley and Van de Ven (1983) provide one way of thinking about organizational interdependence in a manner that does not assume *a priori* that it leads to conflict. They describe what they call the "collective-action" view within organization theory in the following manner,

> Rather than view organizations as pitched in a competitive battle for survival through a direct confrontation with the natural, or exogenous, environment, these authors (those who espouse the collective-action view) emphasize collective survival, which is achieved by collaboration between organizations through the construction of a regulated and controlled social environment that mediates the effects of the natural environment (1983:250-1).

A central concept of the collective-action view of organizations is the interorganizational network comprised of symbiotically interdependent organizations that together shape their environments through

various types of exchange relations. These interorganizational exchange relations, Astley and Van de Ven argue, are governed by normative frameworks of expectations pertaining to codes of conduct, and rights and responsibilities. The normative framework of expectations enables the network to make collective decisions as a unit that meet the network's collective interests as well as those of the individual member organizations. Astley and Van de Ven's discussion of symbiotically interdependent organizations broadens our analysis of interorganizational interconnectedness and suggests that interdependence may be both competitive and conflict generating, as well as symbiotic and coordination generating.[8] The role of normative frameworks in sustaining reciprocal exchange relations is one of the primary concerns of the new institutionalists (Powell and DiMaggio 1991) who also incorporate the role of cognitive frameworks in their analyses of organizational behavior and interorganizational relations.

Whether interconnectedness between organizations leads to competition or coordination hinges on whether a population of organizations is structured as an "aggregation of organizations governed by external economic forces, or viewed as an integrated collectivity of organizations governed by its own internal social and political forces" (Astley and Van de Ven, 1983:258). Embedded in this distinction between types of organizational environments are first, different conceptualizations of the term 'population' and what it signifies for the nature of relations between members of the population, and secondly, differing notions of the relative weights of economic verses social and political determinants of organizational behavior. Astley and Van de Ven discuss these differences in terms of the debate between population ecology and human ecology. They suggest that population ecologists define populations as aggregates of relatively homogenous units that share key characteristics and common traits. Population ecologists such as Hannan and Freeman (1977) argue that as a consequence of their similar characteristics members of the same population share a common vulnerability to the natural environment.[9] Human ecologists, on the other hand, view populations as defined by an internally coherent set of relations based on complementary differences between members of the population, rather than by a common vulnerability to environmental factors (Hawley 1950, 1968). The functional interdependence that evolves between members of the same population creates a socially and politically, constructed environmental network that insulates population

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[8]Granovetter makes the similar and important point that the very social relations that generate trust and cooperation can also create the conditions for conflict and "enormous malfeasance" (1985:491-493). Hage (1978:121) also points out that networks of interdependence can generate interorganizational cooperation as well as competition. Within kuhls this is exemplified by the fact that some of the fiercest conflicts over water can occur between members of the same clan, especially when control over water is related to fraternal conflicts over the partition, ownership and cultivation of previously joint landholdings.

[9]"Natural" in the sense of natural environment here refers to parameters of the organization's environment that are not socially constructed, not enacted (Weick 1979), but rather are objective phenomena that impact an

members from the "natural" environment. Population ecologists emphasize the importance of environmental pressures and competition between organizations for scarce resources in explaining organizational behavior, while human ecologists, with their emphasis on socially constructed environments, attribute primacy to social and political forces to explain organizational behavior.

The insights of the population and human ecology approaches regarding interorganizational and organization environment relations need to be integrated in order to develop a framework able to explain the capacity of individual kuhl systems to persist within a context of recurring environmental shocks. An integrated approach entails acknowledging that there are both "natural" and "social" components to an organization's environment. Within the context of kuhls, the "natural" or "unenacted" aspect of their environment consists of uncontrollable shocks that threaten their persistence. This notion derives from the population ecology definition of a population as a set of relatively homogenous units that share a common vulnerability to the natural environment. The "social" aspect of the environment, which the human ecology approach emphasizes, consists of symbiotic interdependence between kuhls and the construction of a protective set of social exchange relations between them. Integrating conceptualizations of the natural and social environment enables the framework to account not only for competition, but also for coordination, between organizations.

Rather than supplant the natural environment as a key determinant of organizational behavior, this synthesis argues that the socially constructed environment buffers individual members of the population set (i.e. individual kuhl systems) from uncertainty in the natural environment. The social and natural environments may be conceived as nested entities. The socially constructed environment consisting of exchange relations between interconnected kuhl systems is nested within the natural environment and functions to inhibit the natural environment's uncontrollable and potentially destructive perturbations. This formulation implies that interdependence will be competitive and generate conflict when conditions of common vulnerability do not obtain. Conversely, when organizations do share a common environmental vulnerability, it suggests that interdependence will constitute the basis for interorganizational coordination to shield organizations from their shared vulnerability. This helps to explain how and why the socially constructed network of interkuhl relations helps absorb the impacts of unpredictable and random shocks.

A Rational Choice Model of Kuhl Persistence

The first two strands of the explanatory tapestry are fundamentally based on rational choice assumptions about human behavior. They can be woven together to build a model that begins to explain differential kuhl regime persistence. The framework, if valid, should help discern patterns of similarity and

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organization. This is in contrast to a "social" environment that refers to the socially and politically constituted sets

differences among kuhls that did not persist and those that did. The first strand, based on rational choice models of transactions costs, suggests that regime persistence is more likely in regimes with relatively small, homogeneous user groups with a slightly unequal wealth distribution who depend on the benefits the regime provides. Internal regime stress arises when members' opportunity costs for participating in the regime begin to diversify, e.g., through participation in the market economy. This can dramatically alter the distribution of dependence on and interest in the benefits it provides among the user group. Regime stress and conflict caused by varying individual discount rates, and the ability to manage it, is directly related to the size and diversity of the resource and the user group, and to the degree of inequality between regime members. The extent to which regime benefits are core or peripheral to a household's economy, and the degree of dependence on regime benefits influence the scales at which CPR regimes can persist within a context of rapid economic change. Regimes that provide benefits that are core to a household's economy (or economy of any social unit such as hamlet or village) are able to persist at higher scales within a context of environmental change than regimes that provide benefits more peripheral to that unit's economy because the value of the regime's benefit is directly related to the willingness to contribute towards its provision.[10] The degree of dependence on the benefits the regime provides is directly related to the scale at which a regime can persist under conditions of environmental change. If alternative sources of regime benefits are readily available, then the scale at which a regime can persist will be less than if alternative sources are absent.

The degree of interdependence between regimes, i.e. their network density, influences the scales at which CPR regimes can persist within a context of recurring environmental shocks such as floods, drought, and earthquakes. Kuhl regimes engaged in relatively dense networks have greater capacities for exchange and greater potential for developing cooperative water sharing arrangements with each other than isolated regimes or regimes in "thin" networks. More interdependent regimes should be able to persist at higher scales than less interdependent regimes within a context of recurring environmental shocks.

Together these three factors - the extent to which regime benefits are core or peripheral, the relative degree of dependence on regime benefits, and network density - generate a set of expectations regarding the ability of CPR regimes to persist despite economic changes which diversity opportunity costs and recurring environmental shocks. The factors may be measured as high or low and combined to create a 2x2x2 cube producing eight different possible combinations of interdependence, core versus periphery, and

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of interorganizational relationships that link the focal organization to other members of the population.

[10] Another way of expressing the core periphery variable is the value of the benefit that the regime provides. High value benefits, whether measured according to monetary or other value measuring scales are "core", while low value yielding benefits would be considered more "peripheral".

dependence (Figure 2.1). Rational choice and network theories suggest that under conditions of economic change and severe environmental shocks, interdependent regimes which provide high value core benefits for which alternative supplies of regime benefits are unavailable will be able to persist at relatively high scales (cell A). Interdependent regimes that do not provide particularly high value core benefits and for which alternative sources of regime benefits are available will be able to manage environmental shocks through cooperative exchange networks, but will be less able to manage the internal conflicts resulting from the differentiation of members' opportunity costs (cell B). Regimes that are not interdependent but do provide high value core benefits for which alternatives are unavailable should be able to manage conflicts associated with economic change but are vulnerable the destructive forces of environmental shocks (cell C).

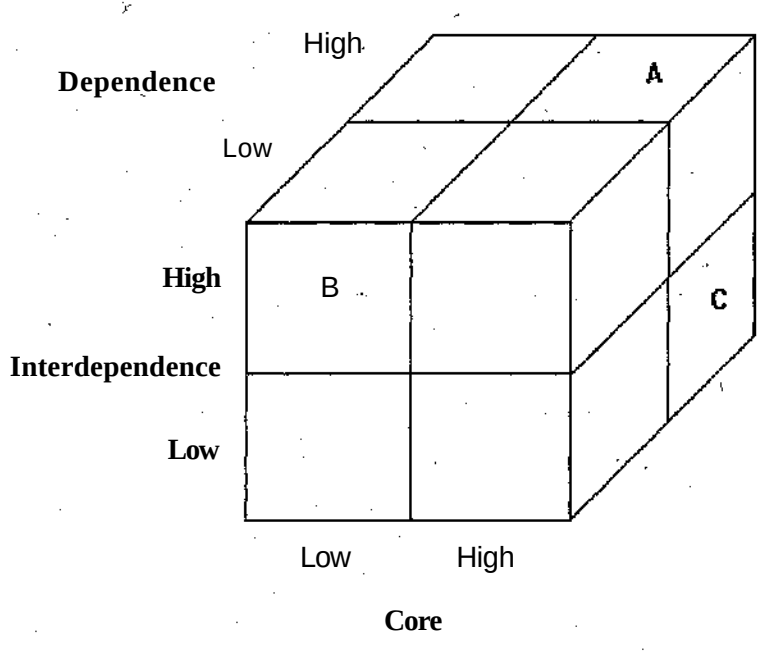

Figure 2.1 A 2x2x2 cube indicating the predicted relationship between the values of the variables "core", "interdependence", and "dependence", and a CPR regime's capacity to persist despite environmental shocks and/or economic change. Regimes in cell A are expected to persist despite shocks and change, those in cell B, shocks but not change, and those in cell C, change but not shocks.

The three factors - interdependence, core versus periphery, and dependence - are general in effect but vary in form. What characteristics of kuhl regimes might be used to "operationalize" these factors? The measure I used for the interdependence of kuhl 'a' is the ratio of the number of other kuhls that irrigate villages kuhl 'a' irrigates to the total number of villages with which 'a' is engaged. This is a rough quantitative approximation of the density of irrigation networks and therefore of the potential for inter-kuhl coordination and exchange.

An important ecological distinction that farmers in Kangra make between areas of different agricultural productivity is an excellent measure of the extent to which the benefits a regime provides are core or peripheral. The low-lying fertile fields on ancient riverine terraces adjacent to the streams that flow from the Dhauladar range are referred as *{har).* These are the prime irrigated rice and wheat growing areas. Rising above the har fields are gently sloping plateau-like areas - the upper shoulder of the alluvial fans that comprise Kangra valley. These areas are drier and less fertile than har fields and are known as *(larh).* Larh fields are used primarily to cultivate maize in the kharif (summer) season and wheat in the rabi (winter) season. Given the greater productivity of har relative to larh fields, returns to labor are higher in har than in larh. Because of the difference in productivity between har and larh fields and in the returns to labor, kuhl irrigation water has a higher value in har fields. Additionally, and not insignificantly, the distance water must be conveyed to reach har fields is always much shorter than the distances involved in conveying water to the higher larh fields. Therefore a kuhl that irrigates har fields is more "core" than one that irrigates larh fields. A rough indicator that may used to compare different kuhl regimes is the ratio of har to larh fields within their command areas.

The degree of dependence on kuhl regime benefits is determined by the availability of alternative sources of benefits. In Kangra seasonal creeks that flow after the onset of the monsoon provide alternative supplies of water to kuhls. This obviates the need to rebuild the labor-intensive headworks, diversion structure and upper channel sections after every monsoon storm and flood. The presence of seasonal creeks whose water may be diverted into downstream tertiary irrigation channels significantly reduces farmer dependence on the kuhl system. The introduction of piped water supply schemes and electric powered mills further weakens the web of dependency on kuhl water because kuhls used to provide water for home gardens and livestock and power for mills.

If the assumptions of the first two sections of this chapter are valid, Figure 2.1 should differentiate between kuhl regimes that are more or less able to persist despite economic change and environmental perturbations. The measures of network density, core verses periphery, and extent of dependence on kuhl regime water make it possible to identify kuhl regimes with different combinations of those factors. However, our investigation of the persistence of kuhl regimes is still incomplete. The two strands of theory used to create Figure 2.1 are relatively ahistorical and apolitical, furthermore, they do not place adequate emphasis on the role of regionality in accounting for the persistence of kuhl regimes. The potential role of state involvement remains to be examined, as well as the extent to which kuhl regimes reinforce and are strengthened by cultural and symbolic notions of community, identity, and place.

State Involvement in Community-based Resource Management

The vignette with which chapter one began, of the colonial administration mobilizing military expertise and labor to rebuild those portions of irrigation channels and headworks the 1906 earthquake destroyed, belies views of the relationship between local traditions of resource management and state authority in which the state either simply provides the neutral political space necessary for local organizations to flourish or promulgates policies which directly or indirectly undermine local capacities for resource management. Indeed, the mobilization of military resources for kuhl repair is only one example of a long history of interaction between state institutions and kuhl regimes that spans the pre-colonial, colonial and post-colonial periods. Understanding the nature, purpose, and outcomes of this interaction requires developing a view of the "state" which explicitly analyzes the mutually constituting relationship between state institutions and civil society. For neither does the state comprise a monolithic undifferentiated social formation, nor do state and society exist separately as non-interacting categories. Rather the state is comprised of a set of differentiated institutions, riven horizontally and vertically by internal fractures, with sometimes competing agendas and mandates, each seeking to acquire, maintain, and strengthen its own legitimacy, power, and influence. The pursuit of legitimacy, power and influence takes different forms in different contexts. In some cases it may have to do with the control of territory or people while in others it may focus on revenue generation. To achieve their goals state institutions may develop strategic negotiations and alliances with different sectors of society and by doing so strengthen the position and power of those very sectors and in effect, create certain kinds of communities. So, for example, Saberwal (1999) has discussed the long running competition between the colonial Revenue and Forest Departments in Kangra District over the control of forestlands and the authority to regulate local practices in those forests. Furthermore, he has shown how, during the post-colonial period, the Gaddi shepherds of Kangra entered into strategic alliances with elected legislative representatives. Gaddi shepherds trade political support for promises and actions by politicians to fend off Forest Department attempts to control Gaddi grazing practices and reduce herd sizes in the name of environmental conservation, thus helping to preserve the Gaddi community and way of life. The differentiated nature of state involvement in local practices can be even more dramatic; in Kangra during the latter half of the nineteenth century the same colonial administration curtailed local rights of forest access and use and simultaneously promoted the expansion of irrigated agriculture and local capacities for water (kuhl) management (Baker 2000).

Understanding the motivations and agendas, behind such diverse policy initiatives requires broadening the scope of analysis to include broader concerns and issues in their historical context. Incorporating a historicized understanding of state involvement in agriculture and forestry in Himachal

Pradesh, for example, enables explication of the shifts in the colonial administration's priorities between giving primacy first to agricultural expansion in the interests of food security and later in the nineteenth century to forest conservation to secure timber supplies for rapidly expanding rail networks. In a similar manner Rangan (2000) has shown how, contrary to conventional wisdom, the history of colonial state involvement in forests in Uttarakhand, east of Himachal Pradesh, does not consist of the steady application of scientific forestry policy and state appropriation of forest resources, but rather proceeded through a series of specific phases each one connected to a larger set of colonial concerns.

Positing a less monolithic, more nuanced and contingent understanding of the state and of the negotiated nature of the relations between state and society also enables analysis of the different types of relationships and experiences that obtain between state institutions and society. Breaking down the dichotomy between state and society allows for analysis of strategic alliances that may evolve between local elites and state agents. Within the context of irrigation management, Wade (1988) discusses the importance of the ability of local elites to negotiate with officials within the state irrigation bureaucracy in order to secure water deliveries for their villages. With regards to forest protection, Someshwar (1995) and Gururani (2000) show how the enforcement of rules regulating forest access and control and the imposition of fines for rule infractions vary by an individual's gender, caste and social position. Even the experience of citizenship can very by class, caste, and gender as Gupta (1998) as shown in the case of contemporary development programs and bureaucracies in Uttar Pradesh.

Within the context of kuhl irrigation systems, employing an understanding of the state as an internally fractured set of institutions competing with each other, connected to a wider set of policy concerns and directives, and entering into strategic alliances and negotiations with local groups in a manner which strengthens both state authority and the local "community" is necessary in order to understand the varieties of state roles in local irrigation management that have obtained over the past two hundred years as well as the effects on local irrigation organization of that state involvement. I will show that state involvement in kuhl irrigation management in Kangra is related to the process of statemaking in a variety of ways. Statemaking, the process of "defining the forms and legitimations of government and governrnentality" (Sivaramakrishnan 1999:5) within the context of Kangra and kuhl irrigation concerns the manner in which relations between state institutions and social groups are negotiated and renegotiated over time. The negotiation concerns the processes through which state institutions secure legitimacy and revenue and achieve other policy goals and objectives on the one hand, while on the other hand, social groups define and create the conditions under which they consent to be governed. The delicate balance between central government authority and local control, a hallmark in particular of British colonial rule in

India, was subject to frequent assessment and revision. The resulting iterative negotiations that obtained between state institutions and social groups shaped and influenced the character of each other, and have been carried forward into the post-colonial era (Sivaramakrishnan 1999).

I would like to conclude this section by making an argument for "bringing the state in" to the study of common property resource management. Hardin's distinction between state, private, and common property regimes contains an implicit assumption that the state is heavily involved in the first, but not the latter two property regimes. I suggest that the state is intimately involved in all three forms of property regimes. This is particularly true at the beginning of the new millennium, a moment in history unprecedented in terms of the spatial extent and influence of the nation state. While it is self-evident that the state is a dominant player within the context of state or public property regimes such as forest management in greater Punjab as described in the previous chapter, I would like to argue that the state also plays pivotal roles within private and common property regimes. Chakravarty-Kaul criticizes what she calls "the Property Rights School" for espousing a view of the role of the state that is too narrow, restricted to the allocation of rights over scarce resources. Instead, she argues that her study shows how the colonial administration played an intimate role in "establishing and altering the constraints within which property rights were established". This included the creation of new types of rights as well as communities of rights holders. In return the state secured its own legitimacy and authority. The specific nature of this negotiated exchange of entitlement for political authority is historically, ecologically, and culturally conditioned, but it almost always affects private and common property regimes. The discussion in the previous chapter of the canal colonies and the ways in which government investment in large-scale irrigation and transportation networks facilitated the consolidation of power and authority among influential caste groups in the Punjab illustrates this point with regards to private property.

With regards to common property resource management regimes, the state almost always plays a more active role than that of simply allocating property rights. Instead many, if not most, common property regimes are imbricated in the processes of state-making discussed above, either as sites for contesting or strengthening the legitimacy of state rule. There are few if any instances in which the state simply provides the neutral political space for a common property resource management regime to flourish. While such situations may have been more commonplace in previous periods, given the current geographic reach and pervasive influence of modern states, communities and their institutions today are either for or against the state; there is no neutral territory. Analyses of common property regimes, whether enduring, declining, growing, or stagnating, must, therefore, explicitly incorporate an analysis of the role of the state into the understanding of regime dynamics.

Regionality's Imprint on Community-based Resource Management

The fourth strand of the explanatory tapestry extends the analysis presented so far to address "the cultural and historical context within which the irrigation economy is developed" (Ludden 1978:4). This involves moving beyond the rational choice assumptions underlying collective action theory to address the influence of Kangra as a historically, politically, culturally, socially and ecologically constituted region on the development and persistence of kuhl irrigation systems. Indeed, I would like to argue that kuhl regimes contribute to the symbolic "production of locality" in Kangra (Appadurai 1997?). Kuhl irrigation systems are not only the product of calculating decisions made by rational farmers seeking to reduce individual risk through cooperation to bring snowmelt to their paddy fields. Kuhl regimes also embody, create, and reinforce Kangri cultural systems of meaning, identity, community, and place. And to the extent that they do so, the persistence of kuhl regimes despite recurring shocks and regional economic changes is not simply a function of rational calculations regarding the material value of water, but rather their persistence also reflects the ways in which kuhl regimes are valued because of their symbolic and cultural meanings and are enmeshed in networks of material and symbolic exchanges.

Assuming that "material interests are often inseparable from social relationships" (Mosse 1997b:472) broadens the scope of analysis from the formal kuhl irrigation organization to the broader set of social and political relationships within which it is embedded. This entails examining the influence of Kangri notions of fairness, norms of reciprocity, and the importance of reputation on farmers' willingness to participate in the management and distribution of kuhl water. Kangri notions of generalized reciprocity, the importance of acting in accordance with the principle of "bhai bundi se" (through brotherhood), and reputation maintenance all influence the emergence of interkuhl water transfer arrangements during droughts or following destructive floods. This perspective also entails analysis of the production of symbolic as well as economic capital with regards to kuhl regimes. It suggests the ways in which state authorities can parlay economic capital into symbolic political capital (Bourdieu 1977:180), for example by sponsoring the construction of kuhls and in some cases redirecting tax revenues from irrigated agriculture to support temples. In this manner state authority was created and maintained through state involvement in kuhl irrigation management. Similarly, from this perspective the annual religious rituals performed by the kohli following the repair and maintenance of the kuhl and just prior to the first water diversion of the season, rituals that involve all those who attended the multi-day work parties, are critical aspects of kuhl persistence because the ritual itself contributes towards the construction and constitution of community. Kuhls also relate to the construction of a particular and unique Kangri pahari (mountain) identity. Kangri oral traditions are replete with stories recounting the difficulties associated with the surveying and

construction of particular named kuhls. As I will show, some of these stories encode the environmental knowledge possessed by different social groups, others reinforce caste privilege, while yet others incorporate social values related to gender and kin-based differences in the status of household members. Thus, kuhl regimes that provide irrigation water during the dry pre-monsoon season, also are sites for the inscription of social relations based on power and difference.

Room must also be made within the analysis for the imperative of nature as it influences kuhl regimes and kuhl organization. For as Mosse, expanding on Leach's (1961) point that hydrology affects social structure, points out with regards to tank irrigation in south India, social structures have "ecological and territorial dimensions" (1997b:473). So for example the possibility that ruling lineages in Kangra could generate symbolic capital by sponsoring the construction of some of the longest kuhls in Kangra valley was created by the local topography that divides the landscape into fertile riverine terraces and less fertile plateau-top cultivated areas. That the distinction between the two types of land is culturally and ecologically important is suggested by indigenous soil type categories that encode the differences between them, and the very different trajectories of change within kuhl regimes that irrigate primarily one or the other soil type. Furthermore, watershed topography strongly influences the possibility for water transfers between separate kuhl regimes through the ways it shapes the network of adjacent kuhl channels. Within Kangra valley itself, some watersheds are relatively steep and narrow with less arable land, while others are broader and have greater scope for irrigated agriculture. Kuhl regimes in the former class of watersheds tend to irrigate smaller areas of hydrologically isolated arable land and thus offer less opportunity for inter-kuhl water exchanges than kuhls that irrigate large expanses of contiguous arable land.

Ecology and social relations themselves interact in numerous ways. For example, topography affects settlement patterns; Rajput and Brahmin hamlets tend to be located at higher elevations than lower caste hamlets. This means that often in kuhl regimes high caste privilege and authority further reinforce the inherent advantages of being upstream. Thus social power and topography together compound the difficulties low caste farmers from downstream hamlets face with regards to water supply and the unequal distribution of the burden of kuhl maintenance and repair between upstream and downstream irrigators. In some cases the only effective way for downstream groups to challenge such caste and locationally derived inequalities has been to withdraw from the kuhl regime altogether. In others, downstream groups have employed a variety of tactics including oral accounts that serve to legitimize their claims against competing upstream high caste claims. More recently, new institutional arrangements have provided some downstream groups increased leverage to counter both caste and location based inequalities. However, in

all these cases the settlement patterns constitute "social variables amplifying or modifying the effect of ecology on local institutional forms" (Mosse 1997a:3).

The imperative of nature has also dramatically influenced the nature of the colonial state's involvement in irrigation in Kangra. Unlike the relatively flat fertile Punjab plains to the south of the hills, in the relatively enclosed and undulating Kangra valley there was no space for the imperial science of large scale canal irrigation and the modernizing projects of which they were a part. This meant that the conjunction of state knowledge and state power prevalent throughout most of the British Raj and constituting a core element in the process of statemaking (Sivaramakrishnan 1999), either in terms of the disciplines of scientific forestry or irrigation engineering, were not applied in Kangra with regards to irrigation technologies. The corollary of this is that there was little or nor opportunity for "modern" irrigation technologies to undermine and supplant indigenous systems of irrigation as occurred in Bali, the Philippines, and elsewhere. Instead, British colonial administrators, once the colonial army wrested control of the region from the Sikh government based in Lahore during the second Sikh war of 1846, played a very different role in irrigation development. Prevented by ecology from large scale irrigation development, and concerned about food security and revenue generation, colonial administrators instead embarked on a series of interventions that in many ways represented a continuation of the role of the pre-colonial state in kuhl management. This included occasional subsidies for kuhl repair, sponsoring the construction of some new kuhls, adjudicating conflict over water rights, and codifying customary irrigation rights. All these roles and more are discussed in chapter four.

Understanding the role of kuhl regimes in the "production of locality" entails supplanting neoclassical economic assumptions about individual rationality and utility maximizing behavior and Parsonian theories of action with a social theory of action derived from the work of Giddens (1976, 1984, 1986), Douglas (1986), and Bourdieu (1977, 1990), among others. Gidden's emphasis on the routine in social life, and his cognitive theory of individual commitment to socially constructed roles and behavior complements and extends Parsonian notions of norms and sanctions as the basis of commitment. Structuration, the continual reproduction in everday life of social structure through individual action and interaction, expands the focus of enquiry from individuals' calculations of the costs and benefits of contributing labor to get water, to the broader relationship between kuhl regimes and the social structures in which they are embedded. This theme is echoed in Bourdieu's notion of habitus, an analytical construct that suggests that people with common histories share internalized regularities in patterns of thought, aspiration, strategies of action, and even disposition (Powell and DiMaggio 1991). These regularities, internalized at the cognitive, affective and evaluative levels, are daily reproduced through individual action.

Douglas (1986) focuses more specifically on the relation between institutions and the social structures in which they are embedded. Douglas relates the legitimacy of institutions to their ability to maintain "naturalizing analogies", i.e. behavioral conventions which have a "parallel cognitive convention to sustain it" within the broader social structure. In other words institutions, in order to persist over time, must contain patterns of behavior and interaction that are analogies of parallel structures of interaction within the larger historically and socially constituted context which both precedes the institution and are ceded authority.

The "naturalizing analogies" that Douglas describes resonate with Zucker's (1991) analysis of the role of instititutionalization in the persistence of organizations. Zucker argues social knowledge, once it becomes institutionalized, exists objectively as part of socially constructed reality. Hence it can be transmitted from one individual to another as part of a shared social reality. Contrary to earlier discussions that relied on internalization of norms and values, self-reward, or other intervening processes to explain persistence, her research shows that individuals comply with highly institutionalized behavior because if they do not comply, their actions are not understandable (Schutz 1962, Berger and Luckmann 1967). During the process of institutionalization "the moral becomes factual", and once institutionalized the factual becomes cognitive.

Zucker defines institutionalization as a variable, and suggests that cultural persistence is directly related to it. The greater the degree of institutionalization, the greater the maintenance of an organizational form without direct social control, i.e. external rules and sanctions. Similarly, Scott (1991) argues that the presence of a strong institutional environment may reduce the degree of elaborateness and the amount of organizational structure because "cultural controls can substitute for structural controls". When symbols and beliefs are shared, categories common, and procedures accepted as routine, the need for them to be formally encoded within the organization is less. As institutionalization declines, external sanctions become increasingly necessary for organizational maintenance.

Given Zucker's and Scott's formulation, an institutionalized irrigation organization, i.e. one with few formal rules, sanctions and enforcement mechanisms, should be more persistent than one with highly formalized rules and sanctions because the latter is less rooted or embedded within socially constructed reality. Or as Douglas would argue, the latter may have less legitimacy because it is not well supported by "naturalizing analogies" within the broader social context. An increase in rule formalization would signify a loss of organizational legitimacy stemming from changes in socially constructed reality that no longer support, or provide naturalizing analogies for the roles and actions required for organizational persistence.

Within this framework the specific organization of kuhl regimes, and their persistence, can be partly explained because they incorporate and reproduce institutionalized elements of social structure that are core to Kangri culture. Four of these elements include norms of reciprocity, role specialization, religious beliefs, and local conceptualizations of honor (izzat).

New institutionalism attributes institutional change to the development of contradictions, to the force of exogenous environmental shocks, or to endogenous factors such as procedural rationality that routinizes change. Contradictions can develop between an institution and its environment, among other institutions, or with basic forms of social behavior (Jepperson, 1991). These contradictions, or environmental shocks, prevent an institution from reproducing itself, thus forcing it to change or disappear. For example, kuhl regimes encounter contradictions between their reliance on norms of reciprocity and the decline in norms of reciprocity as an institutional form within Kangri culture. Without the "naturalizing analogy" of this norm in the broader social structure, its legitimacy within kuhl regimes becomes open to question, challenge and renegotiation. Kuhl regimes respond to this contradiction by formalizing rules and sanctions, changing the basis of resource mobilization for system maintenance, or both.

Finally, new institutionalism also has something to say about the trajectory of organizational change within kuhl regimes. For example Zucker (1983) shows that an organization's institutional environment affects organizations primarily by legitimating a "new procedure, position, or element of structure", and through hierarchically higher elements of the environment, i.e. regulatory agencies or those with the power to provide financial or technical support, which establish requirements that the organization must satisfy before support will be given. For example, a study by Tolbert and Zucker (1983) examined the spread of civil service reform by U.S. cities between 1880-1935. During the initial stages the spread of reform was largely dependent on the demographic characteristics of the cities adopting the reforms. However, later when the reforms became institutionalized and hence legitimated, reform was adopted by cities regardless of their characteristics, even when reforms were not functional from a rational choice perspective. Their analysis provides basis for explaining the relatively recent diffusion of an externally legitimated organizational characteristic of kuhl regimes, the formal kuhl committee, as one of the key organizational responses to the changing environment of water management in Kangra.

Some Propositions About the Persistence of Kuhl Regimes

Having presented the four strands of the explanatory tapestry, it is now possible to weave them together into a set of propositions regarding kuhl regime persistence. The third and fourth strands ground the 2x2x2 cube in history and place. This allows for a fuller analysis than the formal rational choice based model of kuhl persistence would permit. The propositions are not testable hypotheses in the positivist

tradition of science, but rather they serve to crystallize and communicate key relationships derived from the tapestry that will be explored in subsequent chapters. The propositions address regime persistence, the impacts of recurring environmental shocks and regional economic change on regimes, regime responses to the impacts of shocks and change, and the efficacy of those responses with regards to regime persistence. Most propositions are grouped by themes. Each cluster is followed by a brief discussion of how the relationships they identify could be explored.

Proposition 1. Regime persistence is directly related to degree of institutionalization.

Regime institutionalization, the extent to which a regime incorporates cultural practices and relations embodied within the broader social and cultural context, buffers the impacts of shocks and change on regime persistence. If regimes "a" and "b" have the same configuration of interdependence, core versus periphery and dependence, but "a" is more institutionalized than "b", then the maximum effective scale at which "a" can persist will be greater then that of "b". I suggest that the relatively high degree of institutionalization of the kuhls in Kangra partially accounts for their ability to persist at the scales they have despite recurring environmental shocks and regional economic change.

Exploring this proposition involves identifying core elements of the regime's social, cultural, and historical setting, assessing the degree to which these elements are reproduced within the regime itself, and where possible, comparing regime persistence across regimes that are more and less institutionalized.

Two key measures of persistence are the ability to supply adequate water throughout a kuhl's command area, and to distribute the responsibilities for system maintenance and repair among regime members in an acceptable manner. Physical, technical and organizational measures of regime stress include, 1) shifts to less water intensive cropping patterns in the tail end portions of a kuhl's command area, 2) command area contraction, 3) declining sophistication of water measurement and control, 4) increasing conflict among regime members, 5) declining participation in system maintenance and repair, and 6) declines in the physical condition of the kuhl.

Proposition 2. Regime persistence is directly related to the extent to which the state provides resources the regime requires, i.e. capital, technology, coordination and conflict resolution capacities, that would otherwise be unavailable, without undermining local capacities for collective action.

Proposition 3. The importance of state support in enabling regime persistence is directly related to coordination requirements and the diversity of conditions (social and physical) in which the regime operates.

Propositions 2 and 3 can be explored by comparing the effects of different types of state involvement and intervention in CPR regimes with diverse characteristics, resource needs, and coordination

requirements. When state roles and modes of intervention have changed over time in the same area, this proposition can be tested by examining the differential effects of these roles on regime persistence. Alternatively, where state intervention assumes different forms in different places, the effects of those interventions on regimes with similar characteristics could be explored.

Proposition 4. The importance of state intervention in enabling regime persistence is directly related to the frequency and intensity of environmental shocks.

As both frequency and intensity of environmental shocks increase, the ability of regime members to repair the damage with their own resources decreases, and reliance on outside support increases. This proposition can be explored by examining the degree of external support as it varies with the nature of environmental shocks, across regimes with similar degrees of interdependence and diversity of conditions.

Proposition 5. Under conditions of high regime interdependence requiring coordination between regimes, regime persistence is directly related to the regime's ability to employ cooperative strategies with other regimes.

While propositions 2-4 address relations between regimes and state authorities, proposition 5 addresses relations between regimes. Comparisons of the persistence of interdependent regimes between two areas, one with cooperative strategies and one without, would serve to test this proposition. A similar comparison could be made across time.

Proposition 6. Regime responses to environmental shocks will be less formal than responses to environmental changes.

The ability of regimes to coordinate amongst themselves in response to periodic, short duration environmental shocks, e.g., floods and earthquakes, without formal or hierarchical structures is an organizationally inexpensive but effective response. However, contextual changes of long duration and broad spatial effect, e.g. changes in regional political economy, generally lead to permanent changes in regime structure that generally manifest as increased formalization. Testing this proposition requires comparing regime response to these two classes of external factors.

Proposition 7. Regimes are more able to persist under conditions of rapid contextual changes when the change does not affect members' interests in regime benefits, or when it affects their interests in the same manner. Regimes are less able to persist when changes alter the distribution of interest in regime benefits among members.

Proposition 8. The impact of internal regime stress on persistence is related directly to the scale and the scope of coordination necessary for regime management.

Regional political economic change may alter the distribution of incentives among regime members to participate in the management and provision of the collective good. A change which results in an increasingly skewed distribution of incentive, e.g., high among some, low among others, creates tensions within the regime that manifest as higher rates of absenteeism, increasing conflict, and rule infractions. These tensions are exacerbated when they coincide with other inequalities between regime members. The extent of these tensions increases with the degree of coordination necessary for regime management. Exploring this proposition involves comparing levels of stress and conflict among regimes experiencing similar types of change but which have differing coordination requirements.

Proposition 9. Regime formalization, the creation of rules, sanctions, monitoring mechanisms, and other formal procedures, is directly related to the degree of internal regime stress, and to the degree of interaction with the state.

Proposition 10. The more formalized regimes become, the more alike their structures become.

Two different organizational forms, A and B, may equally well meet a regime's operational need. However, during the process of formalization, if form A has greater legitimacy than B within the broader social, cultural and political context, then A will be adopted. In some cases, even if A meets the regime's need less completely than B, A will still be chosen over B because of A's greater institutional legitimacy. Over time, this will tend to homogenize regime form. Exploring this proposition requires analysis of the trajectory of institutional change among regimes, identifying those organizational forms with greater and less institutional legitimacy, and examining the relationship between the choice of form, its degree of legitimacy, and its efficacy relative to other possible forms.

Proposition 11. The impacts of formalization on persistence depend upon the extent to which the forms are consistent with culturally embedded practices and to which state interventions complement local capacities.

This proposition can be examined by comparing the impacts of formalization on persistence across regimes that have formalized in different ways and in which state interventions do and do not complement local capacities.

Proposition 12. The effectiveness of these impacts is inversely related to the scale and the scope of coordination required for resource management.

This proposition can be examined by comparing the differential persistence of regimes with similar trajectories of formalization but different scales of coordination.

These propositions, derived from an interweaving of the four strands of theory presented above, will be used to guide the exploration and analysis of the differential persistence of kuhl regimes in the

following chapters. However, before embarking on the formal analysis, I will first present an overview of the setting of kuhl irrigation.

Chapter Three

Kangra as Place: The Ecological, Social, and Agricultural Setting

A variety of place-specific ecological and social factors conjoin in Kangra to create unique opportunities for agricultural systems based on extensive gravity flow irrigation. Ecological conditions that have enabled relatively large-scale irrigation systems to develop also damage kuhls and threaten their long-term persistence. Social and cultural characteristics of the region, e.g., norms of hierarchy and exchange, patterns of land distribution and settlement, and local constructions and reproductions of community, comprise the broader social context of kuhl irrigation and influence the persistence of kuhl regimes. The relatively recent transformation in the economy of Kangra from a primarily agrarian economy to one in which nonfarm income is increasingly important has dramatically changed the pattern of household dependence on, and hence willingness to contribute towards, the provision of kuhl irrigation water. The resulting stress and conflict within kuhl regimes has challenged their ability to persist. Comprehending the full extent of the challenges increasing nonfarm employment poses for maintenance of kuhl integrity requires understanding the rhythms of labor demands and management tasks associated with kuhls. Accordingly, the last section of this chapter describes the annual rhythm of activities associated with kuhl management.

Geographical Description

District Kangra lies in the eastern part of the state of Himachal Pradesh. It covers 5,739 square kilometres and has a population of just under 1,150,000 people.[1] The Punjab plains border the district to the south and west. In the north the massive snow-covered Dhaula Dhar range separates Kangra from Chamba District. The Beas River marks the eastern boundary of the district between Kangra and Mandi and Hamirpur Districts.

Kangra Valley spreads southwards from the base of the steeply rising Dhaula Dhar range towards the low lying ragged, eroded Sivalik Hills. The Dhaula Dhar dominate the landscape from any point in the valley. They rise 10,000 feet above the valley floor to an average height of 14,000 feet within a distance of less than three miles. Along this escarpment, peaks exceed heights of 19,000 feet. The valley itself is a gently sloping series of terraced and forested alluvial fans and riverine terraces deposited by the mountain streams and torrents originating in the Dhaula Dhar. These streams, known locally as *khads,* flow from the Dhaula Dhar south across the valley and eventually join the Beas River that flows in a southwesterly direction through the Sivalik Hills. The valley is roughly forty-five kilometres long from west to east and

[1]Census of India, 1991, Series-9, Himachal Pradesh, Part-I of 1991 - Provisional population total.

its width varies from ten to twenty kilometres. The elevation of the valley ranges from 4,500 feet at the foot of the Dhaula Dhar to 2,500 feet where it meets the Sivalik Range.

In the first regular settlement of District Kangra completed in 1855, the settlement officer G. C. Barnes described Kangra Valley in the following manner:

> These valleys by no means present a general evenness of surface. Their contour is pleasantly broken by transverse ridges and numerous streams that descend from the mountains above. A hundred canals, filled with clear water, intersect the area in all directions, and convey the blessings of irrigation to every field. Trees and plants of opposite zones are here intermingled, and Alpine vegetation contends for pre-eminence with the growth of the tropics. The bamboo, the peepul and the mangoe attain a luxuriance not excelled in Bengal; while firs and dwarf oaks, the cherry, the barberry and dog-rose flourish in their immediate vicinity...(Barnes 1855:4)

The unusual topography of alluvial fans and riverine terraces, bisected by numerous perennial, snowfed streams provides ecological conditions suitable for some of the most extensive gravity flow irrigation networks in the Himalaya. The broad irrigable valleys stretching out below the Dhaula Dhar range contrast sharply with the hillside terraces or relatively narrow riparian fields commonly associated with Himalayan agriculture. The local topography of riverine terraces and higher plateau-top fields compels most villages in Kangra Valley to engage with multiple kuhls. Short kuhls (less then one kilometer), or the upstream portions of longer kuhls, irrigate the fertile har fields on the riverine terraces immediately adjacent to a perennial stream. A village's larh (higher, less fertile plateau-top) fields are irrigated by the mid and tail-end portions of longer kuhls which must begin many kilometres upstream in order to bring water to these higher fields. Local topography thus creates opportunities for extensive gravity flow irrigation and fosters conditions that promote networks of overlapping short and long kuhls.

While the Dhaula Dhar is an igneous and metamorphic formation, the geologic structure of the Sivalik Hills to the south is a highly erosive sedimentary conglomerate. There streams and rivers have sharply downcut through the hills, thus eliminating the possibility of gravity flow irrigation. This area is known as the Changar, which means dry. The Changar, shaped by wind and rain, has been compared to "an agitated sea suddenly arrested and fixed into stone. The crests are like angry waves succeeding one another in tumultuous array, and assuming the most fantastic forms.." (Barnes 1855:4). Here, the steep dry hillsides restrict cultivation. Where cultivation is possible, maize and wheat, often intercropped with pulses, are the primary foodgrains.

Climate

Himachal Pradesh is divided into four agro-climatic zones based on elevation, rainfall, temperature, humidity and topography. Kangra Valley falls within the mid-hills sub-humid zone.[2] Precipitation in Kangra Valley varies inversely with distance from the Dhaula Dhar range. The average annual rainfall between 1968 and 1991 recorded at the town of Palampur, at the base of the Dhaula Dhar, was 2,700 mm, with a standard deviation of 400 mm. This declines rapidly to only 1,000 mm per year at Dehra Gopipur less than twenty miles southwest of Palampur. Figure 3.1 shows the monthly rainfall at Palampur and Dharmsala from 1968 to 1991 and from 1977 to 1992 respectively. Seventy-five per cent of the precipitation occurs during the monsoon season from mid-June through the third week of September. Winter rains in the valley from December through March fall as snow in the Dhaula Dhar. Runoff from melting snow feeds the perennial streams and is diverted by the kuhls during the hot, dry, pre-monsoon season.

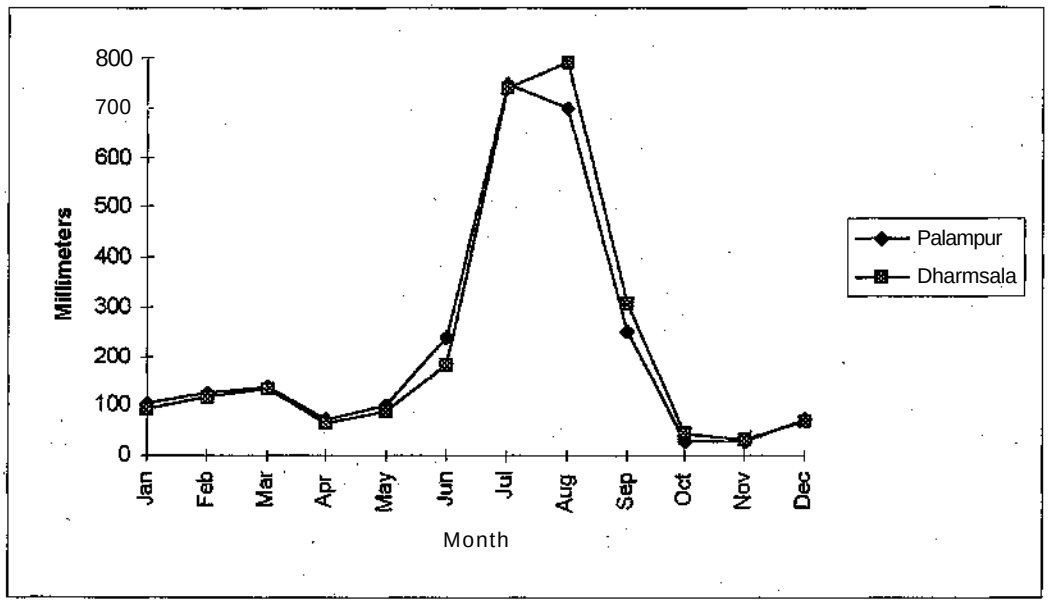

Figure 3.1 Average Monthly Rainfall at Dharmsala (1968-1991) and Palampur (1977-1992).

Monsoon rains can be extraordinarily intense. For example, within one twenty-four hour period in July 1976 more than 53 mm of rainfall was recorded at the Palampur weather station. Intensive periods of rainfall flood the perennial streams flowing from the Dhaula Dhar. Sometimes mudslides in narrow headwater canyons create temporary dams.[3] Eventually the water backed up behind the mudslide breaches the temporary dam and sends a wall of water, boulders and trees downstream, destroying riverside terraces

[2]The three other zones, are, 1) the sub-montane low hills, 2) high-hills temperate wet, and 3) high-hills temperate dry.

[3]Although floods occur more frequently, the last two times that the Neugal River was temporarily dammed by a mudslide were in 1944 and 1952.

and the kuhls in its path. It is common knowledge that when a river's flow suddenly diminishes during a monsoon storm, it is a clear indication of an impending flood and a warning to leave the river channel area. Periodic floods pose a major threat to the long-term stability of kuhls. Repairing a damaged kuhl takes months or years, and in some cases a kuhl's diversion structure and upstream channel may never be repaired. Instead a water sharing arrangement may be negotiated with the next upstream kuhl.

The average monthly temperature varies from 10° C in December to 25° C in May or June. Frosts are rare, although minimum winter temperatures often fall to 3-4° C. Figure 3.2 gives both rainfall and evaporation trends based on more than twenty years of data at Palampur (Singh, CM. et. al. 1992). The graph shows two water deficit periods, from April to June, and from October to November. Evaporation exceeds rainfall by as much as 35 and 20 mm in the former and latter periods respectively. These periods correspond to the sowing seasons for kharif and rabi crops in Kangra Valley, and they constitute the times of peak dependence on kuhl irrigation water.

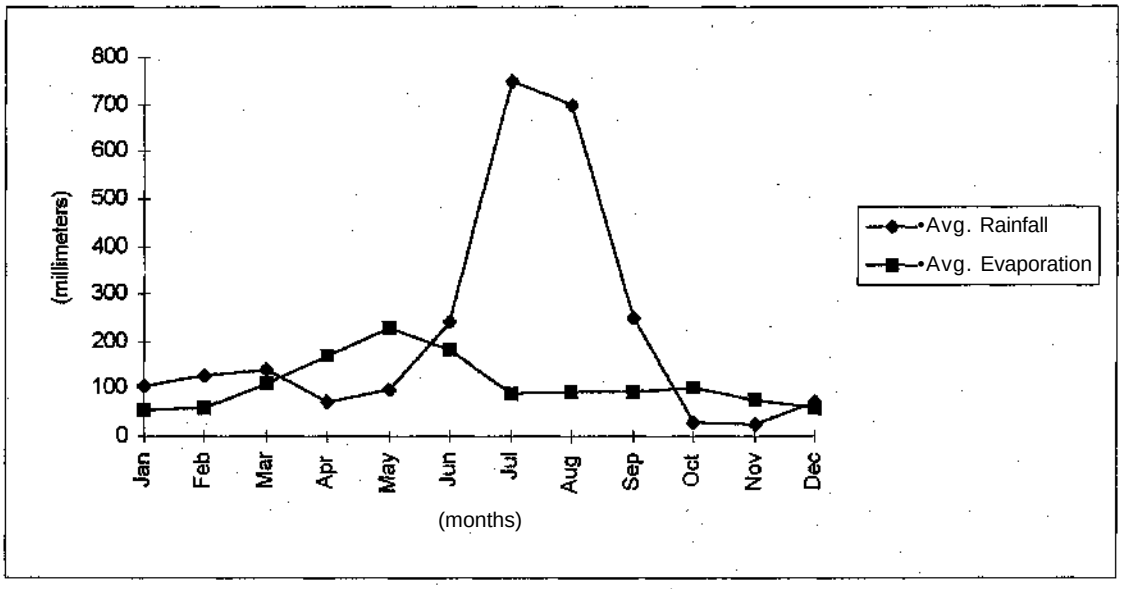

Figure 3.2 Monthly Rainfall and Evaporation, Palampur, 1975-1991.

Administrative Units and Settlement Pattern

At present, four tehsils (district subdivisions) comprise District Kangra. They are Kangra, Palampur, Nurpur and Dehra Gopipur. Kangra Valley includes portions of both Kangra and Palampur Tehsils. Each tehsil is under the administration of a subdivisional magistrate (SDM), accountable to the District Commissioner in Dharmsala. For purposes of providing local level development assistance, the district is divided into twelve development blocks, each with an appointed block development officer from the Indian or Himachal Administrative Service (IAS/HAS).

Talukas were subdivisions of tehsils during the pre-British and British periods. Barnes notes that "...talooquas are of very ancient origin, contemporaneous probably with the first occupation of the hills. They all bear distinctive names, and their boundaries usually follow the natural variations of the country" (Barnes 1855:15). Previously they were an important unit for revenue assessment and collection. Hence, statistics regarding land ownership and use and cropping patterns in colonial documents are generally aggregated at the taluka level. Although no longer used for administrative purposes, taluka names are still used to signify subtle local differences in language, customs, and diet.

The mauza is the next smallest unit of administration. A mauza is a set of hamlets grouped together to form the old fiscal units the rajas used for revenue collection. Its size was determined by the area that one person (an official of the raja) could supervise. Colonial documents sometimes refer to mauzas as townships. Mauzas have little or no importance for ordering social relations. In fact as Parry notes (1976:21) many people are unable to identify if a hamlet is part of their mauza or a neighboring mauza. The declining administrative significance of mauzas is demonstrated by the fact that since the 1971 decennial census, census tract information is provided at the hamlet level rather than the mauza level.

For administrative purposes hamlets, or tikas, are the smallest units of local organization. Tikas consist of one or more house clusters and areas of cultivable, forest, and grazing lands. In contrast to the nucleated villages of the plains, the house clusters of a tika are scattered along ridge tops or on upland plateaus away from the more productive irrigated bottomlands. Barnes described the settlement pattern in this manner:

> The dwellings of the people are seldom grouped together, but lie sprinkled in isolated spots over the whole valley, Every house is encircled by a hedge of bamboos, fruit trees and other timber useful for domestic wants. Sometimes a cluster of five or six houses occurs, and here a grain-dealer's shop and extensive groves denote the headquarters of the township. These scattered homesteads, the pictures of sylvan elegance and comfort, relieve the monotonous expanse of cultivation, and lend an additional charm to the landscape (Barnes 1855:4).

Tikas vary tremendously in size, ranging from as few as ten to over two hundred households. Smaller tikas are generally single caste settlements. Larger tikas tend to be multi-caste. As will become apparent in subsequent sections, whether or not a tika is single or multi-caste influences conflict levels resulting from increased nonfarm employment. Rarely, a tika will have no households and will instead be comprised of forestland to which adjacent tikas have a variety of usufructory rights. The fields that the inhabitants of one tika cultivate are likely to be distributed within the boundaries of several different hamlets within one or two mauzas. The patwari (village-level officer of the Revenue Department) maintains revenue records at the tika level. These records include field maps and registers showing each

field terrace, its size, crops sown, ownership, rights to irrigation water, and the revenue assessed, a register stating the tika's rights to forest and grazing lands, and various summary statements describing cropping patterns and village land use at the tika level. The patwari also assesses crop damage from storms, drought or pests, and measures rabi and kharif crop yields from sample plots.

Tika boundaries were not fixed until the first revised settlement of 1874. Regarding this process Lyall notes that "when the hamlets or family holdings were large and compact, each formed one tika; in the contrary case two or more were clubbed together into one" (1874:216). In most cases formal tika boundaries paralleled the "natural lines that had always been more or less vaguely recognized" by the inhabitants (Lyall 1874:216). Often, during the process of defining tika boundaries, it was found that a family or lineage group lived in one tika (A) but owned a large patch of cultivated land "a", or a series of smaller isolated patches, in another tika (B) surrounded by land owned by members of that tika (B). When the patch was relatively large and continuous, it was detached from tika B and for the purpose of the revenue records, assigned to tika A. Therefore in some cases tika A consisted of the contiguous area within that tika, as well as a smaller area "a" surrounded by tika B (Middleton 1919:13).

The smallest spatial unit is the house cluster *(narar),* A house cluster is a tightly concentrated group of homes, usually from two to twenty, sometimes sharing adjacent walls, but almost always connected by interlocking courtyards. The house cluster has no administrative status nor corporate property. However, it has great significance for social relations because its members tend to be of the same lineage, descended from a common ancestor who founded the settlement. Partitions of the joint family, combined with patrilocal marriage, over time produced the house cluster. In cases where a house cluster is comprised of more than one caste, this generally reflects the fact that the high caste founders of the cluster also brought with them low caste families as their servants (Parry 1976:20). Members of the same house cluster share in the preparations required for the major life cycle rituals, they engage in reciprocal exchange of gifts of cloth and money at these occasions, and they are expected to observe some degree of mourning restrictions after the death of a member of the house cluster. The norms of reciprocity that characterize relations between residents of a house cluster are replicated throughout other spheres of life in Kangra including the management of the kuhls, communal cleaning of village wells and labor exchanges.

There is a vague correlation between altitude and status. Although exceptions abound, high caste clusters tend to be situated on the ridges and hill slopes above lower caste clusters. This does not imply that caste distribution follows an upstream-downstream gradient. Rather, at any point along one of the rivers flowing from the Dhaula Dhar south across the Kangra Valley, a transect extending perpendicular to the river across the agricultural terraces, up hill slopes to ridges and sometimes to a higher series of

terraces, will be somewhat correlated with the status of the house clusters it intersects. At a larger spatial scale Rajputs dominate the steep mountainous areas at the southern edge of the Kangra Valley, the primarily agricultural castes such as Girths and Rathis generally dominate settlements near the edges of the fertile low lying valleys they cultivate, and transhumant Gaddi households are concentrated in villages at the base of the Dhauladar.

Declining Dependence on Agriculture

The primarily subsistence agriculture economy of Kangra has always been supplemented by nonfarm income. As far back as 1874 Lyall remarked that "subdivision has....reached its lowest point; if all these people relied on their land only for a livelihood, numbers would be starved" (1874:85). During pre-British rule, men, especially Rajputs, left their villages to fight as mercenaries in the Mughal, Sikh and local Katoch armies.[4] Often one male from each family was employed in this manner. Throughout Kangra a portion of the land revenue was cancelled in exchange for military service.

The tradition of out migration for military service continues to this day. During the colonial period a contingent of Dogras raised primarily from Kangra District helped suppress the 1856 'Sepoy Rebellion' in Delhi. By the early 1900s Dogras comprised 3 Regiments, 9 Squadrons and 39 Companies of Infantry in the Indian army (District Kangra Gazetteer 1909, Part A Vol. 1, p.243). Kangra District supplied about seventy per cent of all Dogras, a term applied to Rajputs, Rathis, Thakurs and Brahmins from the hills. 17,113 men from Kangra District served in the first world war, and by 1921 approximately 40,000 Kangra men were serving in the military (District Kangra Gazetteer 1926:125,465).

Tea estates, first introduced in Palampur and Kangra Tehsils by the British in 1849, also provided nonfarm employment. By 1902, 4,615 hectares had been planted to tea. Its cultivation provided employment to almost 5,000 persons (District Kangra Gazetteer 1909:123). Many laborers came from the Changar at the southern edge of the valley. Tea planters complained of a labor shortage during their busiest season, which they attributed to the demand for recruits for military service from local villages, and to agricultural intensification resulting from the construction of roads (presumably by improving access to markets) and rising grain prices.[5] Lower caste men and women were generally employed on the tea estates. Lower caste migrants also worked as unskilled and skilled laborers in the plains, and as coolies and rickshaw pullers in Simla (Parry 1976:42).

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[4]After the British defeated the Sikhs in 1846, thousands of men who had served in the Sikh army, mainly from Nurpur and Haripur, returned home unemployed. Not only were the families of these men deprived of their earnings used to meet the state revenue demands, but the returned men, trained as soldiers, were poor agriculturists and generally only added to the household burden (Barnes 1855:53).

The expansion of the nonfarm employment sector during British rule was accompanied by long-term changes in the area under cultivation. Figure 3.3 shows changes in the cultivated area of the Neugal basin from 1851 to 1990.[6] After an initial increase between 1851 and 1889, the cultivated area within the Neugal basin declined from 7,100 to 5,450 hectares between 1889 and 1990, a total decline of 23 percent. More importantly, half of the abandonment occurred during the ten-year period between 1971 and 1981. Much of this land is now used as *banjar,* i.e. for grass production for livestock fodder. Land reform legislation in Himachal Pradesh in the early seventies is partly responsible for the increased rate of noncultivation between 1971 and 1981. Some landowners, fearing the loss of title to tenant-cultivated fields, evicted their tenants prior to passage of the land reform legislation.[7] Previously tenant cultivated fields now lie fallow and are used for producing grass, either to sell or to feed the landowner's own livestock during the seasonal fodder shortages in January and February. However, responses to the recent land reform legislation do not explain the long-term trend of abandonment beginning at the turn of the century.

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[5] Although planters "threatened to import labor on a large scale" because the local supply of labor was so "uncertain and irregular" this does not appear to have occurred. Note regarding Kangra Tea written in 1892 by R.A. Ballard, Honorary Secretary to the Kangra Valley Tea Planters' Association (Kangra District Gazetteer 1909:120-123).

[6] To track these changes at the local level I compiled information on the area cultivated and the proportion of agricultural to non-agricultural male workers for all the tikas (hamlets) within the Neugal Khad basin. Information was used from the tika-level because, despite numerous changes in the boundaries of the larger units of administration, i.e. mauza, taluka, patwar circle, tehsil, and district, the area within each tika has remained constant since the first regular settlement in 1850. In the rare instances in which two tikas had been amalgamated, or their names changed, I confirmed the changes with the concerned patwari and adjusted the data accordingly. This permitted the comparison of tika-wise cultivated area over time. To compile the time series data for the area cultivated within Neugal basin, I first identified the 24 mauzas within the basin, and the over 300 tikas that comprise them. I excluded mauzas downstream of the kuhl irrigated areas where the Neugal enters the Changar. Taluka level assessment reports provided tika-wise cultivated area information for the 1851, 1871, 1889, and 1915 settlements. The next available information sources are the 1971, 1981 and 1990 censuses. Prior censuses did not include the area cultivated. After compiling tika-wise time series data on cultivated area for the dates mentioned above, this information was aggregated first at the mauza level and then at the basin level.

[7] Statistics on tenancy are available at the tika level as part of the patwari's records. I did not collect these statistics for the more that 200 tikas in the study watershed, nor was I able to find aggregated data regarding tenancy . In a sample of eight tikas of Mauza Chadhiar the patwari's revenue papers show that 27 percent of agricultural land was tenant cultivated (Parry 1976:48). However, these records underestimate the actual area under tenancy. Parry estimates that unofficial tenancy arrangements may account for as much as 15 percent of the current cultivated area.

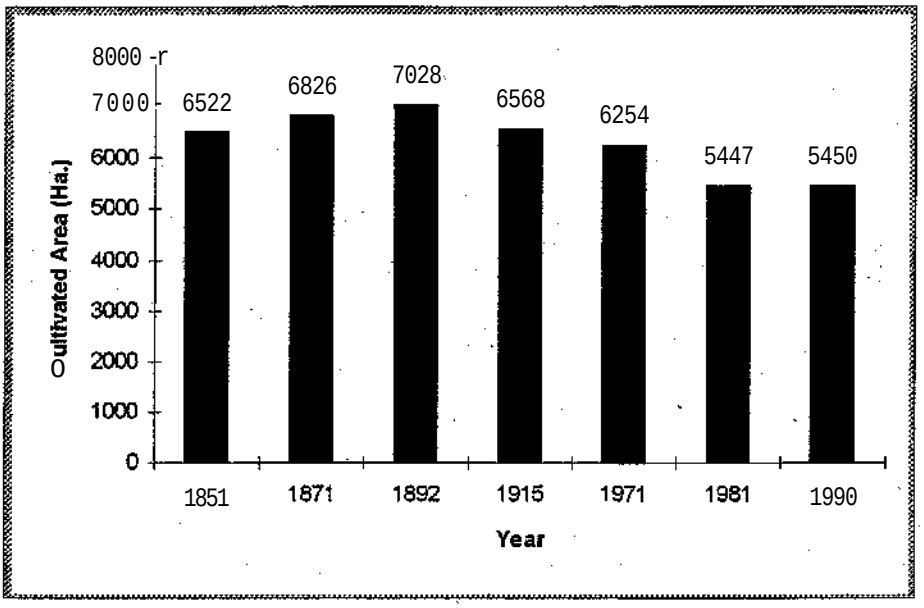

Figure 3.3 Cultivated Area, Neugal Basin, 1851-1990.

While the cultivated area was decreasing, the population of Kangra was steadily increasing. Between 1901 and 1991 the total population of the District increased threefold from 478,364 to 1,149,744. At the local level between 1951 and 1991 the population of the kuhl irrigated portion of the Neugal basin increased from 29,309 to 60,680 (Figure 3.4). Coupled with the rise in population and the decrease in cultivated area was the rise in nonfarm employment. Between 1961 and 1991 the numbers of males in the Neugal basin engaged in full-time nonfarm employment increased from 2,095 to 7,012, while those engaged in full-time agricultural work remained about the same (although many enumerated in the census as full time agricultural workers seek nonfarm jobs, especially salaried positions, and are under-employed in agriculture) (Figure 3.5).[8] Although consistent with historical trends of nonfarm employment, the magnitude of the male work force currently engaged in wage labor, either locally or outside the district, far exceeds prior levels.[9]

[8]Figure 3.5 indicates that between 1981 and 1991 the number of males engaged in agricultural employment increased, despite the declining trend between 1951 and 1981. This may be due to changes in the way agricultural workers were classified in the 1991 census, or to the increase in the basin's population. If the latter, then it is possible that while the absolute number of nonagricultural jobs continued to increase, the relative proportion of the male population engaged in nonfarm employment decreased due to population growth. This would appear in the census data as increased agricultural employment.

[9]1 began the process of also tracking agricultural and non-agricultural employment trends for women. However, wildly fluctuating ratios of agricultural to nonagricultural women workers, and even in the total number of women workers, rendered the data suspect and unusable. For example, the 1961 census reports 6,594 female agricultural workers in the irrigated portion of the Neugal watershed. Ten years later this figure had inexplicably plummeted to 944 and the number of non-agricultural female workers had also declined - this despite a total population increase from 32,728 to 39,768. In effect, several thousand woman workers had simply disappeared from the census records during a period when increased nonfarm employment for males was shifting the burden of agricultural work to women (Sarin 1989). These fluctuations were most likely due to inconsistencies in the ways

The nature of nonfarm employment varies greatly, often by a person's educational status. Private sector jobs in transport, commerce, and small businesses are found in the few regional economic centers within the district. Private sector jobs in industry and other large businesses are found in the larger economic centers of Chandigarh and Pathankot in the neighboring state of Punjab, and in Delhi. The military is the largest public sector source of employment. Other public sector employers include the Revenue, Forest, Irrigation and Public Health, and Public Works Departments.

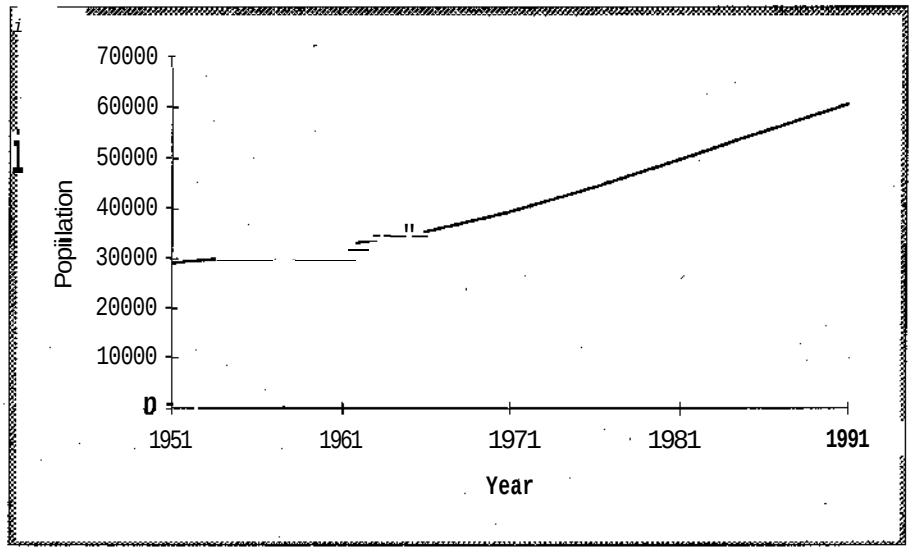

Figure 3.4 Population, Neugal Basin, 1951-1991

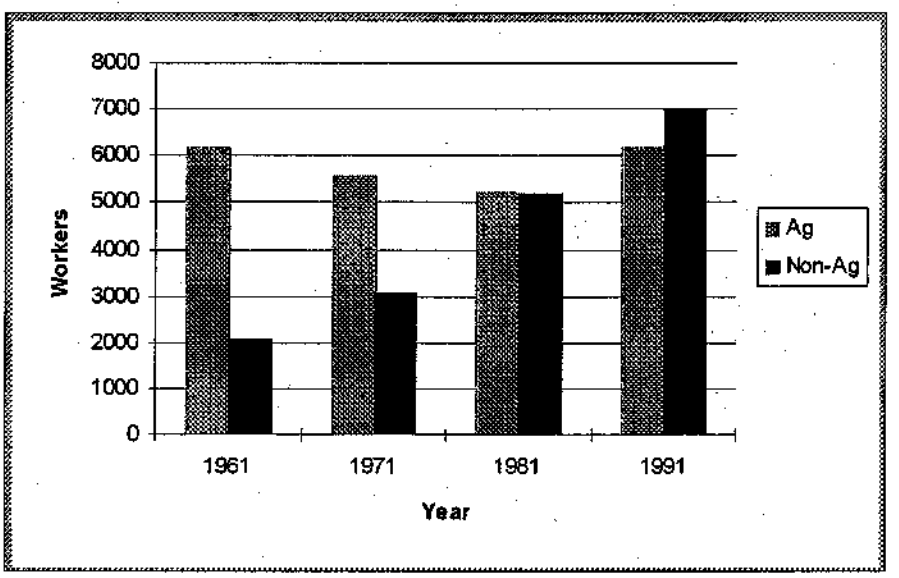

Figure 3.5 Agricultural and Nonagricultural Workers, Neugal Basin, 1961-1991

census enumerators phrased questions about women's employment and the bias among most households to not admit that women work in the fields. The ability to withdraw female labor from agricultural work is a strong and

The expansion of the non-agricultural work force has been accompanied by changes, primarily within the younger generation, in attitudes toward farming. The majority of boys complete the tenth standard and many go on to complete their ten plus two schooling. Almost every male youth who has completed this much schooling would prefer a job as a government clerk or even a less secure daily wage job in the private sector, over farming. With the expansion of primary and secondary schools throughout most of the district has come a devaluation of manual labor and farming in general.

As the remittance component of the economy has increased, there has been a corresponding decrease, among some segments of the population, in reliance on agriculture as the primary mode of subsistence. The declining dependence on agriculture is tempered by the strong local bias against buying food grains and the high value attached to self-sufficiency, at least as far as grains are concerned.

Current Land Ownership Patterns

Relative to dominant land distribution patterns throughout most of the grainbelt regions of the Indo-Gangetic plains, hilly regions tend to have more equitable distributions of agricultural land, less concentrated land holdings, and lower rates of landlessness. In this respect, Himachal Pradesh, including Kangra, is no exception, Lorenz curves and gini coefficients, both measures of inequity, indicate that Himachal Pradesh has the third most equitable distribution of land and wealth in India (Greenberg 1997:86). Himachal Pradesh also has the smallest average landholding size in India, a trend that preceded the land reform legislation of the 1970s. The average land holding size is only 1.3-1.6 hectares. Furthermore, tenancy and sharecropping is less pervasive in Kangra than on the plains, and landlessness is almost nonexistent. According to the 1950 district census approximately 90% of all cultivators partially or wholly owned the land they worked, 8% of all farmers were tenants or sharecroppers, and only 1% of landholders were non-cultivating land owners (Vashishta 1951:130-131, cited in Greenberg 1997:87).

Landholdings in Kangra have historically been quite small; even "large" holdings are relatively small compared to many other regions in India. In Tehsil Palampur of Kangra Valley only 58 holdings in the tehsil exceeded 10 acres of cultivable land, and more than half of the holdings greater than five acres were less than eight acres (Parry 1976:36). The district level figures from 1976-77 are given in Table 3.1. The table indicates that at the district level 64 percent of landholdings are one hectare or less, while only 7 per cent are greater than 4 hectares.

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public indicator of a household's class status. Consequently households that cannot afford to do so, will be reluctant to tell census enumerators that women in the household are agricultural workers.

Land Holding Size (ha)	Number of Holdings	Per cent of Holdings
< 5	59,531	44.3
.5-1	26,586	19.8
1-2	24,430	18.2
2-4	14,934	11.1
>4	8979	6.7

Table 3.1 Number and Proportion of Land Holdings by Size Class, District Kangra, 1976-77, (Agricultural Census Report, 1976-77).

The lack of skewed land ownership and of a politically powerful and entrenched landowning elite are two reasons why land reform legislation was passed in Himachal Pradesh and why it was, at least partially, implemented. Land reform in Himachal Pradesh consists primarily of land ceiling and tenant rights legislation. The Himachal Pradesh Abolition of Big Landed Estates and Land Reform Act of 1953 established land ceilings of 18, 27, and 72 acres for irrigated double cropped, irrigated single cropped, and other types of land, respectively. The 1972 Tenancy and Land Reforms Act further restricted the ceilings to 10, 15, and 30 acres. This bill also directed that all occupancy tenants were to become owners of the land they cultivated, subject to specific conditions controlling the conditions under which an owner could resume leased land. The 1951 Himachal Pradesh Tenants Security of Tenure Act, the 1952 Punjab Tenancy Act, and the 1971 Tenant Protection of Rights Act, along with the 1972 Tenancy and Land Reforms Act, were developed to protect security of tenure for tenants by governing the conditions under which eviction was permissible, and to govern the amount the landowner could claim in rent by establishing a ceiling of 1/4 of the produce (Singh 1985, cited in Greenberg 1997:93). Despite the fact that implementation of these laws has, in some cases, been lax (see Chapter 5 for examples) one of the outcomes of land reform legislation, which has exacerbated the push for nonfarm employment, is that while all households now have some land, most do not have enough for foodgrain self-sufficiency. When combined with population increases, a common pattern has resulted in which one brother will stay home to manage the agricultural responsibilities while the other brothers leave the area for various nonfarm jobs.

More recently, Negi (1993) analyzed changes in land holding patterns at the state and regional levels from 1970 to 1986. He shows that holdings in the size class greater than four hectares declined by nine per cent between 1976-77 and 1980-81, and by another eighteen per cent between 1980-81 and 1985-86. During the same two periods holdings less than one hectare increased by two and thirty-seven per cent respectively, and the average holding size decreased by fifteen per cent. While the area cultivated at the state level has increased, in the two districts (Una and Solan) he surveyed in the mid and low hills he reports a slight decline in cultivated area, and a thirty percent increase in the number of small farms (1-2

hectares). He suggests that land fragmentation due to inheritance patterns, the weakening of the bonds of joint families, and land reform legislation explain why there are more small farms and fewer large farms.[10]

While land distribution patterns do differ among different kuhl regimes, and while they do influence conflict levels within kuhl regimes, the narrow range of difference in land ownership in Kangra relative to other regions of India has promoted the persistence of kuhl regimes by forging a shared interest in kuhl water for irrigation and by muting the class- and caste-based tensions more commonly present on the plains. The absence of large absentee landlords, a non-cultivating elite, and landed estates in Kangra, coupled with the fact that that many landowners are also tenants and vice versa, has supported the historical development of a base of common interest in irrigation. To some extent, increasing nonfarm employment opportunities have disrupted this shared interest in irrigation water. Conflict running along the fault lines of caste and landownership differences has also erupted. However, in most cases continuing reliance on kuhls also provides some of the necessary incentive for farmers to search for institutional mechanisms for managing increasing conflict, and to sustain the collective action necessary for kuhl maintenance, repair, and management.

Cropping Patterns

The two most important cropping systems in District Kangra are paddy-wheat and maize-wheat. In Kangra Valley because of kuhl irrigation, the dominant cropping system is paddy-wheat, with maize-wheat in the unirrigated portions of the valley, which are almost always located in larh areas. Together, paddy, maize and wheat accounted for ninety percent of the total cropped area in the district in 1985-86. Figures 3.6 and 3.7 show the cropping patterns for the 1989-90 kharif and rabi seasons for District Kangra and the Neugal basin.

[10] The 1953 Himachal Pradesh Consolidation of Land Holdings Act and the Himachal Pradesh Holding Consolidation and Prevention of Fragmentation Act of 1971 provide legal leverage for consolidating land ownerships, which in 1977 averaged 13 different parcels (Mehta and Kumari 1990:74). Consolidation, contingent upon the request of a majority of farmers, has been most successful in the flatter portions of the state (below 2,500 feet elevation), which border the Punjab plains. While consolidation is supported by academics, policy makers, and government officials, farmers themselves generally prefer a dispersed rather than concentrated pattern of land ownership to distribute risk across a variety of elevational gradients, soil types, and other microclimate variables (Greenberg 1997:94-95). With respect to labor obligations for kuhl irrigated parcels, consolidation has minimal impact as labor contributions are generally calculated as a proportion of irrigated land, regardless of its degree of dispersal or concentration.

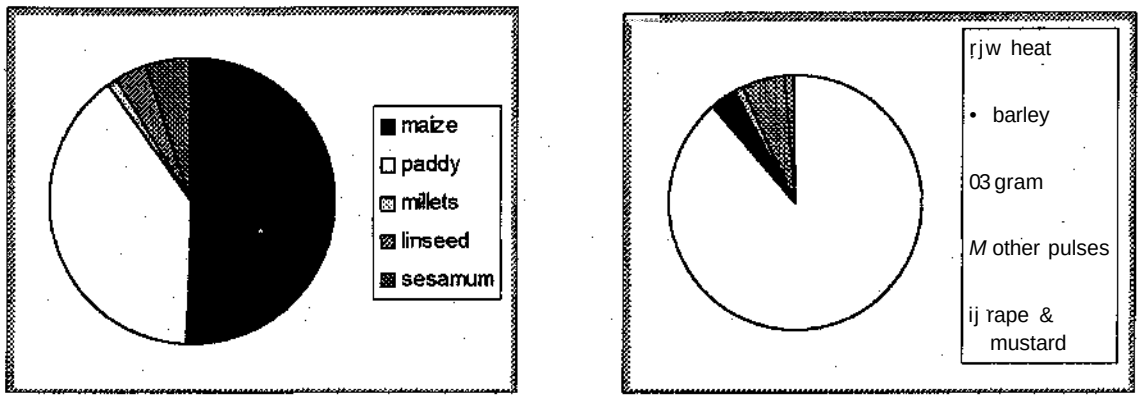

Figure 3.6 Kharif and Rabi Cropping Pattern, District Kangra, 1988-89.

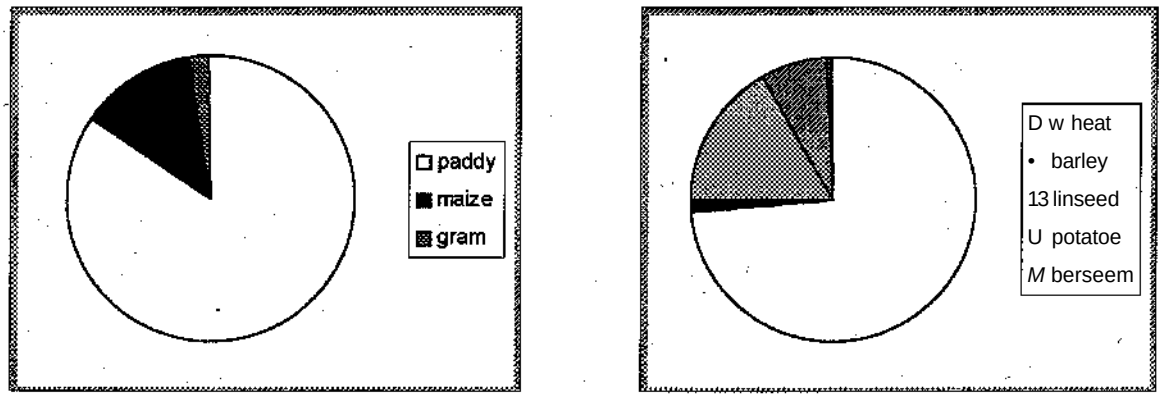

Figure 3.7 Kharif and Rabi Cropping Patterns, Neugal Basin, 1991-92

The smaller area sown to maize in the Neugal Basin relative to the rest of the district (Figure 3.7) reflects the greater availability of kuhl irrigation water. In villages with irrigation maize is sown only in the unirrigated larh areas along the ridgelines and in the upland terraces. The cropping patterns for Kangra Valley are similar to those for the Neugal basin. Often barley and wheat may be sown together, or either may be sown with gram. In unirrigated areas mustard is often intercropped with wheat, and a pulse such as gram may be sown with maize. Berseem, *T. alexandrinum*, also known as "Egyptian clover", and linseed are two important rabi crops. The former provides fodder during the annual period of fodder scarcity from January through March. Linseed is believed to improve the yield of the next paddy crop. It is no longer pressed for its oil.

Crop Yields and Returns to Agriculture

Table 3.2 gives the average yields of the major crops in district Kangra for 1988-89. Average yields, hpwever, mask important variations between irrigated and unirrigated crops. Averages also do not reflect local variation in soil fertility and productivity, and yield differences between farms with different levels of inputs, field preparation, weeding, etc.

Table 3.2 Average Yields of Important Crops, District Kangra, 1988-89.

Crop	1988-89 (qtls/ha)
Wheat	15.3
Maize	10.9
Rice	8.6
Barley	11.5

Source: Himachal Pradesh Statistical Outline 1990 p.64.

Crop yields under irrigated and rainfed conditions have been compared at Palampur by the HP Agricultural University following the recommended package of practices regarding fertilizer application, varieties, spacing, depth and date of sowing, etc. While the yields will be different from those under field conditions, the results nevertheless demonstrate the effects of irrigation on crop yield. Table 3.3 summarizes the results of the trials. The table clearly indicates the dramatic increases in crop yields resulting from irrigation, and by implication demonstrates the important role of kuhl irrigation in the local cropping system.

Table 3.3 Irrigated and Rainfed Crop Yields (qtls/ha), Palampur.

	Rice	Maize	Wheat	Gram	Potato
Irrigated	22.5	25.0	.34.0	6.1	100
Rainfed	15.4	18.3	26.0	2.0	29

Source: Singh et al. 1992.

On kuhl irrigated farms, maize and dry sown paddy yield a negative net return of Rs 750 per hectare, irrigated wheat yields only Rs 350 per hectare, and HYV varieties of paddy sown by the mach method yield Rs. 810 per hectare (Sharma 1990: appendix 5.7). Low returns from hill agriculture have been reported for Uttar Pradesh as well. Annual returns of only Rs 239 to Rs 460 per capita have been calculated for guhl[11] irrigated farms in Almora District of Uttar Pradesh. The per hectare estimate of net returns ranged from Rs 3600 to Rs 5700 (Pande 1991:95). However, the labor provided by family members was not included in the cost estimation. This explains the high per hectare return, relative to District Kangra, which includes the labor contributions of family members.

The marginal profitability of agriculture in Kangra underscores several points. The first is that grain and pulse production is not approached as an economic activity, but as a subsistence activity for meeting a household's own grain consumption needs. During fieldwork, I found no examples of households

[11] In Uttar Pradesh "Guhls" is the local name for gravity flow irrigation systems.

that sold either grains or pulses. Given the use of draught power in Kangri agriculture and the labor intensive methods of cultivation, neither grains nor pulses can compete on the market with green revolution grains produced in the Punjab and sold in provision shops in Kangra. However, green revolution paddy and wheat, while cheaper than that produced in Kangra, is universally believed to be inferior in both flavor, quality, and nourishment than locally grown grain. This partly accounts for the pervasive and deep seated preference for eating one's own, rather than store-bought, grains and pulses. The strong local subsistence ethic favoring self-sufficiency in grain production may also be a holdover from earlier periods when self-sufficiency was a partial hedge against crop failure due to floods, frost, hailstorms, or other calamities. Extreme weather events still periodically disrupt local agricultural production. Stories of dominant landowning households distributing surplus grains during periods of crop failure in the past and local sayings that describe the famine-relief qualities of millet, which resists insect and other damage for several seasons, attest to the reality of localized food shortages and underscores the importance of self-sufficiency.

There are some cash crops in Kangra. The primary ones are potato and mango and lichee orchards that have been planted in larh areas during the last couple of decades. A short-lived wave of export-oriented flower production passed through the district in the 1980s but proved to be uneconomical due to transport, market linkage, and other problems. The overall marginal economic viability of agriculture in Kangra partially accounts for the drive to find nonfarm employment. When household members do have nonfarm employment, the resulting high opportunity cost of labor constitutes a disincentive to allocate labor for labor intensive subsistence crop cultivation and for the maintenance and repair of kuhls. The impacts, both in terms of cropping pattern and kuhl management, are discussed in subsequent chapters. However, in order to discuss those impacts, it is first necessary to provide an overview of the organization and structure of irrigation management in Kangra.

Extent of Kuhl Irrigation

Historically, kuhls were the only source of irrigation in Kangra. In 1897 kuhls accounted for 100 percent of the irrigated land in the district (Anderson 1897:8). Kuhl irrigation still accounts for ninety-five percent of the net irrigated area of the district. In 1988, of the 32,511 hectares of irrigated land in the district, 30,895 were irrigated by kuhls and lift irrigation systems while only 1,616 hectares were irrigated by wells and tube wells (Himachal Pradesh Statistical Outline 1990:58). The kuhl irrigated Kangra Valley in Kangra and Palampur Tehsils accounts for the majority of irrigated land within the district. Hamirpur, Dehra and Nurpur Tehsils are located in the dry Changar region of the district where the absence of perennial snow-fed streams and broad irrigable valleys, precludes the development of kuhl irrigation. Table 3.4 shows the tehsil wise percentage of irrigated and unirrigated cultivated lands in 1897. The table

shows the large difference between the proportion of irrigated land in Kangra and Palampur Tehsils, relative to the rest of the district.

Table 3.4 Percentages of Irrigated and Unirrigated Land, by Tehsil, District Kangra, 1897 (Anderson 1897).

	Kangra	Palampur	Hamirpur	Dehra	Nurpur	Total
Unirrigated	47.9	50.3	97.9	83.7	87.6	79
Irrigated	52.1	49.7	2.1	16.3	12.4	21

In Kangra Valley, approximately 715 major kuhls and more than 2500 minor kuhls[12] irrigate more than 30,000 hectares. Kuhls range in size from command areas of only a few hectares to single systems that irrigate more than four thousand hectares. As their command areas vary, so do the number of villages that fall within a single kuhl's command area, from one to over fifty. Similarly, their length varies from less than 100 meters, to greater than 40 kilometers. The institutional arrangements for managing these systems are diverse. They range from simple collective arrangements among farmers with little or no role specialization, to elaborate and refined organization with several designated watermasters (kohlis) and sophisticated methods for measuring water flow.

The distinction observed earlier between har and larh areas has important implications for understanding the interlocking kuhl networks that exist in many of the watersheds in Kangra Valley. As mentioned earlier, har areas are the lower terraces that lie just above the riverine cliffs, ten to fifty meters above the river, and larh areas are the upper terraces usually separated from the har areas by a steep hillslope, generally fifty to one hundred meters above the river.[13] Due to the elevational differences between har and larh, the kuhls that irrigate larh areas must begin ten to fifteen kilometers upstream of those that irrigate the lower terraces in the har areas. Often a kuhl that irrigates larh areas in village (B) will irrigate the har areas of an upstream village (A), while another kuhl which irrigates the har areas in village (B) will also irrigate the larh area of a downstream village (C), and so on. At the basin level, the pattern of multi-village kuhls and multi-kuhl villages creates a network of interdependence between upstream and downstream water users. The pattern of overlapping kuhls flowing downhill on either side of a perennial river is not entirely unbroken. In the lower reaches of the irrigated portion of the Neugal basin some

[12] A major kuhl has a perennial water source and irrigates two or more villages. This information comes from the Riwaj -i-Abpashi (Book of Irrigation Customs) compiled as part of the 1915 settlement of District Kangra.

[13] In general the lower terraces (har) receive a more assured supply of water and are more fertile than the upper areas (larh). In most cases hamlets are located in larh areas in order to maximize productive use of the lower terraces, and because ridgelines an high areas are more defensible. During periods of peak agricultural activity draught animals are kept in simple sheds in the har and often farmers will also sleep there to prevent illicit water use, especially during times of water scarcity.

villages do not have larh areas. In the lowest reaches where the Neugal River cuts deeply through the sedimentary conglomerate of the Changar, villages have no har areas. Overlapping kuhl networks create opportunities for inter-kuhl cooperation and exchange. Water sharing arrangements between kuhl regimes facilitate the persistence of individual kuhl regimes despite calamitous events such as floods and earthquakes. Chapter 6 six presents an analysis of network density, inter-kuhl water management arrangements, and the extent to which such arrangements are associated with network density.

The *Kohli*

The institution of kohli (watermaster) is central to the management of many kuhl systems. The kohli organizes and supervises the communal tasks related to kuhl maintenance and repair. He conducts the religious rituals associated with kuhl management. He oversees water distribution during the times of peak demand and minimal water supply; during these periods he resolves conflicts between farmers regarding water utilization and decides whether or not to install water measuring devices, or under particularly severe conditions of water scarcity, to shift the kuhl from continuous to rotational flow. If and when the kuhl is destroyed by a flood, or if a drought combined with upstream diversions reduces waterflow in the river, then the kohli will negotiate water sharing arrangements with the kohli(s) of the next upstream kuhl(s). In return for his services, the kohli receives a fixed proportion of the both the kharif and rabi harvests. Besides their economic value, the in kind grain payments farmers give the kohli at harvest time acknowledge and reinforce the kohli's right to be kohli. They serve to reinforce the social relations of resource management. In like manner, where and when it exists, reluctance to give the kohli his share of the harvest represents an implicit challenge to those relations; it is suggestive of the changing patterns of authority associated with kuhl management.

Stories abound of kohlis in the past who commanded respect, a certain amount of fear, and who possessed supernatural powers to bring water to their kuhl during times of drought and to control destructive flood waters. The right to be kohli was a valued and inheritable right whose origin seems to have derived, in some cases at least, from performing a public service relating to the construction or repair of a kuhl. A family who holds the right to the post of kohli retains that right even if they are unable to fill the post and another individual acts as kohli.[14] In recent decades, as households in Kangra participate more fully in the market economy and the centrality of agriculture and the institutions which support it

[14]In one kuhl the sons of the family with the warisi (inheritable right) of kohli were all serving in the military. During this period another individual served as "temporary" kohli until one of the sons returned from military service and assumed the responsibilities of kohli. In a second kuhl the kohli "resigned" citing the declining authority of his position as his reason. Although the panchayat appointed another to carry out the kohli's responsibilities, the warisi remains with the original kohli's family.

diminishes, the respect and status accorded to kohlis have declined. The position of kohli also commands less respect now than previously because of changes in the organization of kuhl regimes.

Notwithstanding these changes, the institution of kohli is still vital to kuhl management. That it reproduces many of Kangra's core cultural practices and reinforces key social formations further contributes to its importance. The institution of kohli reproduces hallmark characteristics of the caste system: role specialization and the exchange of services for in kind payments. Warisi, the word used to describe the inheritability of the right to be kohli, also refers to the inherited right to cultivate land, and to claim other inherited village posts during the pre-colonial and colonial periods. As an ascribed role, the institution of kohli parallels the ascription of status and role by birth within the caste system. The institution of kohli also derives support from the long tradition of military service in Kangra. The emphasis on hierarchical authority and the concentration of decision making and conflict resolution authority in military culture resonates with and supports the roles and functions of the kohli. The reproduction of these relations from the broader cultural and social context of Kangra within the institution of kohli suggests that it is a highly institutionalized role and would therefore be expected to persist over time.

There is not a one-to-one correspondence between kohlis and kuhls. The Irrigation and Public Health Department (IPH) currently manages nine of the thirty-nine kuhls within the Neugal Basin. These kuhls tend to be the largest in the basin. Prior to government control of their management, which began in the 1970s, most of these kuhls had three to five kohlis, each responsible for one of the main channels. Of the remaining thirty locally managed kuhls, fourteen have one kohli each, two groups of two and two groups of four are managed by single kohlis, and ten are informally managed with no kohli.

Khana

At the end of March or early April, when the winter wheat is ripening, there is a lull in the agricultural cycle. During this lull farmers recondition their kuhls in preparation for the pre-monsoon hot season when reliance on kuhl irrigation water reaches its peak. The local word for this work is *khana:* Khana involves removing accumulated sediment and vegetative growth from the channel bottom and sides, reconstructing the small dams that carry kuhl water across seasonal streambeds and narrow gullies, reinforcing weak sections of the channel bank, and rebuilding the diversion structure (*danga)* at the head of the kuhl that diverts water from the river into the channel.[15] Because most villages are engaged with

[15] While farmers' dependence of kuhl water for irrigation is seasonal, others depend(ed) on it year round and hence had interests in maintaining year round flows. Kuhl hydropower was previously used to power small scale mills *(graths)* to grind" all the wheat, corn and other grains and pulses of the area. In exchange for grinding fifteen kilograms of grain, the owner of the *grath* would keep one kilogram of flour. Every kuhl had at least one or two *graths* along their channel. The larger kuhls had as many as fifteen to twenty-five *graths. Grath* owners had a strong vested interest in maintaining water flow in the kuhl. They would regularly walk the length of the channel

multiple kuhls, many farmers contribute towards the maintenance of one kuhl that irrigates fields in the har, and another kuhl that irrigates fields in the larh.

The organization of khana

The organization of work appears to vary directly with the amount necessary to maintain the kuhl.[16] Kuhls with relatively short channel lengths (1 km or less) and relatively small command areas, generally do not have kohlis. In these kuhl regimes small groups of farmers informally organize kuhl maintenance tasks. In most cases smaller kuhls can be readied for water in one day. A day or two prior to the first irrigation of the kharif season, a group of two or three farmers walk the length of the kuhl removing sediment and vegetative growth as they go. At the head of the kuhl they construct a small dam of river stones. When water is distributed rotationally, the farmer whose fields are irrigated at time A is responsible for maintaining the kuhl at time A. If and when farmers distribute water on a continuous flow basis to the whole command area, then farmers not receiving adequate water will clean the channel and strengthen the danga until the flow is adequate to continuously flood their fields.

Kuhl maintenance tasks can be organized informally when command areas are small because farmers who cultivate contiguous plots within a relatively small area almost always live in the same hamlet and often live in the same house-cluster. This is significant because residents of a hamlet are often members of the same sub-clan consisting of agnates descended from a common ancestor. In Kangra, blood ties and proximity lead to frequent interaction and generate joint interests (Parry 1976:136-139). At election time the entire sub-clan will often form a political faction, or a sub-unit of a faction composed of the whole clan, which votes as a block. All the households in a single house-cluster will be invited to send a representative to join the marriage party of a groom of the clan when it leaves to bring the bride to the groom's natal village. Similarly, they will attend the important life-cycle rituals at each other's households and at these times exchange gifts of money and cloth and occasionally help with the necessary preparations.

The joint interests shared by members of the same house-cluster are usually strong enough to provide adequate basis for the collective efforts that maintaining smaller kuhls require. In these systems conflict stemming from water use is likely to be low level. Because one individual in a matter of hours can substantially increase the flow of water, the stakes involved generally do not warrant acrimonious conflict. When conflict over water use does escalate, it often stems from friction in another arena, for example an

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clearing debris, repairing leaks, etc. to maintain the flows required for their mills. Often they would fashion wooden screens to prevent leaves, twigs etc. from being picked up by the water wheel. These activities helped provide clean water flows throughout the year. With electrification, most *graths* have been replaced by electrically powered mills, despite people's stated preference for *grath-groxmd* flour.

internal feud over the division of a joint estate, or accusations of encroachment on each other's land, which spill over into water management.

Formally organized khana is more common in kuhls that have one or more kohlis. The formal organization of khana varies between kuhls in terms of 1) the rules used to determine each household's contribution, 2) the order in which different sections of the kuhl are cleaned, and 3) the determination of which channel sections are to be cleaned communally and which are the responsibility of individual farmers.

In late March or early April, the kohli determines and announces the day on which the annual cleaning of the kuhl will begin.[17] On the morning of the chosen day, the kohli, wearing a white turban to symbolize his authority and usually carrying a stout stick used for balancing on rough terrain, measuring water depth, and encouraging laggard workers, walks through the hamlets within the kuhl's command area calling loudly for each household to send a laborer to begin khana. From eight to twenty or thirty men will gather at the work site. Those gathered usually divide themselves into two groups. One group, using the *kudal,* a short handled implement with a blade similar in shape to a heavy spade, scrapes the accumulated sediment from the channel sides and bottom into piles. The second group follows the first group. They lift the sediment out of the channel and remove vegetation using the ubiquitous, general purpose hand held sickle *(dratf).* Often the kohli will try to maintain the pace of work by building and playing on rivalry between the two groups. With taunts and threats, he challenge the second group to try to catch up with the first group, who, if this does begins to happen, will respond by increasing the pace of their work. As both groups move along the channel the kohli ensures the work is of adequate quality to enable the kuhl to operate at full flow without overflowing its banks. Except for short breaks for water and tea, the work continues throughout the day until early evening. At the end of the day the kohli records in his notebook the names of all present. He sometimes also notes whether a household sent a small boy instead of a grown men, or if someone came late, worked especially hard, or was slothful.

Until approximately forty years ago, rosters were not maintained of who did and did not show up for khana. The kohli kept a mental tally of who had not sent a member of the household or a laborer for khana. Farmers who did not participate in khana had low priority for water, both in terms of timing and

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[16] Similarly, Martin reports that in the farmer managed irrigation systems he studied in Nepal the structure of the organization for irrigation management was directly related to the amount of labor required to maintain the system (1986:317).

[17] In recent years many kohlis have scheduled khana to begin on a Sunday in order to increase the participation of men who are engaged in off-farm employment during the week.

quantity of water delivered. Households with no male head, or in which men were unable to do khana due to illness, were excused from khana.[18]

At present, khana is formally organized in twenty kuhls in the Neugal basin. In thirteen kuhls, every household is expected to send one male member each day the kohli calls for communal khana.[19] Households that do not send a member are expected to pay for a laborer to go in their stead. In six kuhls labor contributions are directly related to the area of kuhl irrigated land.[20] In one kuhl (Samruhl Kuhl) labor contributions have been replaced by monetary contributions based on irrigated area. In fourteen kuhls committees have been formed.[21] One of the functions of kuhl committees is to enforce the formalized rules governing labor contributions for khana that have developed during the last forty years.

Non-cultivating landowners do not participate in khana. The relative contributions of tenant cultivators and owner cultivators partially depend on the way khana is organized. For the thirteen kuhls mentioned above tenants and cultivators alike are expected to contribute equally for khana. In the six kuhls for which labor contributions are based on irrigated area, tenant and owner cultivators both contribute labor in proportion to the area they cultivate. In Samruhl Kuhl they both contribute money in proportion to the area they cultivate. While I did not investigate the relative decision making authority of tenant and owner cultivators in all fourteen kuhl committees, in the kuhl committees for Makruhl, Samruhl, Sonia, Pangwan and Gagruhl Kuhls, tenants as well as cultivators vote for the committee officers and to support or oppose the various decisions the kuhl committees make.

In each of the twenty kuhl regimes that organize khana the construction of the danga, and the cleaning and repair of the main channel from the danga down to the most upstream *tup* (diversion point), is organized communally. The communally maintained portion of the main channel ranges from one to fifteen kilometers long. It generally traverses the vertical riverside cliffs, and often crosses smaller streams and gullies. Without exception, responsibility for cleaning the subsidiary channels that carry water from the main channel to the terraces, lies with the individual(s) whose fields the channel irrigates. While women

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[18]I do not have complete information regarding the number of women headed households in the kuhl irrigated portion of the Neugal Basin. However, casual observation suggests that women headed households do not comprise more than ten percent of the total households. The attendance register for Pangwan Kuhl shows that 7 of the 75 households that use Pangwan Kuhl water are women headed. All but two of these households have sons who participate in khana. The remaining two households are excused from khana but still receive irrigation water. The proportion of women headed households is much higher in the nonirrigable Changar region bordering the southern edge of Kangra Valley. In the Changar the majority of households are women headed for substantial periods of time due to male outmigration.

[19]The thirteen kuhls are: Bhradi, Chanogi, Raniya, Bhagotla, Katuhl, Saprahl, Pathan, Masanol, Makruhl, Pangwan, Sonia, Upperli and Buhli.

[20]The six kuhls are: Mahang, Loharal, Tarahl, Chamruhl, Menjha, and Gagruhl.

[21] Kuhl committees, as one aspect of the process of regime formalization, are discussed in Chapter Five.

play important roles in maintaining the subsidiary channels and controlling irrigation water on their household's fields, only men participate in the communal khana activities.

Channel maintenance below the top tup is organized in a number of different ways. The most common method, used in eight kuhls, is to divide the channel into sections bounded by tups and to allocate responsibility to farmers that share a tup for maintaining the main channel from that tup to the next upstream one.[22] In these kuhls the kohli does not supervise the tup to tup work. Rather, he inspects the work done by farmers on their own accord, and requests them to do more if necessary.

The second most common method for organizing khana along the main channel below the top tup is for the kohli to supervise small groups of farmers along different sections of the main channel. This occurs in five kuhls.[23] The amount of work required to maintain the main channel below the top tup influences whether or not the kohli will supervise it. If the distance between *tups* is relatively short and no labor intensive repairs are required, then in most cases the kohli will simply inspect the work done by farmers without his direct supervision. If the distance between *taps* is relatively long, i.e. greater than fifty meters, then in most cases the kohli will supervise work parties responsible for different sections of the kuhl. Farmers sharing tail end *taps* work together to maintain the lower reaches of the main channel, those sharing mid-reach *taps* maintain the central sections of the channel, and likewise to the top tup.

When a kuhl's main channel divides into two or more branches that convey water a substantial distance before tups' divert it to tertiary channels, responsibility for maintaining the branch is shared by all the farmers who receive water from it. This occurs in two kuhls in the Neugal basin (Kathul and Sapruhl Kuhls). As with maintenance of the main channel above the top tup, the kohli will call all those farmers that share a common branch of the kuhl and will supervise their work from the top tup upstream to the point where the branch diverts from the main channel.

In a similar manner, responsibility for khana for the sections of the main channel between two villages lies with the downstream village. In cases where two or more villages are adjacent to each other, and a long stretch of main channel (1-10 or more kilometers) separates them from the next upstream village, then khana is generally divided such that each village is responsible for an agreed section of the main channel. Larger kuhls that irrigate 30-40 villages have four or five main channels. Responsibility for each of the main channels is divided amongst those villages sharing the channel.

There is one example of khana organized on a communal basis from the tail to the head of the kuhl (Bhagotla Kuhl). In this kuhl the top and bottom *taps* are very close to each other, thus obviating the need

[22]The eight kuhls are: Menjha, Sapruhl, Masanol, Makruhl, Sonia, Gagruhl, Upperli and Buhli.
[23]The five kuhls are: Mahang, Loharal, Taruhl, Chamrahl, and Pangwan.

for a tup to tup organization of work. Under the kohli's supervision, khana begins at the tail end of the kuhl and continues upstream to the head end.

The last variation in the organization of work for khana is found in three kuhls (Bhradi, Chanogi, and Raniya). In this case while the danga and upstream portions of the kuhl are maintained communally under the kohli's supervision, there is no formal organization for main channel maintenance below the top tup. In each of these three kuhls the distance between tups is relatively small and the maintenance levels are low. The banks of the main channel are covered with thick grass cut and stored as winter fodder by the landowners through whose land the channel passes. Other than this, very little channel maintenance is necessary for these kuhls.

The amount of time required for khana differs dramatically among kuhls. Khana for smaller kuhls irrigating one or two villages can be completed in two or three days. Maintaining the larger kuhls with multiple main channels is more time consuming. Kohlis of privately managed large kuhls call farmers for khana twenty-five to thirty-five days each year. If damaged by monsoon rains, channel repairs require further labor contributions. Prior to IPH management of Dewan Chand Kuhl, one of the longer kuhls in Neugal Basin, farmers cooked, ate and slept by the channel where that day's khana work ended. After more than three weeks of continuous work, the work crews from each main branch converged at the common channel leading to the danga. More than 200 men would congregate to construct the danga and participate in the religious ceremony the kohlis performed.

For all kuhls one of the most difficult sections to maintain is between the top tup and the danga. This section traverses the steep riverine cliffs created by the downcutting action of the river, and presents continual maintenance and repair challenges. A leak at this point soon becomes a waterfall that can quickly destroy a whole section of the channel. In order to minimize the risk of channel collapse due to carrying too much water, many kuhls have one or two spillways just downstream of the danga through which excess water can be returned to the river. After monsoon cloudbursts the spillways are opened to regulate the kuhl's waterflow and prevent water from spilling over the channel sides. If the kohli lives near the danga he will control the kuhl's water flow using the spillway. If he lives away from the danga, he will designate a farmer to do this who lives near the head of the kuhl and who generally uses water from the top tup. This farmer, known as the *mctloli,* receives no formal compensation for performing this task. In the Neugal basin only three kuhls had *maloli* at the time of my fieldwork.

In past days, for the larger kuhls with multiple kohlis, rebuilding the danga involved as many as 200-300 people. Now the largest kuhls are maintained by the IPH Department, and for smaller kuhls fewer farmers are required - but the danga construction method has not changed. Rocks, and the mud and grass

sod mixture known as *cheb,* are handed from person to person from their source at the river's edge to where they are needed to repair the channel sides and to plug leaks. After completing the khana, attention is turned to the danga. Stones, *cheb,* sticks, sand and pine needle bunches are used to extend the diversion structure from the stony riverbank into the current.

Rules control the materials that may be used in constructing the danga In order to preserve a minimum water supply for downstream kuhls, the dangas of upstream kuhls must be more permeable than those of downstream kuhls.[24] Thus only stones may be used to construct the danga of the most upstream kuhl. Further downstream, needles and branches of the chir pine (Pinus longifolia) may be used, below this other riverine vegetation may be added, and by about midway through the watershed, *cheb,* the sod-like mixture of earth and grass excellent for plugging the spaces between stones, is added to the repertoire of permitted danga construction materials. Using cement to make a permanent danga is forbidden. Simple observation of the relationship between position within the watershed and the materials used in the danga confirmed that farmers follow this rule.[25]

After the danga is completed the kuhl will operate at-full flow. In many kuhls the volume discharge is gauged just downstream of the danga by observing the water level of the channel against a customary depth marker, often a large boulder. The kohli judges the kuhl to be at full flow when the water level in the channel reaches a spot on the boulder that, from past experience, he knows indicates full capacity. For most kuhls the next khana will be one year later. However, for some kuhls, a secondary khana is carried out prior to field preparation for the rabi crop in early autumn.

Puja

Barnes (1855:23) describes a ritual that takes place for one kuhl in the western part of the district that irrigates fifteen villages, "On the 1st *Sawun* (July) a grand procession takes place to the canal head." There, "a sort of fair is held, and five *'bulees** or heads are offered in sacrifice - one buffalo, one goat, one

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[24] Ambler describes a similar system observed in the Tampo river in W. Sumatra in which local custom *(adaf)* forbids the use of mud or straw in the headworks of upstream irrigation systems to ensure water flow for downstream irrigation systems (1989:358).

[25] The Riwaj-i-Abpashi describes an unusual situation in which the permitted materials for *danga* construction vary not just with relative upstream-downstream position, but with distance from the river's edge as the *danga* extends into the current. The kuhl in question, Raniya Kuhl was constructed under the patronage of the Rani of Raja Ghumand Chand (1751 to 1774). After an unspecified period of time, flooding destroyed the kuhl's danga and cliffside section. A Rani by the name of Jamwali, sponsored the construction and repair of the kuhl to its original condition. Interestingly, the Riwaj-i-Abpashi states that the half of the danga extending furthest into the current is made of only stones and leaves, while *cheb* is used in the half closest to the river's edge. The kuhls immediately up- and downstream of Raniya Kuhl use *cheb* in the whole danga. If followed, this rule would result in Raniya Kuhl losing more water through its danga than both kuhls adjacent to it. The logic of this de jure rale is history's secret. Neither the kohli of Raniya Kuhl (who stated that *cheb* was used throughout the danga), nor other key informants, knew of this rale.

sheep, one cock and one pitcher of wine." In every private kuhl today, although the number of "heads" offered is fewer, and less frequent, *puja* (ritual) is still an integral part of the annual cycle of water management. Puja, in this context, serves several purposes. Primarily it ensures that adequate water will flow into the kuhl during the dry season before the onset of the monsoon. The object of devotion in this case is the kuhl's *mata*, the mother of the kuhl, the feminine deity that inhabits the kuhl itself. In some cases the object of the puja is more personalized. In the case of Raniya di kuhl, (queen's kuhl), the local hill queen who provided the funds for constructing the kuhl in the late 18th century is herself propitiated. Similarly, in order to induce water to first flow into Sapruhl Kuhl, the individual who sponsored its construction sacrificed his daughter-in-law at the canal head. In her honor a small temple was built at the spot and to this day the shareholders of the kuhl worship her.

The puja to the kuhl's mother is invariably conducted by the kohli, and more often than not, is performed immediately after completing spring khana when most of the shareholders of the kuhl are present. The kohli, at the danga or a nearby designated large boulder, will call out to the feminine spirit of the kuhl to bless the farmers with her presence in the upcoming dry season. *Prasaad* (any offering of food to a deity, in this case a cooked sweet dish or sweet bread), is offered to the goddess and then shared amongst all those present. The shareholders of the kuhl make a small contribution (two to five rupees and one or two kilograms of grain) to the kohli to cover the cost of the *prasaad.*

I observed an elaboration of the puja directed towards ensuring adequate water flow in several downstream kuhls of Neugal River. For those kuhls a red flag on a pole was positioned in the kuhl's danga and a *chadre* and *choli* were placed in the river.[26] Placing pieces of cloth representing a *chadre* and *choli* in front of a feminine deity is a common part of puja in the area today. In Sapruhl Kuhl, referred to above, a complete set of bride's clothing is offered at the temple of the sacrificed daughter-in-law.

Puja to the kuhl's feminine deity is important to ensure adequate water flow before the monsoon rains begin. However too much water can also be a problem, especially when in the form of destructive floods. To ward off destructive floods, the kohli does puja to *Quaja Pir*.[27] Quaja pir is a local deity that can control, guide, and calm the flooded river. Following severe monsoon rains, the small rivers draining the Dhaula Dhar range can be transformed into roaring torrents that transport huge boulders and wield tremendous destructive power. This is especially true when a mudslide in a narrow upstream canyon

[26] The *chadre* and *choli* were part of the traditional female dress of Kangra until the beginning of this century when they were gradually replaced by the Punjabi salwar kamiz. The *choli* was a sort of blouse, but without a back. It had long sleeves, embroidery on the front piece, and was held in place by strings tied around the back. The *chadre*, a type of light shawl, was draped over the women's head and flowed down her back to below her knees. The *choli* and *chadre* were worn with the *ghagra*, a type of skirt, and a *sothan*, similar to long trousers.

creates a temporary dam that eventually bursts, sending a wall of water, boulders and trees hurtling downstream. These flood bursts remove all signs of the kuhls that lie in their path, often carry away large sections of agricultural land, and usually change the course of the river. Village elders who remember past flood bursts (which occurred on the Neugal in 1944 and 1952), describe the deafening roar of the water and the thundering sounds of the boulders crashing against one another as the engorged river hurled them downstream. Puja to Quaja Pir involves supplicating the deity to spare the kuhl from the flood's destructive fury. It is generally performed at the same time as to the kuhl's deity. *Prasaad* will be offered to Quaja Pir and then distributed to all those present. Sometimes the puja is performed separately from that of the kuhl's deity, and closer to the coming of the rains in the month of July.

If the puja to the kuhl's deity was effective, if adequate snow fell on the Dhaula Dhar the previous winter, and if the monsoon is not delayed, then puja to the kuhl's deity will be done only once every year. If however, water scarcity threatens the paddy crop, then another puja to the kuhl's deity will be performed at the danga. As before, the kohli will preside, but rather than offer *prasaad* of a sweet dish, a goat will be sacrificed, offered to the deity, cooked on the spot and distributed to all those present. The kuhl's irrigators will make voluntary contributions to cover the cost of the goat. Stories abound of past kohlis with unusual powers, who, during times of great water scarcity were able to bring more water into their kuhls after performing this puja.

There are no caste restrictions on who can fulfill the position of kohli, and it is not uncommon that the kohli will be of a low caste. Although the kohli is rarely a Brahmin, Brahmins, Rajputs and other members of high castes are required to contribute labor for khana and are present at the rituals performed by the kohlis to the kuhl's deity and to Quaja Pir. The anomaly of high caste members present at a puja presided over by a kohli from a low caste helps to strengthen the argument that alone, caste is not an overriding factor in kuhl management. Caste becomes an influential factor when it intersects with land ownership and/or position within a kuhl's command area in a manner that reinforces its inherent inequalities. This is consistent with Parry's (1976;82) analysis of caste in Kangra. Parry suggests that on a continuum from the ideal model of *jajmani* relations, to *quasi-jajmani* relations, to agrarian class relations, to urban wage labor, the role of caste as the basis for organizing relations decreases while the material contributions of each sphere to the local economy increases.[28] Parry concludes by arguing that to

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[27] *Pir* is a muslim saint. *Quaja* is also probably a Persian term and thus helps establish the link between Kangra and the peoples and cultures to the northwest.

[28] *Jajmani* relations are permanent, hereditary exchange relationships between castes in which the "patron" receives services necessary for life crisis rituals from a specialist "client" in exchange for an unsolicited gift. *Quasi-jajmani* relations are more contractual relations between the patron, generally a landowner *(zamindar),* and the client *(kamin),* generally a member of one of the service castes (e.g. blacksmith, carpenter, basketmaker) who in

the extent the material economy of a village is represented in terms of the division of labor between castes, it is misrepresented.

Most of the rituals in kuhl management occur at the level of the individual kuhl. However, due to the lack of a one to one correspondence between kohlis and kuhls, and because many individuals cultivate land irrigated by more than one kuhl, there is considerable variation in the organization of puja. As mentioned above there are three sets of two or more kuhls in the Neugal basin each managed by one kohli. The kohli of each set performs one puja for the whole set, rather than separate pujas for each individual kuhl in the set. Conversely, one privately managed kuhl, Raniya Kuhl, has two kohlis, one for each of the two main branches of the kuhl. Each kohli performs a separate puja for "his" branch of the kuhl. The two kohlis generally perform the puja for their branches of the kuhl on the same day, and always at the same spot - a large boulder that is considered sacred. The irrigators of each branch only participate in the puja done by the kohli of their branch.[29] When an individual cultivates land irrigated by more than one kuhl, then that person may participate only in the puja of the kuhl that irrigates the majority of his land, or if substantial areas are irrigated by each kuhl than he may participate in the puja for both kuhls.

One might expect to see rituals at the head of a watershed, or other central location, which involve members of all the kuhls that share the same riverbasin. The lack of a basin-wide puja may indicate that competition between kuhls for water outweighs cooperation when it comes to bargaining with the gods and goddesses. Or it could imply that the threats posed by water scarcity and flooding selectively discriminate between kuhls and therefore do not provide a common basis for collective action i.e. puja, at the basin level.[30] Or it could reflect the prohibitively high cost of organizing and coordinating a basin wide function involving many people and large distances. Finally, and perhaps most likely, it could be because puja reflects social rather than hydrologic units of organization and there are no basin level social units.

The ritualistic elements of kuhl management that puja embodies strengthen and reproduce the group of irrigators as a community of people. Offering prasaad to the deity and then distributing, sharing and consuming the blessed offering marks all that participate as members of the same community. This notion is reinforced by the fact that while walking home after performing the puja, the kohli will continue to distribute prasaad to all whom he encounters on the way. The symbols, actions, and relationships that kuhl puja encompasses are repeated in daily domestic rituals, at every trip to a shrine or temple, and at all life

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exchange for providing their artisan-type services throughout the year receive a share of the kharif and rabi harvest, or receive payment at the time of service.

[29]This may have been the model for puja that was followed by the other large multi-kohli kuhls that are now managed by the IPH Dept. I was unable to confirm whether or not puja for these kuhls was done by all the kohlis together or by each kohli separately for "his" branch as in Raniya Kuhl.

crisis ceremonies. During life crisis ceremonies members of the household sponsoring the ritual will walk to every household in the same house cluster or tika and distribute prasaad to each household. Each household must be given a small amount of prasaad - to miss a household is not taken lightly and may symbolize the cutting off of social relations or a feud. In this manner the distribution of prasaad identifies the community with which one enjoys reciprocal relations. In an analogous manner when the kohli distributes prasaad to all the irrigators of a common channel or kuhl he is simultaneously marking, making and strengthening community among those individuals.[31] To do this the kohli invokes one of the core principles discussed earlier, the principle of reciprocity, and he links it with the notion of family and clan.

Field Preparation for Kharif

After completing khana for the one or more kujils that irrigate an individual's land holdings, attention is turned to the wheat and potato harvest, the two main rabi crops of the area. Harvesting of both these crops usually takes place from the last week of April through the first week of May. Immediately after the harvest, field preparation for paddy sowing begins.

There are three types of plowing, depending on the land use of the previous growing season and the degree of difficulty of breaking up the soil. Those fields either fallowed or sown to oilseeds during the rabi season are usually dry and hard by May. The plowing of these fields, known as *ghuhar,* is quite difficult, both for the driver and the two bullocks pulling the single furrow wooden plowshare. The large clods left behind after *ghuhar* plowing are broken by women swinging a long handled wooden mallet-like implement known as *bhataan.* The *ghuhar* plowing is followed by another lighter plowing known as jel. Those fields sown to wheat during the rabi season are not so difficult to plow, the plowing of these fields is also called *jel.* After the completion *ofjel,* the *kudal,* a spade-like implement, is used to cultivate the edges of the irregularly shaped terraces that the plow could not reach. The *kudal* is also used to shave off the sides of the terrace bunds to make them smooth and slightly outward sloping thereby maximizing the cultivable area.

The method of paddy sowing employed determines the next stages of field preparation. There are two main methods, *battar* (dry seed sowing), and *mach* (sprouted seed sowing). Transplanting seedlings from a nursery field to the flooded terraces, a practice known as *oor,* is rarely done. The two most

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[30]Water scarcity selectively discriminates between up- and downstream kuhls. Flooding selectively discriminates between those kuhls that lie in the flood's path and those that do not.

[31]Puja no longer occurs in those kuhls now managed by the IPH Department. This contributes toward the common perception that IPH managed kuhls are less rooted in local traditions, less subject to local forms of authority, and that water distribution is more prone to manipulation through strong arm tactics than when the kuhl was privately managed.

frequently stated reasons for not transplanting paddy are labor constraints and the view that output from oor is only marginally higher than from mach.

Mach is always preferred over battar as sowing sprouted seeds gives the seedlings a head start, results in a higher production rate than dry seed sowing (primarily due to increased tillering), and enables an earlier harvest.[32] On kuhl irrigated farms dry seed and sprouted seed paddy sowing yields average 14.7 and 18.1 quintals/hectare respectively for local varieties, and 23.9 and 32.1 quintals/hectare for HYV varieties (Sharma 1990:147). The risk associated with mach is that it requires a constantly flooded field. If after sowing the sprouted seeds, kuhl water is inadequate to keep the field flooded, then the seedlings will die and the dry and hardened soil must be replowed and resown.

The advantage of battar is that it does not require a constant flow of kuhl water. After sowing the dry seeds, they will not sprout until the monsoon rains begin, at which point there is little risk of the fields drying out during the life cycle of the paddy. The advantage of reducing dependence on kuhl water and minimizing the risk of damage to crops from water scarcity that battar provides, comes at the price of a reduced and delayed harvest. The choice of paddy sowing method for a field reflects the farmer's confidence in the availability of kuhl water that season. If the kuhl water supply becomes less certain over time, then a farmer will switch from mach to battar.[33]

Fields to be sown with the mach method will be given one flooding from the kuhl after completion of *jel.* Generally one or two days are required for adequate saturation. The flooded field is then leveled with a horizontal plank drawn by two bullocks and weighted with a large stone and the driver. This leveling implement, like the method of paddy sowing, is known as mach. After leveling, men and women wade through the mud smoothing out any remaining clods, and removing clumps of grass. Throughout this period the water level is maintained about 6 cm deep. The level is controlled by adjusting the depth of the *chanu,* or cut in the terrace bund leading to the next downstream field. In this manner the flow of water from plot to plot is controlled. Depending on local topography, from one to several *chanu* may be cut into the bund of one plot, each leading to separate plots, or to different sections of the same one. When plots

[32] The risk of damage to the ripening crop from autumn and spring hailstorms has implications for the timing of crops, varieties sown and method of sowing. The advantage of mach is that the paddy crop gets a head start several weeks before the rains and therefore can be harvested sooner than paddy sown by battar. This reduces the likelihood of damage by an autumn hailstorm. Varieties of paddy that have a longer growing cycle and whose stalks are easily broken cannot be sown in the mid to upper reaches of the watershed. The risk of damage to them by hail is too great. A early wheat harvest is preferred because it enables early sowing of the paddy crop. Therefore the sooner the wheat can be sowed following the paddy harvest, the less likely the next season's paddy will be damaged by hail.

[33] In Kangra the relationship between mach and battar and water supply was constant enough for Middleton (1919:15) to suggest that the method of paddy seed sowing be used to distinguish between first class cultivated

are fertilized with manure, the farmer dumps the headload of manure under the flow of water from the upstream *chanu.* The moving water facilitates the distribution of organic matter throughout the plot.

Six days before sowing mach, the rice grains to be sown are placed in a burlap sack and submerged in water for three days. The sack is removed from the water after three days, closed tightly to keep out air, and placed in a dark room for three more days. After the flooded field has been leveled, the remaining clods smoothed and the grass clumps removed, the burlap sack in which the paddy seeds were sprouted is brought to the field. The farmer places the sprouted seeds, known as *lung,* in a flat basket and separates them by hand to avoid clumping. With the basket tucked against his waist, he wades through the field. With three to five quick flicks of the wrist per handful, he broadcasts sprays of sprouted seeds throughout the plot. After two to three days the seeds will send out shoots, and the root, sprouted while in the sack, will grow down into the mud. After five to six days the seedlings are two to five centimeters above the water level.

Approximately twenty-one days after sowing, a third type of plowing, known as *hod,* will be done. Weeds, as well as root clumps from the previous wheat crop, grow along with the paddy seedlings in the flooded fields. The rice seedlings are also unevenly distributed, growing in clumps in some areas and not at all in others. The purpose *of hod* is to remove the weeds and sprouted wheat rootstalks, and to thin out the rice seedlings. This is done by lightly running the plow just underneath the layer of water, mud and seedlings. Men and women follow behind, throwing the weeds and wheat stalks onto the terrace bund and distributing the rice seedlings from areas of high density to low. *Hod* is a combination weeding, thinning and transplanting operation.

Once the sprouted seeds have been sown, the paddy yield depends on maintaining adequate levels of water within each plot, further weeding, and fertilizer applications. Farmers are responsible for distributing water to their fields after it passes through the tup from the main channel. Farmers control water flow between plots, and water levels within plots by changing the depth of the *chanu* with the *kudal.* They check the water levels twice a day.

Fields sown using the battar method are not flooded, nor is the hod operation carried out. The fields are plowed as described above, and then leveled with the horizontal plank. But here the dry leveling operation is known as *mai,* as opposed to mach when the field is flooded. After leveling, the dry seeds are broadcast by hand, the field is replowed, and the *mai* operation is repeated. The dry seeds remain dormant in the fields until the monsoon rains begin.

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areas with assured water supply and second class areas with uncertain water supply, and to assess revenue accordingly.

Water Distribution in the Kharif Season

The kohli is responsible for distributing adequate water to each tup. The manner of water distribution varies from kuhl to kuhl. The time of most intensive water use is when the dry fields are first flooded just prior to mach. During the period of initial flooding some form of rotational irrigation is invariably practiced. No kuhl has the capacity to flood its whole command area simultaneously. In some kuhls the pattern of rotational flooding is from downstream to upstream tups, in others it is reversed. In yet others the order is by village and the order is rotated every year so that no village is consistently disadvantaged or advantaged. The de facto order in which fields are initially watered is a function of the rules in use and which fields are ready for flooding, i.e. for which *ghuhar* and jel operations have been completed. If a farmer has not finished plowing before his turn comes up, then he will miss his turn. The kohli will redivert water to his tup only after others have received their turn.

Water stealing is a real threat during this time of intensive water use when farmers are anxious to flood their fields and complete mach operations. Water stealing occurs at the canal head when irrigators from downstream kuhls (usually under cover of darkness and in good numbers) dismantle the danga and block the water flowing into upstream kuhls, thereby increasing the flow of water into their kuhl. It also occurs along the main channel when farmers divert water into their tups out of turn, when a farmer with no rights to a kuhl's water makes a break in the channel to take water to his fields, and when the main channels of two kuhls are adjacent to each other for a stretch and the irrigators from the downstream kuhl surreptitiously divert water from the upstream kuhl into theirs.

Organized guarding against water stealing is called *honda.* Responsibility for doing *honda* shifts between the collectivity, the individual irrigator, and the kohli. During the period of rotational flooding it is the responsibility of the person whose fields are flooded to do *honda.* This presents the difficult situation of the farmer having to protect his share of water from illicit upstream use and needing to control and direct the flow of water from plot to plot. A common solution to the problem of needing to be two places at once is to create an informal arrangement with an adjacent farmer such that each will do *honda* for the other.

During this period the kohli also makes frequent trips to the canal head, usually with an assistant or two, to prevent illicit water use and to make small repairs where leaks appear. If an illegal diversion has been made, it will be blocked and the person benefiting from the diverted water may be reported to the kuhl committee. If the kohli catches someone in the act of stealing water, they will be at least loudly chastised on the spot, and possibly allotted less water when their turn comes up. If the culprits are stealing water to divert into another kuhl, there are many possible outcomes, partially depending on the strength of the two parties. In most cases the culprits retreat quickly, hastened by threats and blows of the bamboo stave that

everyone doing *honda* carries. Other times the offender may be thrown into the main channel. If the conflict is a recurring one, the kohli may ask the kuhl committee to resolve it. If the conflict cannot be resolved at the local level, then a case may be lodged with the sub-district judiciary.[34]

Once the initial flooding of the fields and sowing of mach has been accomplished, the pattern of water distribution shifts from rotational to continuous flow to each of the main channels, secondary channels and tups in the kuhl. The rule used to allocate water is area based and does not vary by kuhl, by position in kuhl or by soil type. It is constant across all conditions. For every four kanals (.16 ha.) of land, one finger of continuous flowing water is allotted (one finger of water is a stream of water one finger wide and two fingers deep).[35]

The kohli knows how many fingers of water should be allotted to each division within the kuhl, whether between two main channels, a main and a secondary channel, or a secondary channel and a tup. This knowledge is based on the area irrigated downstream of each fork. Although the records of the patwari (village revenue department officer) contain this information, the kohli rarely consults them. He knows by memory the number of fingers of water each channel is entitled to. Walking the length of kuhl, the kohli is able to rattle off the name and water duty of every tup and channel within the whole kuhl. Precise measurement of water flow, however, is time consuming and costly. Measuring devices are installed and measurements taken only when the total volume of water flowing in the kuhl from the canal head approaches the minimum required to fulfill downstream allocation quotas. If the danga can be kept in good repair, leakage minimized, and illicit water use effectively guarded against, then more often than not precise water measurements are not necessary. Under such conditions the kohli controls water flow to each branch by placing stones known as *chakotli* at the point of division, and packing them with *cheb*, the soil and grass mixture used for plugging leaks. In some cases, where main channels divide, concrete structures have replaced the *chakotli* and *cheb* method of distributing water to the two branches.

If, prior to the onset of the monsoon rains, the water flow in Neugal Khad and others draining the Dhaula Dhar range diminishes to the extent that scarcity threatens, then the kohli may decide to install the measuring devices known as *thellu* or *bandu*.[36] Thellu are installed at every division point within the kuhl.

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[34] This is since the beginning of the British period. Prior to that the highest arena for resolving a dispute was to take it before the raja.

[35] The finger is the smallest unit of measure for water. The kohli also measures flow using the following cross-sectional areas; 1) *bilroo* - the mouth of an earthen vessel used to carry and store water, 2) *gala* - the space created by touching the thumbs and forefingers of both hands, 3) *seer* - the space created by touching the thumb and forefinger of one hand, 4) *nakhod* = two *galas* and, 5) *nala* = four *nakhods*.

[36] The *thellu* consists of a piece of bamboo placed horizontally at the bottom of the channel whose flow is to be regulated. Two notches are cut into the top side of the bamboo. The distance between the notches is the number of fingers to be allotted to that channel. Vertical uprights are jammed into each notch. Stones and *cheb* are packed

Smaller kuhls require from between twenty to thirty thellu and larger kuhls need three or four hundred. One or two local carpenters, *tarkhan*, are called to construct the thellu. The installation of all the thellu requires from one to three days. The kohli, the tarkhan, and the farmers who receive water from the branch being regulated are present at the placement of each thellu. A kuhl is never partially regulated: either the flow through every tup is regulated or no tup is regulated. The tarkhan, in exchange for constructing the thellu for all the division points within a kuhl, is absolved of his responsibilities for doing khana. In some cases he also receives payment on a per thellu basis.

After overseeing the placement of all the thellu, the kohli walks the length of the kuhl every day or two to check the their placement, to guard against water thieving, and to repair breaks in the channel banks and danga. Farmers, under cover of darkness, sometimes dig underneath the bamboo horizontal of the thellu. This increases their water supply by allowing water to flow both under the bamboo piece, as well as between the two uprights. To the casual observer such illicit water use is difficult to spot, even in daylight. The kohli must therefore examine each thellu carefully and regularly to prevent water stealing, and to ensure adequate water delivery at each diversion point.

Dol is a special form of water allocation in which all, or most of, the water in a kuhl is allocated to one village for a predetermined number of days and nights. In some cases dol begins on a set date each year. In others, the village with dol rights requests the kohli of the concerned kuhl to start their dol on a day of their choosing. A village with dol rights has no legitimate claims on the water of that kuhl other than for the number of specified days. Neither is it responsible for helping do khana or kuhl repair work. Members of the village are, however, responsible for water guarding on the days they receive water. The purpose of receiving a large amount of water for a short period of time is to carry out the operation known as *sag battar*, the flooding of dry land in preparation for plowing and dry seed sowing.

The period when reliance on kuhl water is greatest is from paddy sowing until the onset of the monsoon rains. During this time kuhls provide the only source of water for irrigation. Once the rains begin in late June or July, reliance on kuhl water diminishes in areas through which annual streams flow. Water from these nearby rainfed streams is diverted into the kuhl's channel, thus obviating the need to repair and maintain the danga and upstream sections of the kuhl. Command areas that do not constitute micro-watersheds for annual streams, rely on kuhl water from the canal head throughout the paddy season. Each time the river reaches flood stage the danga and sometimes the upstream portion of the kuhl, is damaged. In some seasons the danga must be rebuilt as many as four or five times. Depending on the

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on the bank side of each upright, as well as underneath the horizontal bamboo, thereby restricting water flow to between the two uprights.

severity of the damage, the kohli either repairs it with the help of a few fanners from the upstream sections of the kuhl, or calls for help from each household in much the same way labor is mobilized for khana.

Depending on weather and the variety, paddy is harvested from three and one half to four months after sowing. The kohli receives payment at the time of harvest at the rate of one *thimbi* of paddy for every four kanals of land under paddy cultivation.[37] Previously the kohli received one *thimbi* of paddy for every six kanals of land under paddy cultivation.

Rabi Season Crops and Water Distribution

The paddy harvest extends from October through the beginning of November. Immediately . following the paddy harvest and threshing, field preparation for the rabi season begins. The primary rabi crops are wheat and oilseeds. In the upper and mid reaches of the watershed, potatoes are also cultivated. Oilseeds are sown hi the fields with the ripening paddy crop. At the time of the paddy harvest the seeds are just beginning to germinate. Field preparation for wheat is similar to paddy. After plowing, the remaining clods are broken by hand, and the field leveled with the *mai* drawn by two bullocks. The wheat seed is sown by hand in the same way as dry seed paddy sowing. Wheat seed sowing takes place from mid-November through early December. Potatoes, a relatively recent crop, are sown in December and early January.[38]

Demand for kuhl water during the rabi season is much less than for the kharif season. The primary reason is that no rabi crop requires continuous standing water at any point in its growth cycle. A secondary reason is that the winter rains from December through early March are usually sufficient to maintain adequate soil moisture levels. Kuhl water is used to flood the fields once, after the kharif harvest and before rabi season field preparation, in order to make plowing easier. Following rabi crop sowing, kuhl water may be used to provide intermittent irrigation if the winter rains are late or if a dry period of three or four weeks results in inadequate soil moisture. Wheat and oilseeds often receive no kuhl water throughout their growth cycle. However, potatoes are usually irrigated three times by channeling water down the deep longitudinal furrow, from where it flows into the shallower furrows between the rows of potato plants.

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[37] A *thimbi* is a local measure, previously made of a hollowed piece of wood, now metal, that holds approximately two kilograms of threshed, unhusked rice. Traditionally, harvest time is also when members of the other service and artisan castes such as the carpenter *(tarkhan),* blacksmith *(lohar),* potter *(kumhar),* and basket maker *(dhoumna)* received payment in kind for rendering their services during the previous agricultural season. Except for the kohli, in many villages the system of payment in kind at harvest time has been replaced by cash payments made at the time of service.

[38] Field preparation for potato sowing entails plowing, breaking remaining clods, removing the kharif crop residue, leveling, and furrowing. A long furrow (12" deep) is dug through the middle of the longitudinal axis of the field.

Kuhl management during the rabi season is, predictably, less formalized than during the kharif season. In many, but not all, kuhls, khana will be done to remove the grass, sediment and other debris that accumulated during the kharif season. If water flow is adequate without doing khana, then no khana will be done until the following spring. The autumn khana is generally not as intensive and thorough as the spring khana. Nor is every household required to contribute labor, rather, labor is mobilized on a voluntary basis with those expecting to sow potatoes contributing the most. In some cases an annual stream bisecting the kuhl's channel downstream of the danga has enough water flow to meet the water requirements for rabi crop irrigation. In such cases autumn khana will be done as far as the annual stream.

Because of the low demand for kuhl water during the rabi season, the kohli's responsibilities are less than for the kharif season. If khana is to be done, then the kohli is responsible for organizing labor and overseeing the work. If an unusually severe winter storm damages the kuhl's danga, then the kohli is responsible for mobilizing labor for its repair. When farmers require water for a one-time irrigation prior to plowing, they ask the kohli to direct water through the main channel to their tup. The kohli also is responsible for directing water as and when required for the potato crop. Because there is no need of continuous flow irrigation during the rabi season, water measurement devices are never used. Water guarding is generally not practiced at this time. Farmers may walk the length of the kuhl when receiving water for pre-plowing irrigation. But this is more to check for leakages and breaks in the channel than to prevent water theft. Also, due to the low demand for kuhl water during this season, conflicts over water are rare. This further lightens the kohli's burden of duties. At rabi harvest time the kohli receives half of what he receives at the kharif harvest. Prior to the rabi crop harvest, the kohli assesses the amount of work that will be required for khana for the upcoming kharif season and organizes khana as described above. This completes the annual cycle of water management activities.

Conclusion

Recurring environmental shocks and dramatic changes characterize the context of kuhl irrigation in Kangra more than narratives of stability within traditional village India. In addition to the ecological shocks of floods, drought, and earthquakes, a variety of other changes affect kuhl regimes. Since 1850 the extensive land transfers, shifts in average landholding sizes and expansion of irrigated agriculture resulted in increased investment and expansion of kuhl irrigation networks. More Recently, the declining cultivated area, increasing population and expansion of nonfarm employment have severely stressed kuhl regimes. These trends suggest the dynamic interplay between social, political, and economic forces that characterize the context of kuhl irrigation. Throughout its history Kangra has experienced fundamental changes which

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Shallow furrows (6" deep, 18" apart) are dug at right angles to it as far as the field bund. The seed potatoes are

belie notions of village stability and continuity. For example, the Gurkha invasion of 1805 brought chaos to the district. During their four year occupation most of the population of Kangra fled elsewhere, fields were abandoned and the kuhls fell into disrepair. Yet following the Gurkha retreat most of the population returned; cultivation and irrigation resumed. The core organizing principles of reciprocity, hierarchy and duty help to account for the persistence of kuhls despite the social, political and economic transformations that have occurred. The incorporation of core cultural practices and relations promotes regime persistence by increasing its degree of institutionalization. The institution of the kohli incorporates several core relations. And kuhl puja helps to create community. This provides the basis from which to expand the analysis of regime persistence to include horizontal relations between kuhl regimes and vertical relations between kuhl regimes and state organizations, to interpret the effects of increasing nonfarm employment on regime management, and to analyze the different trajectories that regime formalization has taken and the impacts of formalization on regime persistence.

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planted in the raised rows between the shallow furrows.

Chapter Four

Kuhls and the State: A Historical Overview

The role of the state in common property resource management regimes is often viewed as one of defining and legitimating a particular set of property rights. The structure of state-supported property rights establishes the basic framework within which common property resources are managed. This implies that the role of the state is limited to a rather passive context setting function. If and when the state is considered as a more active player, it is generally because of policies promoting the privatization of hitherto commonly owned and managed resources, or attempts to assert direct state control over the resource. The dominant perspective regarding the role of the state in common property resource management is that it either provides the necessary "neutral" political space for communities to manage resources collectively, or it undermines the viability of that space through actively promoting privatization of the resource or asserting state control over it (Pinkerton 1990).

I would like to push this conceptualization of the state a little further by suggesting that the legitimization of a particular regime of common property rights is itself an active process. Rather than passively legitimating communal tenure, state support reinforces a constellation of power relations at the local level, thus helping to forge specific types of communities. As I demonstrate below, the state, through various policy interventions such as the assessment of land revenue and the mechanisms for collecting it, can strongly influence, even create, village communities that did not previously exist. Furthermore, the state may actively intervene in the process of determining the nature of the communal rights to a resource, including the specification of who possesses rights of access and under what conditions. In greater Punjab, including Kangra, this occurred during the colonial settlements of the late nineteenth century when rights of access and use of common lands were restricted to revenue paying landowners, thus weakening the entitlements of non-landowning groups to these resources. In this case, because of the linkage between ownership of private cultivated land and access to common uncultivated land, the colonial state strongly influenced the nature of rights in common land resources.

State involvement in common property resource management regimes not only affects local power relations and systems of property rights, it also contributes to the project of statemaking as described in Chapter Two. Drawing again on the example of greater Punjab, state interventions that consolidated access to resources and power among landowning elites helped to strengthen the colonial state in a number of ways. Alliances between dominant clans, castes, and lineages and the colonial administration, fostered the political support of powerful groups for the colonial state. Granting authority to the "community" of

landowners to expand cultivation into previously unenclosed common lands encouraged dramatic increases in cultivated area in the Punjab during the latter decades of the 19th century. This concomitantly increased the revenue the administration received in areas where variable settlements had been implemented.

The notions of negotiation and exchange, often used to describe the basis of political authority in precolonial India, may also be used to illuminate a key dynamic that may obtain between the state and local communities with regards to common property resources. Within this formulation the state legitimates or helps to create a particular constellation of rights which specifies which groups are entitled to use the resource and under what conditions, while in return the state itself is accorded legitimacy by the local communities benefiting from those rights. The nature of this negotiation can vary dramatically. It can be cooperative or mutually beneficial such as the nineteenth century efforts in Punjab to create canal colonies by distributing newly irrigated land to dominant clans and lineages thereby bolstering support for the colonial regime and strengthening local social power.[1] And it can be contestatory or antagonistic as in the case of state efforts to reserve forest resources for their own use in the face of competing claims from local groups.[2] Describing the relationship between the state and local groups in terms of exchange and negotiation avoids the pitfall of reifying the state/local dichotomy. It forces investigation into which local groups and which branches, departments, or agencies within the state are actually engaged in the negotiation and exchange process. Thus, in one plausible but contemporary hypothetical village in Kangra, dominant landowners may negotiate favorable forest access and use rights with the local range officer, disenfranchised non-landowning groups might continue to illicitly gather timber and nontimber products, local Gaddi shepherd groups may seek the support of the Revenue Department and their elected representatives in the state legislature to defend their grazing rights against competing Forest Department claims, and all the residents of the village might benefit from grants from the Block Development or District Commissioner's office for the repair and maintenance of a storm or earthquake-damaged kuhl. This hypothetical scenario, based on the notion of strategic exchange and negotiation, provides a more nuanced and analytically complex framework in which rigid state/society dichotomies quickly dissolve.

Thus, kuhl regimes are sites for the production of symbolic political benefits as well as material economic benefits. Aquisition of these benefits has motivated supra-local pre-colonial and colonial political

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[1] Alliances between elements within the state and dominant social groups that may be mutually beneficial often work to the detriment of other social groups, as in the case of the nomadic graziers whom the canal colonies displaced. In some instances groups displaced by one set of policies may seek redress through strategic alliances with other elements within the state, as Saberwal (1999) documents with regards to Gaddi-Revenue Department alliances in Kangra.

[2] When the state chooses to exercise its monopoly over the legitimate use of force against local communities and groups, the metaphor of negotiation fails and the situation becomes analogous to what Peluso (1993) has called "coercive conservation."

entities to sponsor the construction of some kuhl irrigations systems, and provides the basis for the various forms of state involvement in kuhl management discussed below. The exact nature of this involvement, and the various forms it has assumed over time, varies with the basis of state authority, changing systems of property rights, the broader policy context especially with regards to colonial agricultural expansion and forest conservation policy agendas, and beginning with the colonial period, rivalries between different governmental departments, e.g. the revenue and forest departments. Throughout this period kuhls remained local systems, not owned or the property of supra-local authorities. However, while primarily locally managed and maintained, almost all kuhl irrigation systems articulate with the state in some way. This articulation simultaneously contributes towards the creation and reification of the village "community" and the strengthening and legitimacy of state structures of authority.

The primary purposes of this chapter are first, to provide basis for the argument that the model of negotiation and exchange to characterize state/local relations has relevance within the context of common property resource management regimes (thus "bringing the state back in" to the study of common property), secondly, to demonstrate, within the context of kuhl regimes, the various factors which influence the nature and effects of that negotiated relationship, and thirdly, to demonstrate how state involvement in kuhl regimes has contributed to their persistence. In order to achieve these purposes I briefly review the pre-colonial history of Kangra and then discuss the various roles the pre-colonial state played with regards to kuhl regimes. I then examine the colonial state, in terms of both changes and continuities relative to the precolonial period. In order to illuminate these processes, I situate the colonial state's involvement in kuhl regimes within the broader context of the settlement process and agricultural and forestry policies. I reserve discussion of the post-colonial state's involvement in kuhl regimes for the following chapter.

The Pre-colonial Period

A brief discussion of the pre-colonial political history of Kangra is useful for several reasons. First, it establishes negotiation and exchange as one of the dominant "technologies of power" (Ludden 1999:77) for establishing and maintaining territorial political authority in Kangra. Early state regimes in Kangra conformed to Ludden's definition of medieval kingdoms as "networks of transactions rather than bureaucratic institutions", the latter being more characteristic of state regimes in Kangra just prior to the onset of colonial rule in 1846. In his discussion of medieval kingship Ludden notes that "a donation to Brahmans, monasteries, monks, or temples represented an investment in agrarian territoriality" (1999:80). In like manner, in Kangra the idiom of exchange as the basis for political authority included state sponsorship of the largest kuhl systems in the Neugal basin. Second, this review shows that whether through hill Rajputs fighting in Central Asia or Katoch rulers paying tribute to Mughal rulers in Delhi,

Kangra, far from being an isolated mountain valley, was intimately engaged with broad regional political processes and events. This engagement constituted an important vehicle through which ideas about political authority, hierarchy, and duty (dharma) arrived in Kangra, took root, and filtered through village institutions including kuhl regimes. This engagement also contributed to the pattern of periodic migration, primarily during the non-agricultural season, of upper caste men to join the ranks of the armies on the plains of south and central Asia. The mobility of segments of Kangra's population established what was to become a hallmark characteristic of life in Kangra - seasonal migration out of Kangra. Its current form, that is, migration for nonfarm employment, has severely challenged the ability of kuhl regimes to maintain their integrity. Thirdly, this review establishes that there has been a long tradition of extra-local political involvement in the kuhls of Kangra, and that while kuhls have been and still are, primarily local systems, their articulation with extra-local political regimes is an important part of the explanatory tapestry that accounts for their persistence.

Negotiating Political Autonomy by the Katoch Rulers

Prior to the emergence of the Rajput-ruled hill kingdoms during the first millennium A.D., local rulers known as Ranas or Thakurs functioned as small independent chieftains (Hutchison and Vogel 1933:13). Their origins are difficult to identify, but they probably displaced earlier Buddhist settlements that can be dated back to the 2nd century A.D.. Hutchison and Vogel note that both "Rana" and "Thakur" are titles used by many of the ruling families of Rajputana, thus signaling an early connection with present day Rajasthan. That the founders of the hill states who reduced the Ranas and Thakurs to tributaries came either directly from the plains, or from families which trace their origins to the plains, is indicative of the cultural and political linkages between the Western Himalayan hill states and the Indo-gangetic plains to the south.[3]

Very little is known about the pre-history of Kangra State and the origins of the ruling Katoch lineage.[4] However, the wide dispersion of the Katoch lineage throughout the hills, the numerous smaller independent states founded by its offshoots, references to the "Katooch mountain Kings" by chroniclers accompanying Alexander the Great to the region, and the descriptions of Trigarta (an early appelation for Kangra) provided by the Chinese pilgrim Hiuen Tsiang in the fifth century, all attest to the lineage's

[3]Wolpert (1982:108) notes that the major Rajput dynasties themselves originated in Central Asia.

[4]According to local legend, the first Raja of the Katoch lineage, Bhum Chand, sprang from the perspiration of the goddess in the temple at Kangra. Two-hundred and thirty-four generations later, his descendent Susarma-Chand, fought on the side of the Kauravas in the great war of the Mahabharata. Tracing dynastic lineages back to their mythological origins is another "technology of power" used to legitimate political authority which developed during the 6th and 7th centuries in south Asia (Ludden 1999:77)

antiquity.[5] Based on analysis of genealogical records Hutchison and Vogel (1933:104) argue that the dynasty the ruling Katoch Rajputs established was among the oldest in India.

The Katoch Rajas ruled Kangra State as independent sovereigns for at least six hundred years prior to the Muslim conquests of the eleventh century. In 1008 A.D. the rulers of Kangra and the neighboring hill state Chamba, joined forces with Raja Anand Pal Shahi of Kabul against Mahmud of Ghazni in present day Afghanistan (Charak 1978:138). Mahmud of Ghazni, the first of a series of Turko-Afghan Muslims to invade North India, defeated Anand Pal and went on to take the fort at Kangra in 1009.[6] This early military alliance between Kangra and Kabul suggests some of the political and economic interests that have linked Kangra with much wider regional political entities for centuries.[7] These linkages have served as important conduits for the diffusion of technologies such as irrigation from central Asia to the western Himalaya, as well as technologies of power, e.g. the gifting of entitlements in exchange for political legitimacy. They also indicate the long history of out migration from Kangra for military service. These patterns of mobility continued through the colonial period and more recently expanded to include migration for employment as well as military service.

From 1009 to the dissolution of the Mughal empire in the mid-seventeenth century the Katoch Rajas negotiated with the Mughal regime for maximum political autonomy. At various times they ruled independently of Delhi, swore their allegiance to the various Islamic dynasties that ruled from Delhi, and engaged in armed guerrilla resistance against them. The remoteness and inaccessibility of the hill states from the centers of Islamic rule in Delhi and Kabul helped ensure their relative autonomy during this period. Barnes writes that during this time, the hill rajas "enjoyed a considerable share of power, and ruled unmolested...they built forts, made war upon each other, and Wielded the functions of petty sovereigns" (Barnes 1855:9). Some hill rajas raised their own Rajput armies and fought for the empire in far flung

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[5]The principalities of Jaswan, Guler, Siba and Datarpur were founded by members of the Katoch lineage. Two separate Rajput clans to the west and southeast of the old Kangra State also claim descent from the Katoch lineage (Hutchison and Vogel, 1933).

[6]Upon his return to Ghazni, Mahmud displayed the vast amounts of gold, silver and precious gems he had taken from the fort and the nearby devi temple. Because it is doubtful that the Rajas of Kangra could have accumulated such vast wealth, Cunningham and other historians have argued that the Hindu Rajas of Kabul had stored much of their wealth in Kangra for safekeeping, including their genealogical tree. This is corroborated by the fact that Anand Pal Shahi of Kabul had organized a confederacy of his vassals and fellow rulers to protect Peshawar and his trans-Indus dominions against the Muslim invaders. The hill Rajas of Kangra and neighboring states were part of this confederacy and had left their own states unprotected while serving with Anand Pal Shahi. This explains the relative ease with which Mahmud of Gazni was able to capture Kangra Fort and install a garrison there (Hutchison and Vogel 1933:115-120).

[7]Trade between Kabul and Kangra continued throughout the period of British rule. Kangra green tea, introduced by the British, was prized in Kabul through the middle of the twentieth century.

provinces, hi return for their services the Muslim rulers appointed them to positions of authority within the Mughal regime and gave them rent free estates (jagirs).

The garrison Mahmud of Ghazni left at Kangra Fort remained there only 34 years. Afterwards, the Katoch Rajas ruled as independent sovereigns for three hundred years until 1365 when Sultan Firuz Tughluq, who occupied the throne in Delhi, laid siege to Kangra Fort. The siege ended with the surrender of Raja Rup Chand after which the Kangra Rajas paid a nominal tribute to Delhi. Preoccupation with competing claims to the throne following Firuz Tughluq's death in 1388 and subsequent internal conflicts, meant that Kangra and the other hill states were only nominal tributaries until Akbar solidified Mughal control over them in the mid-sixteenth century. In the early 16th century Akbar annexed the whole of Kangra State and attempted, unsuccessfully, to secure control of Kangra Fort. His famous revenue minister, the Hindu Raja Todar Mai, was deputed to oversee the annexation of the hill state. He left only Rajgir Taluka (district subdivision), adjacent to present day Palampur Tehsil, as a jagir to support the Katoch Raja and annexed most of the rest of Kangra and portions of neighboring hill states. Upon returning to Delhi, Todar Mai reportedly told Akbar that he had "cut off the meat and left the bones", referring to the productivity of the lands over which he asserted Mughal control and those given to the Katoch Raja as a jagir (Kangra District Gazetteer 1926:61).[8] The Mughals did not capture and establish a garrison at Kangra Fort until 1620 during the reign of Jehangir (Hutchison and Vogel 1933:146).

After forty years of guerrilla resistance against the Mughal regime, waged from the protective heights of the Dhaula Dhar range, the deposed Katoch rulers reconciled themselves to their status as subordinate tributaries and abandoned armed resistance. For the next one-hundred and thirty years the Katoch Rajas paid tribute to the Mughal rulers. The reign of Raja Ghumand Chand (1751-1774) marked the ascendancy of Katoch rule. In the mid-eighteenth century the Mughal empire was preoccupied with suppressing Marathi attacks from the south and Sikh revolts in the Punjab. Raja Ghumand Chand took this opportunity to wrest control of many of the former territories of Kangra State from the Mughal Governor (Saif Ali Khan) installed in the Kangra Fort. He also founded Sujanpur, at the confluence of the Neugal and the Beas River, which became the seat of Katoch power. As an assertion of the growing ascendency of Katoch political power, Ghumand Chand's Rani sponsored the construction of a twelve mile long kuhl known as Raniya Kuhl. Although subsequently destroyed by a flood, its repair was later sponsored by a Rani of Sansar Chand who linked the kuhl's repair to religious patronage.

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[8] Akbar's interest in Kangra was stimulated by the unusual things for which it was famous. These included: 1) the manufacture of new noses, 2) the treatment of eye diseases, 3) basmati rice, and 4) the strong fort. New noses were in demand as it was not an uncommon punishment for criminals, especially those accused of sexual offenses, to

The Katoch dynasty reached its zenith under the rule of Raja Sansar Chand who reigned from 1775 until his death in 1823. Raja Sansar Chand consolidated Katoch control over the former territory of Kangra State and in 1787 he gained control of Kangra Fort. He then launched a series of expansionist campaigns and subjugated many neighboring hill states.[9] Sansar Chand encouraged the arts, and his court, established on the banks of the Beas River, first at Nadoun and later Tira-Sujanpur, attracted skilled artisans, story-tellers and performers. Under Sansar Chand's patronage the famous school of Kangra Painting flourished. He constructed many magnificent royal buildings and temples which still stand today. Sansar Chand also embarked upon an impressive project of sponsoring the construction of some of the longest kuhls in Kangra Valley. His sponsorship of kuhls, like his support and contributions to temples typified the "investment(s) in agrarian territoriality" which Ludden (1999: 80) argues characterizes pre-colonial kingship. These investments, along with state patronage of the arts, served to simultaneously mark and strengthen the legitimacy of Katoch rule.

The political autonomy of the Katoch rule lasted until the Gurkha invasion of Kangra in 1805. The neighboring hill states that Sansar Chand had subjugated, created a confederacy with the Gurkha commander Amar Singh Thapa. These hill states promised to assist the Gurkha leader against Sansar Chand in exchange for restoring their independence. During the four year Gurkha occupation of Kangra, anarchy reigned throughout the region. A large portion of the local population fled to neighboring states.[10] During this period many of the kuhl irrigation systems were abandoned and fell into disrepair. Most were subsequently repaired. Barnes (n.d.: 110) describes the reconstruction in the early 1850s of one such kuhl, noting that "the people of their own free will... re-excavated the line at their own cost" and were able to bring irrigation water once again to villages twelve miles from the kuhl's headworks.

Sansar Chand, from his refuge in the besieged Kangra Fort, was forced to seek military assistance from Ranjit Singh in order to oust the Gurkhas. Ranjit Singh, concerned that Gurkha aspirations to control the western Himalaya as far as Kashmir could threaten his sovereignty in Punjab, promised to assist Sansar Chand in expelling the Gurkhas, but only on condition that Sansar Chand relinquish control of the Kangra Fort to him (K.S. 232, Hutchison and Vogel 1933:186). Knowing that giving up the fort to the Sikh leader

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have their nose cut off. The practice continued into British rule and at least one early European traveller in Kangra described the technique (Hutchison and Vogel 1933:148, District Gazetteer 1926:61).

[9]There are twenty-two arched doorways leading into the great audience hall he constructed at Tira-Sujanpur. Each doorway was said to be assigned to one of the conquered hill chiefs (Hutchison and Vogel 1933).

[10] Describing the conditions that prevailed during the Gurkha occupation of Kangra Barnes notes that "in the fertile valleys of Kangra not a blade of cultivation was to be seen; grasses grew up in the towns, and tigresses whelped in the streets of Nadoun" (Barnes 1855:10). In 1820, eleven years after the end of the Gurkha occupation, the English traveller Moorcroft, passing through the once bustling commercial center of Nadoun, observed that

represented at least a symbolic loss of Katoch political autononmy, Sansar Chand only reluctantly agreed to this condition. However he had no other choice as neither his appeal to the British for help nor his attempt to negotiate a settlement with the Gurkha leader Amar Singh were successful. Therefore with the help of Ranjit Singh in 18Q9 the Gurkhas were defeated and forced to retreat back across the Sutlej River. Ranjit Singh received possession of Kangra Fort and the revenue from the 66 villages that had been attached with the fort during the Mughal period. Ranjit Singh appointed Desa Singh Majithia to be Subedar of the hill areas and Pahar Singh Man governor of Kangra (K.S. 233). Between 1811 and 1825 Ranjit Singh expanded the hill area under his control by reducing the other hill states of Haripur, Nurpur, Jaswan, Dutarpur, and Kutlehr to the status of his tributaries (Barnes 1855:11-12). In most cases the ruling Rajput lineage of each state was granted a jagir by Ranjit Singh. Usually the jagir would be large enough that the revenue it generated supported the ruling lineage, but was not large enough to enable the, Katoch or other Rajput ruler to assemble an army large enough to threaten Sikh supremacy. This illustrates the ways in which "gifts", in this case of revenue, could be used as a subtle means to placate, gain the support of, and control, potential political adversaries.

Sansar Chand, who retired to Alampur by the Beas River after the Sikhs gained control of the Kangra Fort, was compelled to go to Lahore annually to pay tribute to Maharajah Ranjit Singh.[11] Following Sansar Chand's death in 1823, his son Anrudh Chand travelled to Adinanagar to pay Ranjit Singh an investiture fee and for confirmation of his ruling authority. In 1827 in order to avoid an unacceptable demand by Ranjit Singh that he give his two sisters in marriage to Hira Singh, the son of the Governor of Jammu who was not a hereditary ruler and therefore of lower social status than the Katoch Rajas, Anrudh Chand and his immediate family secretly fled to neighboring Tehri Garhwal in Uttar Pradesh which was under British control.

The departure of the Katoch Raja provided Ranjit Singh opportunity to assert Sikh control of Kangra State to an unprecedented degree. Ranjit Singh granted a large jagir to Sansar Chand's younger brother Fateh Chand who had not left the country and is said to have set favorable terms for remitting the revenue from the rest of the state to the Sikh leader. However Fateh Chand died almost immediately and when his son, Ludar Chand, failed to pay the amount demanded in the lease, the leased portion of the state

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although the local population had begun to return, "the bazaar which was formally crowded by bustling traders, is now frequented by only a few fakirs and pilgrims" (1841:78).

[n] In 1820 Moorcroft, during an extended stay with Sansar Chand at Alampur while waiting for permission from Ranjit Singh to continue onwards to Ladakh, notes that "the loss of territory, and falling off of his dependencies, have so much reduced the revenues of Katoch, that... he has but 70,000 rupees a year for the expenses of himself and his family after paying his troops" (1841:130). This suggests the loss of revenue from neighboring hill states once his tributaries and now under Ranjit Singh as well as the loss of control over territories within Kangra State such as the Kangra Fort and neighboring villages.

was granted to two Sikh zamindars who tax farmed Kangra for one and two years respectively (Hutchison and Vogel 1933:194). After this Palam, a fertile taluka in the Kangra Valley, was given as a jagir to Nau Nihal Singh. Nadaun and the surrounding villages were given as a jagir to Jodhbir Chand a younger son of Sansar Chand who also received the title of raja, and the rest of Kangra State was placed under the control of Lehna-Singh Majithia who at his father's death had assumed his father's position as Subedar of all the hill states under Sikh control (Hutchison and Vogel 1933:194-5, Singh 19XX:269, Barnes 1855:12). In 1833, through the intercession of the British Government, Ranjit Singh also gave a jagir worth 50,000 rupees to the two sons of Anrudh Chand who then returned from Teri-Garhwal. Lehna Singh continued as governor of the hill states until the assumption of British control in the region in 1846.

Negotiated pre-colonial exchanges of land and water for political autonomy

The control and exchange of land was one of the most important currencies used during the pre-colonial period to consolidate, strengthen and maintain political power. For a ruler, whether a Katoch Raja, Sikh chieftain, Mughal Emperor or Afghan Durani, the importance and meaning of land derived from its use as a medium of exchange for negotiating sovereign claims to territory and for transforming potential adversaries into political allies.[12] As the preceding narrative demonstrates, rulers made gifts of land to individuals who served the ruler in a military, administrative or other capacity.[13] They gave land to religious institutions such as temples or mosques, to religious leaders, theologians and saints.[14] Land grants were given to potentially rival political groups as a way of securing their support for the ruling regime. The series of land grants made by Ranjit Singh to various members of the ruling Katoch lineage illustrates how land exchange could be used as a means to neutralize a former and potential future adversary.[15] In Kangra at the assumption of British control of the district in 1846 approximately one

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[12]See Neale (1969) for a good discussion of the meaning of land control in pre-colonial India as a source and instrument of political power, in contrast to British conceptualizations of land as an input within an economic system whose internal logic is profit maximization. Further analyses of the political and social functions of land in pre-colonial India are found in Embree (1969), Dirks (1985, 1992) and Cohn (1987).

[13]For example during the reign of Aurangzeb the Raja of Nurpur, in exchange for controlling the frontier outposts of Bameaean and Ghorbund on the western frontier northwest of Kabul, was given an official rank (mansab) and a jagir commensurate in size to the rank (Barnes 1855:9). Habib argues that the governing class within the Mughal Empire were primarily compensated by jagirs of this sort (1963:258). In Kangra this is exemplified by the Chaudharys who in exchange for collecting land revenue in the khalisa lands were given small grants of land known as inams (Lyall 1874:11).

[14]These grants of land were known as imams. The term imam originally referred to religious leaders but later was applied to the lands they were granted. Most imams were fully hereditary. The importance to the legitimacy of the Mughal regime of the support from the religious institutions and class of people given imams was recognized by Jehangir who is reported to have said that they were as important to the Empire as the real army (Habib 1963:310).

[15]This pattern of exchange of land for political support also obtained in cities and urban areas. Describing urban political relations in North India during the decline of the Mughal empire Bayly (1983:125) notes that "regional

quarter of the district had been given as political jagirs, religious grants, and other miscellaneous grants to individuals (Barnes 1855:31-33).[16] As Ludden (1978:7) notes with regards to political authority in southern Tamil Nadu "gifting became the constitutive ritual of kingship". Indeed, in Tamil Nadu Dirks (1992:179) notes that by the 18th century 60-80 percent of all cultivable land had been given away as inams (tax-exempt land). In Kangra, gifting as a means of establishing and maintaining political legitimacy also included state sponsorship of kuhl construction and religious patronage.

When a ruler assigned a jagir to an individual or an inam to a temple or shrine he transferred to that individual or institution only the right to the revenue from the area encompassed within the jagir or inam - the existing array of occupancy, cultivation and other usufruct rights was left untouched.[17] This conforms to the pre-colonial model of property relations based on overlapping sets of interests rather than on exclusive claims of ownership (Embree 1969:47). Habib suggests that in ryotwari areas a "single owner cannot be located" and that instead one finds the allocation of "different rights over the land and its produce, and not one exclusive right of property" (1963:118).[18]

However as Dirks (1992:179) points out, land was only one of many mediums of exchange by which a ruler secured political legitimacy and maintained sovereignty. Dirks suggests that "the king ruled by making gifts, not by administering a land system in which land derived its chief value from the revenue he could systematically extract from it." In addition to gifts of land, rulers in Kangra distributed the hereditary right to cultivate a particular field, the rights held by transhumant Gaddis and Gujars to particular grazing runs, the right to some inherited administrative posts, and the right to operate a water mill or to erect a fish weir. These rights were all called *warisis* and derived from the raja as a separate, taxable tenancy (Barnes 1855:18-19, Lyall 1874:17,4-5, Baden-Powell 1892 2:693-4). The proof of entitlement to a particular warisi was the *patta*, a deed that spelled out the rights and responsibilities that the warisi entailed and the terms by which it could be renewed. Maintaining monopolistic control over the

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rulers ....needed to mollify the suburban gentry by appointing members to local public office (usually to be kazi or kotwal) or by enhancing their grants of revenue-free land.

[16] Although I use here the system of classification of land grants used in the first settlement report for Kangra district I am aware of the pitfalls of allowing the language of historical source material to also become the language of analysis that Dirks (1985:128) warns against. Indeed the separate classification of political from religious grants masks the inherently political functions that "'religious" grants also played.

[17] For this reason jagirs especially, and to a lesser extent inams, were classified by the amount of revenue they produced rather than by the extent of cultivated area they contained.

[18] For example interests in, i.e. claims to, the produce of a field are distributed amongst the cultivator, the various village artisans such as the potter, basketmaker, ironsmith, and watermaster who receive a portion of the harvest as compensation for the services they provide, the individual who may hold the hereditary right to cultivate the field but who engaged with another for the fields' actual cultivation, and the individual who claims the right to the revenue from the field whether that be the jagirdar, inamdar, or representative of the state. None of these

power to grant a patta was central to the ruler's sovereignty. Lyall (1874:21) mentions that the rajas "jealously" guarded their monopoly to grant pattas for warisis - "under them (the rajas) no *wazir* or *kardar* (administrative officers) could give a patta of his own authority." To do so would threaten the legitimacy of the ruler. In exchange for granting the entitlements specified in warisis and pattas the ruler would receive the political support of the grantee as well as a share of the benefits the specific entitlement produced. Thus Lyall notes that the "Rajahs received "the best hawk caught in a net, the largest fish caught in a weir, a share of the honey in the bee-hives, and the fruit of the best fruit trees" (Lyall 1874:24).

The regulation of access to cultivated areas through the monopoly over the authority to grant pattas to cultivate land as a mechanism for strengthening state authority is a model that appears to also have applied in the case of forestlands in Kangra. Lyall, in his revision of the original land settlement and possibly seeking legitimacy in history for asserting increased colonial rights in forests in Kangra, notes that pre-colonial rulers claimed all rights to forests and that they recognized two classes of forests. In forests reserved as shooting preserves no grazing or fodder collection was allowed. In other forests individuals could cut timber for roofing or the construction of an agricultural implement, and for marriage and funeral ceremonies (Lyall 1874:19). In forests where grazing was permitted, the ruler sometimes imposed a ban on grazing during the monsoon (Lyall 1874:21). Lyall postulates that in addition to benefiting "trees and game," the imposition of a grazing ban served as an assertion of the ruler's authority, and for Lyall's purposes, provided a legitimizing model of strong state control of forest resources.

The raja's near proprietary claim to cultivated lands also extended to the extensive forests, grazing pastures, grasslands, scrublands, and rivers and streams. All of these resources were the exclusive proprietary domain of the raja. *Bartans*, or customary use rights in the waste, included the right to graze livestock, cut grass and leaves for fodder, remove thorns for hedges, and collect dry wood for fuel (Anderson 1897:19). All individuals, whether cultivators, traders, artisans or shop keepers, had the right to use the waste in this manner. Other usufruct rights - the right to operate a water-mill, to set a net to ensnare game or hawks on a ridgetop, to put a fish-weir in a stream, or the rights of nomadic herders to graze a certain pasture - derived from the raja as a separate, taxable tenancy (Lyall 1874:24).[19]

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individual claimants, including the state, possessed the hallmark of a proprietary right - the right to alienate the field

[19]In addition to payment in kind the raja also received monetary rent on these tenancies. Lyall gives an example of a village's revenue papers which enumerates the taxes that the Gaddi shepherds pay for grazing rights, a Katoch Rajput pays for setting ridgetop falcon nets, and the mill operators pay in return for the right to operate waterpowered mills (1874:29). While this suggests that the raja's proprietary claims to these resources were enforced, the degree of state control over other customary use rights of a more general nature is difficult to determine.

Unlike tenure systems in the plains - where village boundaries invariably included uncultivated areas of common land used for grazing and the locally regulated rights to those resources were a function of residency and land ownership (Kessinger, 1974) - use of the uncultivated lands in Kangra appears to have been more informally regulated and at least nominally at the ruler's discretion. All individuals regardless of whether or not they held rights to cultivated land or were even agriculturists possessed usufructory rights to uncultivated areas for subsistence purposes (Douie 1899:69). These rights included the right to graze livestock, cut grass and leaves for fodder, remove thorns for hedges, and collect dry wood for fuel (Lyall 1874:19). These usufruct rights were generally subordinate to the right of the ruler to grant a patta to an individual to bring a section of the uncultivated area into cultivation. However, Singh (1998: 95) does note that farmers could object to such a grant if it was made to an individual from another village, especially if they had already requested to extend cultivation to that area.

In addition to giving grants of land, pre-colonial rulers in India sponsored the construction of irrigation systems and other public works projects, and patronized temples in order to extend and solidify their domains of authority. Pre-colonial Katoch rulers were no exception; they or their family members sponsored the construction of nineteen of the longest and largest kuhl irrigation systems in Kangra. Table 4.1 shows the major kuhls in the two tehsils that pre-colonial rulers or family members sponsored. Fourteen of the nineteen state sponsored kuhls are named after the raja or rani who built them. By naming the kuhl after themselves a raja or rani ensured that his or her name would endure. Today, in contrast to the rajas who did not sponsor the construction or repair of kuhls, the names of the rajas and ranis who did are familiar to those who reside in the areas through which the kuhls flow.

The construction dates of nine state sponsored kuhls may be ascertained by using historical accounts to determine when the sponsor ruled or lived.[20] All of these kuhls were constructed between 1690 and 1805 (Table 4.2). Seven of the nine dateable kuhls were constructed during the height of Katoch power during the last three decades of the eighteenth century.

[20]Nine state sponsored kuhls are not dateable, in most cases because they were constructed by a rani whose husband's name the Riwaj-i-Abpashi does not give, or by minor rajas not mentioned in the historical record.

Constructed By	Kangra Tehsil	Palampur Tehsil	Total	%
Collectivity of Landholders	332	217	549	77.0
Individual	66	37	103	14.4
Raja/Rani	5	14	19	2.7
British Gov't	1	1	2	0.3
Not Known	5	35	40	5.6
Total	409	304	713	100.0

Table 4.1 Origin of the Major Kuhls in Tehsils Kangra and Palampur, by numbers of kuhls, (Riwaj-i-Abpashi, 1919).

Kuhl Name	When Constructed	# of tikas irrigated	Command Area (ha.)	Length (km)
Dewan Chand Kuhl	1690-1697	24	185	25
Kirpal Chand Kuhl	1690-1697	62	1713	33
Raniya Kuhl	1759-1774	10	545	12
RaiKuhl	1775	28	820	20
Giaruhl Kuhl	1760-1785		—	—
Dadhuhl Kuhl	1775-1805			—
Dai Kuhl	1775-1805	22	357	25
Dei Kuhl	1775-1805	—	—	—
Mian Fateh Chand Kuhl	1775-1805	23	256	20
Sangar Chand Kuhl	---	16	324	26

Table 4.2 Origin Dates of Nine of the Nineteen State Sponsored Kuhls in Tehsils Kangra and Palampur, with indicators of scale for those kuhls within the Neugal basin, (Riwaj-i-Abpashi, 1919, Hutchison and Vogel 1933, Charak 1979, and author's field notes).

The kuhls whose construction pre-colonial rulers sponsored are longer and more complex than those constructed by village landowners. Seven of the nineteen state sponsored kuhls were constructed in

the Neugal basin. The average length of these seven kuhls is 23 kilometers, and they each convey water to an average of 26 different hamlets. By contrast, in the Neugal basin those kuhls constructed by landowners have an average length of 4 kilometers and each irrigates on average 4 tikas. The differences in scale between ruler- and landowner-sponsored kuhls are dramatic. They suggest that the importance of external support for kuhl regime persistence is directly related to the coordination requirements of kuhls and the scales at which they operate. Quite simply, the larger kuhls in Neugal basin may not have been constructed without state support; in most cases the labor mobilization requirements for their construction exceeded local capacities. This is especially true in cases where the downstream portions of ruler-sponsored kuhls convey water to the larh areas of hamlets, which as already noted, are less productive than the harh areas. Because of the relatively low returns to labor investments in larh areas, it is particularly unlikely that local landowners would have chosen to invest the resources necessary for bringing water long distances to irrigate relatively unproductive fields, especially when rainfed maize is a viable non-irrigated crop for larh regions.

What does ruler-sponsored kuhl construction entail? The Riwaj-i-Abpashi states that the sponsors bore the expense of constructing the kuhl. What this actually means probably varies from kuhl to kuhl. At the least, it would entail making the decision to sponsor a kuhl, arranging for the surveying and construction of the kuhl, and providing the materials and labor for these tasks. Raja Dewan Chand provided the funds for constructing Dewan Chand Kuhl, but he contracted the work out to another individual. Similarly, one of Sansar Chand's *wazirs* (official/minister) supervised the construction of Giaruhl Kuhl, with funds provided by Sansar Chand's mother.

The organization of labor for state-sponsored kuhl construction is difficult to determine. The Riwaj-i-Abpashi clearly refers to the monetary outlays required for constructing state-sponsored kuhls as well as kuhls whose construction dominant landowners sponsored. The most significant, if not the only, expense associated with kuhl construction must have been for paying laborers. Whether or not all workers were always compensated for their efforts is an open question whose answer probably partially depends on caste dynamics, the strength of state claims on corvee labor, and whether or not the workers were also those whose land the kuhl would irrigate. All workers were at least given the midday meal, one of the two main meals in Kangra.[21] Circumstantial evidence, based on oral tradition, indicates that corvee labor (begar) was used. The story "Brahmins Don't Do Begar" included in appendix 2, concerns the construction of one

[21]I base this statement on circumstantial evidence. The story of the origin of Saprahl Kuhl states that the individual who sponsored its construction used one quintal (100 kg) of hing to feed the workers. Hing, a local forest product, is used sparingly to flavor dahl. Rural daily wage laborers are generally fed the mid-day meal. This is also done during communal labor exchanges.

of the longest kuhls in Kangra Valley, Kirpal Chand Kuhl, whose construction was sponsored in the 1690s by a Katoch Rajput of that name. The story describes how upper caste Brahmins, were exempted from providing corvee labor for kuhl construction. By implication it suggests that corvee labor was used to construct at least some state-sponsored kuhls. The use of corvee labor for kuhl construction is not corroborated by the settlement records even though they do describe many other aspects of begar, including the purposes it was used for, and who had to do it. This may be due to the fact that the last state sponsored kuhls were built at the beginning of the nineteenth century, fifty years before the first regular settlement took place. Barnes in his "Notes on the System of Irrigation prevailing in the upper valleys of the Kangra District" also refers to the construction of Kirpal Chand Kuhl, specifically the remuneration the laborers received. He notes that Kirpal Chand had sponsored the kuhl's construction because he was childless and desired to undertake a public works project that would perpetuate his name. Barnes mentions that Kirpal Chand was "munificent" in his "liberality to the people employed" because to those who worked on the kuhl he gave "six seers of rice, half a seer of dahl, and the usual condiments", additionally every pregnant woman employed received "an additional half allowance in consideration of the offspring in her womb" (n.d., 111).[22] This description, no doubt based on oral history accounts of events which occurred 150 years earlier, does suggest those employed to construct state sponsored kuhls did receive substantial in-kind payments.

State sponsorship of kuhls was a means, much like land grants, whereby a ruler could strengthen sovereign control over a region, legitimize their rule, and augment the amount of grain received as assessed rent. For example, the kuhl the Rani of Raja Ghumand Chand sponsored after the Raja regained control of the former territories of Kangra in 1752, after 130 years of Mughal rule, could easily be interpreted as a symbolic reassertion of the ruling authority of the Katoch dynasty in contradistinction to Mughal rule. Linkages between state-sponsored kuhls and religious patronage served to further establish the legitimacy of Katoch rule. The same kuhl that Ghumand Chand's Rani sponsored was subsequently destroyed by flooding sometime between 1759 and 1805. A Rani of Raja Sansar Chand offered to sponsor the reconstruction of the kuhl on the condition that the village Saloh, which the kuhl irrigates, agree to remit Rs. 1,400 annually toward the support of the Narbadeshwar temple in Tira-Sujanpur, the seat of Sansar Chand's political power and the center from whence he ruled. This condition was agreed to, the kuhl was reconstructed, and to this day the village remits Rs. 1,400 to the temple in Sujanpur-Tira, despite complaints by the current priest that the amount should have increased over time. Located at the confluence of the Beas and Neugal Rivers, Tira-Sujanpur is 30 kilometers from Saloh and more than 40

[22]One seer = just over two pounds.

kilometers from the kuhl's diversion structure on the Neugal River. Linking state sponsorship of a kuhl with religious institutions in this manner strengthened the basis of Katoch political authority and symbolically underscored the importance of Sujanpur-Tira as the regional center of political power. State-sponsored kuhls also constituted physical manifestations of state political authority distributed broadly across the landscape.

In Kangra political authority based on the exchange of entititlement for support, and patronage of religious institutions, clearly resonates with broader regional models of political authority throughout the subcontinent. These models were conveyed to Kangra and took root there through the on-going political and economic interactions that linked the region with various other state regimes. State investment in kuhl irrigation was a statemaking strategy that served a similar political function as gifts of land (jagirs) and temple patronage.

Sponsoring the construction of a kuhl was an effective way to generate political support because not only cultivators, but artisans, traders, and others benefited from the kuhl. In addition to providing irrigation water, kuhls also used to meet all the water needs of the villages they flowed through. This was especially true during the hot, dry pre-monsoon season when local springs were low or dry. Kuhl water satisfied household water needs as well as the water requirements for livestock and the small domestic gardens found in almost all domestic compounds. *Doumnas* soaked split bamboo and reeds in small pools filled with kuhl water prior to weaving them into baskets. *Kumhars* used kuhl water to turn their pottery making wheels. Most kuhls powered at least one, and as many as twenty, water mills *(graths* used for husking and grinding grain. The Riwaj-i-Abpashi notes that many of the proprietors of the graths were widowed women who supported themselves and their children (if they lived with them) on the in-kind earnings they received for grinding others' grain.

State sponsorship of kuhls provided material in addition to symbolic benefits because the revenue assessed on irrigated land was significantly higher than on unirrigated land. In unirrigated tracts the raja's share varied from one half to a fourth depending on the productivity of the land. Irrigated tracts were usually assessed at one half of the gross produce (Anderson 1897:11). These assessments were complemented by other cesses including an army tax, a war tax, the weighman's cess, the money tester's cess, watchman's cess, a cess to cover the cost of transporting the grain payments to the State granary, and even a tax to cover the costs of writing receipts for the revenue (Lyall 1874:37).

State sponsorship of kuhls did not lead to state ownership or on-going involvement in kuhl management. Management authority for kuhl maintenance and repair, including labor mobilization necessary for those tasks, and water distribution, was the responsibility of the family that held the warisi

(inheritable right) to the position of kohli. The right to be kohli of state-sponsored kuhls was awarded by the ruler to a family or clan which had played an important role in the construction of the kuhl, either by providing a significant amount of labor for constructing the kuhl, supervising its construction, or by making some other noteworthy contribution. While this is consistent with Coward's (1990:81-82) suggestion that for some kuhls the Rajas (or their agents) appointed the kohli and therefore exercised some degree of control over the kuhl's management, it is unclear how much direct management authority the ruler exercised beyond designating which family or clan held the warisi of kohli. In general, the ruler's involvement in kuhl management did not extend beyond awarding the right to be kohli. It is highly unlikely that the state had any involvement, including the appointment of kohlis, in the management of the kuhls whose construction it did not sponsor. In this regard Barnes (1855:23) notes that the kuhls in Kangra "...are managed entirely by the people, without any assistance from the government".

While the precolonial state played important roles in the kuhls whose construction it sponsored, it is important to note the relatively limited scale of involvement of supra-local authorities in irrigation system construction, repair, and maintenance. Out of a total of 713 multi-village kuhls, 694 and all of the more than 2000 intra-village kuhls in Kangra were sponsored by local groups of irrigators or individuals, not supra-local political entities. Additionally, responsibility for the repair and maintenance of all the kuhls in Kangra rested with the irrigators themselves, not supra-local entities. This contrasts significantly with the degree of supra-local involvement in other indigenous forms of irrigation in India such as the tank systems of Tamil Nadu and the irrigation systems of south Bihar. In his study of irrigation in Sivagangai and Ramnad Districts of southern Tamil Nadu Mosse (1997:10) notes that villagers historically never made contributions for major tank repairs; they viewed that as "government work.. .the responsibility and action of political overlords". Similarly, in his study of indigenous irrigation in south Bihar, Sengupta (1980) describes the important roles played by local zamindars, analogous to the political overlords to which Mosse refers, in the construction and maintenance of the local irrigation systems. In both these cases the undermining of the political authority and economic viability of these supra-local authorities during colonial rule resulted in the decline and in some instances, collapse, of these local irrigation systems.[23]

[23] In Bihar the colonial administration replaced the produce rent system with a fixed cash assessment. The prior produce rent system of revenue collection varied with agricultural production. It thus internalized uncertainties in production. It also provided zamindars (often absentee estate owners) incentive to support local irrigation systems because the tax was simultaneously a rent on land and water. The colonial administration's fixed cash assessment was insensitive to annual fluctuations in agricultural productivity; barring a remission of the revenue, it was due regardless of actual production. Furthermore, it eliminated zamindar incentive to support local irrigation systems as the burden of meeting the fixed revenue demand fell on the zamindars tenants. Zamindars consequently withdrew their support for local irrigation. Irrigation systems consequently declined and/or collapsed (Sengupta 1980). In contrast to this, when the revenue was commuted to cash and fixed for twenty years in Kangra, kuhl

The relatively limited role of the state in kuhl irrigation becomes more apparent through a comparison with patterns of state investment in irrigation in Hunza, in the Northern Areas District of present day Pakistan (Sidky 1997). In the valley of Hunza, due to the steep and rugged mountain topography, only the state was able to mobilize adequate resources to construct gravity flow irrigation systems. This occurred during the 18th century when the Mir (ruler) of Hunza embarked on an ambitious campaign of state making. Local communities in Hunza relinquished control over water rights to the Mir. hi exchange, he mobilized the labor and resources necessary for the construction of the irrigation systems. The resulting expansion of irrigated area enabled the Mir to further expand and consolidate his political authority by establishing settlements in the newly irrigated areas and, using a now familiar technology of power, granting tax-free lands to leading families as a way to gain their allegiance. Furthermore, the increased revenue resulting from irrigated agriculture provided the Mir with the resources he used to acquire adjacent territories. Thus in Hunza state investment in irrigation clearly contributed to centralization of authority and state formation. The relationship between state formation and irrigation is particularly strong in Hunza because of the state's monopoly control over the labor and materials necessary for constructing irrigation networks. In Kangra, on the other hand, the state held no such monopoly; individuals and villages were able to mobilize enough resources to construct most of the kuhls. In Kangra the pre-colonial state played a more circumscribed role in irrigation management than it did elsewhere in the subcontinent. As the next section demonstrates, the role of the colonial administration in kuhl management displays both continuities and discontinuities with that of the pre-colonial state.[24]

Colonial rule and kuhls: continuities and disiunctures

In Kangra, Sikh rule continued until the First Sikh War in 1845 when Ranbir Chand with an army of Rajputs, assisted the British in expelling the Sikhs. In return the British granted Ranbir Chand a tract of land and reimbursed him for the expenses incurred in the war." Kangra came under British rule under the treaty of 9th March 1846 in which the Sikhs ceded the hill tracts between the Sutlej and the Beas to the British. In 1848 three hill Rajas, including the Katoch Raja of Kangra, rose against the British in insurrection during the Second Sikh War of 1848-49. Following the violent suppression of the Katoch

construction and irrigated agriculture expanded because farmers retained for themselves the benefits of increased agricultural production. Kuhl regimes, unlike irrigation systems in south Bihar or the tank irrigation systems of Tamil Nadu, were not so dependent on extra-local political support. The absence of zamindari tenure in Kangra, coupled with relatively equal land ownership patterns, accounts for the quite different impacts of commuting in-kind revenue payments to cash that obtained in Bihar and Kangra.

[24] Although various Sikh leaders controlled Kangra District for approximately twenty years prior to British rule, they had relatively little effect on land tenure and kuhl management during this brief interregnum. The Riwaj-i-Abpashi notes that new kuhls were constructed during the period of Sikh rule, however the Sikhs did not alter the

rebellion by British troops, they were imprisoned in Almora, Uttar Pradesh (Barnes 1855:15). This marked the beginning of a century of British rule in Kangra.

The early years of British rale in Kangra were marked both by strong continuities with and disjunctures from pre-colonial administration. The first summary settlement (land registration for the purposes of assigning revenue obligations) was made in 1846, immediately following the forcible annexation of Kangra from the Sikhs. This summary settlement was only a slightly modified version of the Sikh government's prior system of revenue collection. And in some important respects the first regular settlement by Barnes was also modeled after the Sikh system. Symbolic continuities with prior ruling regimes also existed. For example, British officers chose Kangra Fort as the first district administrative headquarters. Barnes writes that although the fort had a garrison and was close to the town of Kangra, the main reason for choosing the fort was "the prestige attaching to the name... the same spot which had ruled so long the destinies of the hills still continued to remain the seat of local power, - the center whence order emanated, and where supplicants repaired for redress" (1855:15). As if to underscore the orderliness of British rale, Barnes, at the conclusion of his account of the tumultuous history of Kangra State, writes, "I turn with pleasure from the narrative of wars and insurrections to the quiet details of our administration and the general statistics of the district" (1855:15).

Despite drawing on local referents that emphasized continuity with previous state regimes, British rale in Kangra differed significantly from pre-colonial political authority in several respects. The political legitimacy of the colonial administration in Kangra depended on less on strategic exchange and alliances with local elite and more on superior military strength and the modernizing narrative of colonialism. Resources, rather than valued for their political currency, were important because of their utilitarian potential to yield revenue if they were "properly" developed. Thus while the pre-colonial state sponsored the construction of some kuhls to gain legitimacy, the colonial administration supported some kuhl systems in order to generate revenue and avert famine. This perspective on resources, which emphasized their economic rather than political value, influenced the policy content of the early Revenue Department's settlement reports. For example, the settlement of Kangra promoted agricultural expansion and intensification, including the construction of new kuhls, and it commuted in-kind payments to cash payments. Early colonial policies and institutions in Kangra also facilitated the exchange of land. When combined with other regional shifts such as steady rises in grain prices and the development of improved transportation linkages, it is easy to understand why the early decades of British rale were characterized by

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tenure of land; many areas were under their management for a short period only, and some tracts never (Lyall, 1874:23).

unprecedented changes in the control and access to land, investments in agricultural development, flows of resources between social groups, and the rise of a non-cultivating mercantile elite. New kuhls were constructed and the area irrigated by kuhls increased significantly during this period. The specific array of articulations that evolved between the colonial state and the kuhl irrigation systems, can only be understood within the broader context of these regional economic, social, and ecological shifts. G.C. Barnes' reference to the "quiet details of administration" notwithstanding, British rule wrought rapid change in Kangra.

The Influence of Settlement on Land Tenure and Agriculture

After four years as district commissioner, G.C. Barnes conducted the first regular settlement. In determining the rates of assessment Barnes was guided by the rent rolls from the prior Sikh government and the summary British settlement. In fact as Lyall pointed out twenty years later, Barnes' settlement was "nothing more than the old native assessment very slightly modified" (quoted in Anderson 1897:12). The primary changes consisted of a reduction in assessment rates on unirrigated areas and the removal of the host of extra taxes that had accompanied the land revenue.

However, while the rates of taxation between the pre-colonial and colonial regimes were remarkably consistent, the methods of tax payment and the nature of property rights were significantly altered. The colonial state, rather than legitimating pre-existing property rights systems (their stated intention), wrought dramatic changes in the nature of property in private cultivated land and collectively used uncultivated areas (the "waste"). Prior to the first settlements in the Punjab cultivating households held allotments of land (shares) that consisted of strips of land of equivalent productivity.[25] Appurtenant to these shares were proportional rights in the commons, i.e. the uncultivated areas. Shares in the commons included usufructory rights of grazing and wood collection, as well as the right to break up and cultivate a household's "share" of the commons. On the basis of the size of their shares, allotment holders jointly contributed labor for collective investments in agriculture such as masonry wall building for irrigation, and they paid, generally in-kind, the revenue assessments of the pre-colonial state. The first regular settlements of the Punjab divided this agricultural community into two groups, cultivators and tenants, according to principles of ancestry which previously had had no bearing on the work of agriculture or the allotment of rights in the commons, nor on the corporateness of the community of cultivators. Cultivators who were descendants of the founders of the village were classified as landowners, i.e. proprietary rights holders, while cultivators who were not members of the founding lineage were classified as either hereditary or at-will tenants, depending on the number of years (12) they had been cultivating their allotment. Furthermore,

[25] The allotment of shares was made on the basis of the productive capacities of individuals; it was subject to periodic reallottment, as those productive capabilities changed over time (Smith 1996:33).

because tenants were now no longer classified as shareholders, their shares (rights) in the village commons "passed into oblivion" (Smith 1996:32). Thus, the colonial administration had redefined the village community on the basis of genealogy, rather than the actual pattern of land use based on allotments, in the process disenfranchising "non-landowning" families from the legitimate use of uncultivated areas.[26] While the effects of these transformations in property rights are most evident with regards to forest resources and ability to expand agricultural production, they also affected the context of irrigation management.

Other effects accompanied the first regular settlement. In Kangra, as in other districts of greater Punjab, the "ancient and time-honored custom" of paying rent in kind was reversed by commuting in-kind to cash payments (Barnes 1855:52). The switch from in-kind to cash payments was part of the then prevailing utilitarian philosophy of agricultural development in Europe. That Barnes embraced this philosophy is strongly suggested by his comments on the effects on farmers of substituting cash for kind payments, "it has taught them habits of self-management and economy, and has converted them from ignorant serfs of the soil into an intelligent and thrifty peasantry" (1855:52).

Although Barnes did not explicitly acknowledge this effect, by conveying the same rights in land that had been granted to landowners in the NWP (North-Western Provinces, present day Uttar Pradesh) he conferred full proprietary rights in cultivated land to those individuals who previously held an inheritable but not alienable right. Subsequent Revenue Department officers argued that the introduction of the right to alienate land was an unintended consequence, a "mere incident of the (first) settlement" (Anderson 1897:9). WTiether intended or not, this new right had long reaching consequences - once, rights holders realized they had been granted the power of alienation. Between 1850 and the time of the second settlement in 1870, in Tehsils Kangra and Palampur only 4.6 and 2.5 percent of the total cultivated area had been mortgaged, respectively. However, by 1890 14% of the total cultivated area was under mortgage, and an additional 5% had been sold (Anderson 1897:9). Settlement officers unanimously attributed the increase in alienated land to the need to raise capital for bride price payments among high caste Rajputs as well as upwardly mobile Rathis and Thakurs seeking to legitimize their claims to Rajput status (the dowry system only relatively recently supplanted the prior bride price arrangement) (Anderson 1897, Connolly 1911, Middleton 1919). During this period the price of a bride increased ten-fold from between Rs.20-40 to between Rs.200-400 (Parry 1979:243). Other reasons for alienation included the purchase of cattle and bullocks, expenditures on marriages and death ceremonies, and debts incurred in order to undertake long

[26] Smith notes that "In the ideal conception now, a village community was defined by descent from a village founder,... Having a share in common property was considered the sign of superior status in a village, as a member of the ancestral core of proprietors whose genealogy and history were now matters of official record

pilgrimages that expanding transportation networks had made easier (Lala Moti Ram, cited in O'Brien 1890:6). Parry suggests that the expanding market economy and increasing opportunities for wage labor also fueled land alienation. The increasing monetized sector of the economy facilitated payment of land revenue which had been converted from grain payments "at easy rates" into money (Barnes 1855:52).

The increase in land transactions during the latter part of the nineteenth century was made possible by the recent changes in property rights and by the introduction of a bureaucratic set of procedures and laws (e.g. district courts, land laws, codified statements of rights regarding land ownership, etc.) which provided the means for transferring property from one owner to another.[28] Urban based money lenders and other urban groups began to accumulate land under these laws. The Punjab Land Alienation Act of 1900 was an attempt to slow these forms of land transfers by prohibiting 'non-agricultural' castes from purchasing agricultural land. In Tehsils Dehra and Hamirpur of District Kangra, for the nine year period preceding and following passage of the land act, the percentage of total cultivated land mortgaged declined from 13.8 to 3.8 and from 9.5 to 3.5 percent respectively (Connolly 1911:6).

Following the first settlement the cultivated area in Kangra also increased. By 1890 it had increased 8-10%. Hill slopes that had been infrequently cultivated previously were terraced and cultivated annually and forested areas were converted to agriculture. This agricultural expansion, consistent with that described by Chakravarty-Kaul (1996) for the Greater Punjab but on a much smaller scale, was facilitated by a provision of the first regular settlement which shifted the authority to control the expansion of agriculture into uncultivated areas, e.g. forests, from the ruler to the landholders of a hamlet. This "revolution in the old state of property" (Lyall 1874:19) converted the landholders of each hamlet into a co-proprietary class, and transferred to them ownership rights in the uncultivated areas, known as the waste, to which they had previously only had usufruct rights.[29] By converting usufruct rights into ownership rights,

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(1996:47). Similarly: "A village community is a body of proprietors who now or formerly owned a part of the village lands in common, and who are jointly responsible for the payment of the revenue" (Douiel899:61).

[27]Because the amount of revenue assessed was fixed for at least twenty years, rising prices throughout the British period meant that the share of the harvest paid as revenue declined to as low as eight percent of the total value of the output in some parts of the district by 1920 (Raj 1933:54).

[28] Under certain conditions land transfers also occurred during the pre-colonial context. Land could be transferred by gift ifthe patta holder had no heirs. Similarly, a proprietors in arrears ofrevenue could mortgage their land to another individual who would then be responsible for paying the revenue and in exchange would receive half ofthe harvest from the former proprietor-cultivator. In some cases, ifthe arrangement became long term, or "by error at (the) first settlement", the former proprietor's claim to the land was reduced to that of a tenant and the mortgage holder became the proprietor (Lyall 1874:66). While these forms of land transfers did occur, the hereditary right to cultivate land was not bought and sold as a commodity prior to the first regular settlement (Barnes 1855).

[29] This transfer ofproperty had many implications. It nullified the rights of landless households to forest resources collected from unenclosed uncultivated areas. Revenue from these areas, previously paid to the ruler, was now collected by the lambedar (village tax collector) and distributed to all landholders in proportion to the amount of

treating landowners as coparcenary groups which were now jointly responsible for paying the land revenue, and granting them the collective right to collect certain miscellaneous rents from the waste, the settlement process, in effect, created a type of community which had hitherto not existed (Chakravarty-Kaul 1996:75).[30]

The transfer to landholders of rights in these areas may have been an unintended consequence of the application of land use categories from the plains to the hill states or it may have been an intentional, if implicit policy, to promote agricultural expansion and intensification by simplifying the process of bringing new areas under cultivation and more intensively cultivating already cultivated areas. Evidence suggests that it may have been the former. In the Punjab early village settlements were conducted by field surveyors *(amins* - derogatively referred to as a "host of harpies" by a contemporary British settlement officer) from the NWP who went from settlement to settlement working on a pro-rata basis (Smith 1985:159). As the village level record of rights (known as the *iqrar-nama,* and later, *wajib-ul-arz)* in Kangra was most likely drawn up by itinerant amins from the NWP, there would have been a high likelihood of importing land use categories from the plains to the hills. Barnes' admonition to a subdistrict Tehsildar ".. .to write down the actual practices as observed... and not to fill up details (of the iqrar-nama) after his own imagination" (1855:67) suggests that this was a real threat. This possibility is made more plausible by the fact that Barnes noted that in the preparation of the record of rights for each hamlet he himself gave the subject headings and elicited information with questions and even suggestions. Even if trained local patwaris, and not itinerant amins, did compile the record of rights in Kangra, the possibility for importing non-local forms of property was high because the patwari training manual "Educational Course for Village Accountants" was based on the author's experiences in the NWP. Furthermore, the author, Ram Saran Das, was transferred from the NWP to oversee settlement operations in the Cis- and Trans-Sutlej territories following their acquisition by the British after the 1846 Sikh War. Therefore, whether the Kangra Settlement was conducted by amins from the NWP or by patwaris whose training was based on Ram Das's manual, land use categories from the NWP could easily have been transferred to Kangra despite the lack of local referrents for those categories.

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revenue each paid. And now landholders, rather than the state, had the authority to grant permission to an individual to reclaim and cultivate an uncultivated tract.

[30] During the pre-colonial period revenue was assessed on the basis of cultivated area per family holding, not village-wise as in the plains. This reflects the severalty model of tenure known as *"raiyatwari"* (Baden-Powell 1892:11:537) that existed in Kangra prior to British rule. In this system holdings were separate and not part of a joint estate, there was no joint responsibility for revenue payment, nor were there joint shares in the waste that could be partitioned accordingly.

The history of the term "shamilat", referring to village common property, in Kangra exemplifies this process. Shamilat was first introduced in Kangra as a land use category during the first regular settlement. Shamilat was a term imported from the plains, it had no pre-British referents in Kangra.[31] Twenty years after the first settlement Lyall argued that landholders had not manufactured their own title to the wastes by putting "shamilat" in the village record of rights, but rather that "the real inventors of the definition (of shamilat) were the native officials and clerks who worked under Mr. Barnes" (1874:31) who had inserted shamilat as the heading in the village records. The creation of shamilat as a land use category encouraged the expansion of agriculture by granting landholders the right to break up and cultivate the waste, free of extra revenue, for the duration of the settlement. This was consistent with colonial policy encouraging agricultural expansion and conversion of forests to agricultural lands in other regions during the preceding decades, such as the Ganga-Jamuna doab (Mann 1995:211-212).

Following the transfer of rights in uncultivated areas from the state to the newly created community coproprietary landholders and its designation as "shamilat", Revenue Department officials attempted to privatize as much of it as they could. Barnes described how he approached areas described as shamilat in the following manner:

> Whenever... I saw an opportunity, I insisted on a partition of the estate according to the number of shares. Every inch of profitable ground was divided and allotted to one or another of the co-partners. I ignored as far as my means would allow the very name of "Shamilat", for experience has assured me that the smallest portion left in common will act as a firebrand in the village. It is sure to lead to dissension, and forms, as it were, a rallying point for the discontented and litigious to gather round (1855:67).

Quite possibly the "discontented and litigious" people Barnes referred to were those whose usufruct rights had been nullified through the vesting of common lands in the community of landowners, thus disenfranchising non-landowning user groups.

The incentives to expand agriculture provided by the introduction in Kangra of new forms of property rights were further strengthened by a twenty year fixed assessment and increasing grain prices. One outcome of these processes was the construction of new kuhls by collectivities of agriculturalists and by influential individuals. In Palam subdistrict, between 1851 and 1890, 146 acres of uncultivated area were converted to agriculture and irrigated by constructing new kuhls and/or extending preexisting kuhls (O'Brien 1890:14). Between 1850 and 1916 forty-one new kuhls were constructed in Kangra Valley (Riwaj-i-Abpashi 1916). In 1855 Barnes observed that after the first settlement single cropped fields were double cropped and kuhls were "projected and executed" (1855:63). In 1897 Anderson remarked on the

[31] See Smith (1996, Chapters 1 and 2) for an insightful discussion of the distinction between the colonial definition

"new watercourses" that had been constructed since Lyall's first revision of the settlement in 1874 (1897:60). And Middleton in the introduction to the Riwaj-i-Abpashi noted that the records pertaining to kuhl irrigation drawn up during Lyall's revised settlement were no longer accurate due to new kuhl construction (Riwaj-i-Abpashi, 1916).

The right to alienate land granted to landowners in the first regular settlement of 1851, coupled with subdivision through inheritance, resulted in some tenant cultivators becoming owner cultivators, and decreased the overall average landholding size. In Palam subdistrict, of the 2,060 hectares sold by landowners between 1871 and 1890, 14% was sold to individuals who were landowners in 1871 and who were also money-lenders, 41 % was sold to individuals who were landowners in 1871 and who were not money-lenders, 20% was sold to new agriculturists who did not own land in 1871, and 25% was sold to European tea planters (O'Brien 1890:4).[32] In Tehsil Palampur, between 1871 and 1890 the number of small landowners increased from 13, 854 to 22,081, the number of medium landowners declined from 5,553 to 5,178, and the number of large landowners declined from 1064 to 716.[33] During this same period the average size per holding for small landowners decreased from .8 to .6 hectares, for medium landowners it remained constant at 3.0 hectares, and for large landowners it increased from 9 to 10.4 hectares (O'Brien 1889, 1890, 1891a, 1891b). Many of the large and medium holdings belonged to European and local tea planters (O'Brien 1890).

The primary landowning castes during this period were (and continue to be) Rajputs, Brahmins, Rathis, Thakurs and Girths. Table 4.3 shows the ownership of cultivated land by caste for District Kangra in 1919, and Table 4.4 gives land ownership statistics by caste for Kangra Valley in 1897. Table 4.3 indicates that together, the two highest castes (Brahmans and Rajputs) owned just over fifty percent of the total cultivated land. In 1931 they comprised 44.2 percent of the district's population. Table 4.4 demonstrates a similar trend in Kangra Valley and also illustrates the relatively small differences in average land holding size between castes.[34] The Mahajan caste, composed primarily of traders, has the largest average land holding. During the British period, many Mahajan families accumulated land and wealth as moneylenders.

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of "shamilat" and the pre-colonial nature and extent of rights in the commons in the Punjab plains.

[32] The 2,060 hectares sold between 1871 and 1890 represents 12 % of the total cultivated area in Palam Ilaqa (O'Brien 1890:4).

[33] The size classes for small, medium and large holdings are < 2.4, 2.4 -7.6, and > 7.6 hectares respectively (O'Brien 1890:14).

[34] Prior to land reform legislation in the 1970s, 25 of the 58 holdings greater than 10 acres belonged to Mahajans, 18 were owned by Brahmans, and 9 by Rajput families (Parry 1976:56).

Table 4.3 Percentages of Cultivated Land, District Kangra by Caste, by Tehsil, 1919 (Middleton 1919:3)

Tehsil	Brahmans	Rajputs	Rathis	Girths	Others
Palampur	21.0	20.6	17.5	9.1	31.8
Kangra	11.5	21.3	5.8	33.1	28.3
Nurpur	12.6	55.1	10.0	2.5	19.8
Total	14.9	35.6	11.3	12.4	25.8

Table 4.4 Land Ownership, by Caste, Kangra Valley, 1890 (O'Brien 1889,1890,1891a, 1891b)

		# holdings	cult, area (ha.)	avg. holding (ha.)	% of total holding
Total for					
Kangra	Girths	5466	9676	1.8	14.4
Valley	Brahmans	5869	16723	2.9	25.0
	Mahajans	1282	4194	3.3	6.3
	Rajputs	5557	15259	2.8	22.8
	Rathis	4061	11827	2.9	17.6
	Others	6332	9344	1.5	13.9

The Influence of Settlement on Property in Kuhls

Consistent with their interest in promoting agricultural expansion and concomitantly, revenue, the Revenue Department facilitated, subsidized and generally supported the expansion of irrigation networks. This process involved regulating the construction of new kuhls, codifying irrigation customs and rights, mapping kuhl networks, and shifting dispute resolution from the village level to the district courts. Settlement officers asserted that state claims to the natural waterways of the district represented a continuity rather than a change from previous customs. Lyall (1874:56) wrote that,

> In order to retain in its hands the power of making new irrigation channels where needed, the Government directed all Settlement Officers to assert its title to all natural streams and rivers. In Kangra the title of Government, by old custom of the country, was particularly

> clear, and I accordingly asserted it subject, however, to existing rights of use possessed by shareholders of canals, owners of water-mills, or persons entitled by custom to erect "chip" or fish-weirs in certain places. The actual beds of streams and the water in them belong to the Government.

Permission to construct a new kuhl could not be granted unless the government had a record of the existing network of kuhls. Irrigation rights were first recorded in the second settlement. Maps were drawn of every stream showing the position of each kuhl, its headworks, main channels and the villages it flowed through. Appended were attested records of the customary rules regulating the relations between communities that share one kuhl regarding water distribution, the manner of constructing the headworks, responsibility for repairs and maintenance, and a short history of the kuhl. A glossary of specialized irrigation terms was also included. These statements of rights were bound and copies kept at the Palampur and Kangra Tehsil offices. They constituted the first edition of the Riwaj-i-Abpashi (Irrigation Customs).

The Riwaj-i-Abpashi represented the first time that complex irrigation customs guiding the measurement and distribution of a single kuhl's water to as many as 60 different hamlets were reduced to writing. Settlement officers determined the irrigation customs and practices relating to a specific kuhl by calling a public meeting and asking those present to describe their customs and practices. After writing them down they were read aloud, suggested changes incorporated, and then prominent village leaders attested to the veracity of the statement with their thumbprint or signature.

Lyall himself acknowledges the difficulty of creating an accurate statement of irrigation rights in this manner. He notes that "probably these statements are sometimes incorrect....the custom is often vague and difficult to define" (1874:243). While irrigation customs may have appeared vague to a settlement officer, one wonders if they appeared equally vague to the shareholders whose irrigation water depended on them? Or, factions well represented at the general meeting may have presented the settlement officer with a picture of rights in a kuhl that favored their own interests. In fact the Riwaj-i-Abpashi occasionally explicitly acknowledges these conflicts; in some cases after describing inter-village rights and responsibilities with regards to a specific kuhl, it notes that members of a hamlet contested the version of rights that were recorded and refused attestation. Even on-going litigation concerning contested water rights is mentioned in the Riwaj-i-Abpashi. Social groups appear to have taken full advantage of the new arena to assert competing claims to kuhl irrigation water and to negotiate favorable rulings regarding inter-village distribution of responsibility for kuhl maintenance and repair.

The expansion of irrigated agriculture, construction of new kuhls and changes in tenancy rates and land ownership soon outdated the statements of irrigation rights compiled as part of Lyall's settlement. The tension created by disjunctures between the static record of irrigation rights and the dynamic social

system that under girded it led to the revision of the original Riwaj-i-Abpashi during the third revised settlement from 1913-1919. As the revised edition notes in the preface, it was necessary to update the Riwaj-i-Abpashi because the original was not complete, judicial decisions regarding water rights were at variance with the Riwaj-i-Abpashi, and new kuhls had been constructed. The Riwaj-i-Abpashi register created at this time is today still kept at the Kangra and Palampur Tehsils and is used as the basis for deciding contemporary water disputes in court.

Although the Riwaj-i-Abpashi eventually was viewed as a legal record of right which could be used as the basis for judicial decisions regarding water disputes, it was not initially intended to a be a binding contractual document between a village and the Revenue Department. Instead, the Riwaj-i-Abpashi was part of a much wider effort during the latter half of,the 19th century to codify customary law in settlement reports, statistical reports, and later, District Gazetteers. Information contained in the formal compilations of customary law "had the legal value of evidence of custom, not the presumption of truth which was accorded an entry in a record of rights" (Smith 1985:156). The notion that the codification of custom did not represent legally binding rights and obligations is noted explicitly in the Riwaj-i-Abpashi. Part 9 of the 1918 edition includes the following entry from the 1868 edition, "these conditions does [sic] not form an agreement between government and farmers. Rather this is a system in practice of defined customs and agreement between farmers of different villages."

The colonial administration also indirectly supported kuhl regimes by helping to reconstruct kuhls following natural disasters, and by adjudicating water conflicts during periods of water scarcity. The beginning of chapter one described one example of the manner in which the colonial administration mobilized military labor and resources for the reconstruction of kuhls the 1905 earthquake destroyed. The administration also played third party roles in resolving water disputes. Although I did not examine historical court records for specific decisions regarding water disputes, every settlement report beginning with the first revised settlement of 1874 through the third revised settlement of 1916 refers to the role of the Revenue Department and the district court system in resolving disputes over kuhl water, especially during periods of water scarcity. Revenue Department notification nos. 37 and 38 of 20 March 1907 authorized the District Collector to "regulate the flow of the natural channels" of Kangra Valley, and notification no. 117 of 1 October 1907 restricted the exercise of that authority to "seasons of drought and with the object of supplying water to canals or to the cultivation of lands which are likely to be injuriously affected by the obstruction of natural channels," i.e. the diversion structures of upstream kuhls. This power was exercised in 1914. The Riwaj-i-Abpashi notes that due to a drought that year the downstream kuhls of Baner Khad were not receiving adequate water flows. The District Deputy Commissioner appointed an official to more

equitably distribute the water between up- and downstream kuhls. He was instructed to ensure that the lower 16 out of the total of 32 kuhls starting from the khad, all received one nala of water.[35]

The British also sponsored the construction of two new kuhls. One kuhl was built to supply water to the growing market town of Palampur that the British encouraged as a trading center with Afghanistan and Eastern Turkestan where they sought a market for Kangra green tea. After constructing the kuhl, the government handed it over to the association of traders and business people to manage and maintain. The second kuhl the government constructed started from Gaj Khad in Kangra Tehsil. Although its purpose is not mentioned, it probably was constructed to provide water to the adjacent town of Dharmsala, which the British had established as a hill station and the headquarters for the district administration.

Conclusion

Both the pre-colonial and the colonial state played specific roles in the management of the kuhls of Kangra Valley. These roles were influenced by regionally specific historical and social factors. While neither state regime claimed a property in kuhls, both regimes played periodic, but crucial, roles in the maintenance and repair of kuhls. The pre-colonial state sponsored the construction of some of the longest and most complex kuhls in Kangra Valley, and then handed their management over to the villages they irrigated. In return pre-colonial rulers were able to strengthen the legitimacy of their rule, especially when the construction of a new kuhl, or the reconstruction of a destroyed kuhl, was linked with support for a temple, as in the case of Raniya Kuhl. Although motivated by a more economic rationale that linked agricultural expansion with increased revenue, the colonial government also was involved with kuhl regimes. It provided resources for the reconstruction of kuhls following the 1905 earthquake, adjudicated inter-kuhl water disputes through the district court system, and codified irrigation customs. The transformations the colonial state wrought in the nature of private property and in the creation of village communities promoted agricultural expansion and concomitantly a flurry of locally sponsored kuhl construction. Although neither state regime was involved in the annual rhythm of activities associated with kuhl management, the importance of the facilitative role these state regimes played is evident. The larger kuhls in Kangra Valley might not have been constructed without state sponsorship, and had the colonial administration not helped to reconstruct earthquake-damaged kuhls, some may not have been repaired.

The role the colonial administration played in kuhl management was one part of a much larger set of social, political, and economic processes with which the state was involved but over which it exerted little absolute control. These included shifts in the control of land among different social groups partly fueled by social institutions such as bride price, increased investment in agriculture, increasing grain prices

[35] one nala = eight gala; one gala = the space created by joining the thumbs and index fingers of both hands.

and improved transportation infrastructure, and changes in the proportion of tenant and owner cultivators as well as the rise of absentee landownership. These regional processes of social, economic, and social change continued, and in many respects accelerated, during the post-independence period. The next chapter addresses their effects on the kuhls of Kangra and the various ways farmers have chosen to respond to the challenges they represent.

Chapter Five

Patterns of Change within the Kuhl Regimes of Kangra

Increasing nonfarm employment (Figure 3.5) has changed the pattern of dependence on kuhl water. These changes have generated tensions within kuhl regimes that challenge their integrity. Those with access to new economic opportunities, such as secure nonfarm employment, are less willing to contribute labor and other resources necessary for the maintenance and repair of kuhls, especially when the opportunity costs of their labor are foregone cash wages. The resulting tensions are not unique to kuhl regimes. Increasing market-based economic opportunities weaken the bonds of common dependence between individuals on the benefits common property resources provide (Polanyi 1944, Jodha 1985). The resulting erosion of common property resource regimes is not simply due to the increased opportunity costs of labor for those with nonfarm employment. It is also related to the diminishing salience of village-based authority structures and to broader social changes, such as in inter-caste relations. In Kangra, as regional economic opportunities expand and the electoral politics of democracy flourish, conflicts based on caste-based inequalities increase and the willingness to accept those inequalities decreases. With regards to kuhl regimes, these processes have resulted in increasing absenteeism for khana, the declining ability of the kohli to enforce rules, increasing conflicts between headend and tailend farmers and communities, and contractions in command area.

However, these effects are not distributed evenly across all kuhl regimes. The potential for caste, class or locationally derived conflict among the irrigators of a kuhl, and the degree of reliance on the irrigation water a kuhl provides, shape the tensions arising from increasing nonfarm employment as well as the means people employ to resolve those tensions. Currently, kuhl regimes vary temporo-spatially in their degree of role specialization and organizational formalization, and the extent of state involvement in kuhl management. Regime variation in role specialization and formalization ranges from regimes with no specialized roles, formal rules, or written records, to those with multiple watermasters, a formal committee with elected officers, extensive written records and sophisticated methods for measuring water flow. The extent of state involvement in kuhl management ranges from kuhl regimes that operate independently of any state involvement to regimes that the Himachal Pradesh Irrigation and Public Health Department now entirely manages. This tremendous variation in the organizational characteristics of kuhl regimes reflects their differential responses to the stresses arising from increasing nonfarm employment. The varied roles the state of Himachal Pradesh plays in the management of different kuhls can be best accounted for as a process of negotiation between various state agents and the persons involved in kuhl management. When it

occurs, the basis and content of this negotiation and the outcomes in terms of state involvement in water management, are also shaped by local social and ecological influences rather than by the undifferentiated application of a homogenous state irrigation "policy" across a socially and ecologically differentiated landscape.

The Effects on Kuhls of Increasing Nonfarm Employment

Increased nonfarm employment has affected kuhl regimes in four primary ways. It has resulted in decreased participation in kuhl maintenance work parties, increased inequality between headend and tailend farmers in terms of water consumption and contributions for system repair and maintenance, declines in the authority of the kohli and his ability to enforce customary rules, and changing cropping patterns. These changes embody the social and economic effects of increasing nonfarm employment. When a household's (primarily male) labor supply is incorporated within the nonfarm economic sector, there is a concomitant reduction in the supply of labor and incentive to contribute towards the maintenance and management of common resources. This is particularly true for those activities, such as the repair and maintenance of a kuhl's physical structure, from which women are excluded by gender-based norms.[1] When participation in nonfarm income generating opportunities reduces dependence on local resource systems, forms of authority that evolved within a context of mutual dependence on local natural resource endowments are likely to be weakened and/or more easily contested. The resulting differentiation of dependence on local resources, although moderated by ideologically compelling norms of reciprocity, hierarchicalrelations, and the strong local bias against buying food grains, nevertheless weakens the legitimacy of rules and the ability of village-based authorities to enforce them..

Declining Participation

Declining rates of participation in communal kuhl maintenance and repair activities are a pervasive effect of increasing nonfarm employment. Without exception kohlis cited mobilizing farmers for kuhl maintenance as their most difficult problem. In order to bolster participation in communal work parties and to provide basis for sanctioning absent farmers, many kuhl regimes now maintain attendance registers.[2] While all attendance registers record who contributes labor and who does not, the dynamics of declining participation vary from kuhl to kuhl. Participation in khana may decline for political or economic reasons

[1] In other arenas of agricultural work the increased participation of males in the nonfarm employment sector has shifted the burden of work from males to females (Sarin 1989).

[2] The two kuhls that have kuhl committees but for which attendance records are not kept are Bhradi Kuhl and Raniya Kuhl. The former has no attendance records because the kuhl committee was formed primarily to fight a court case against the IPH Dept. over water rights, not in response to internal stress. Attendance registers were irrelevant for this purpose. Raniya Kuhl has one of the older kuhl committees, but no attendance records. Possible explanations for this are discussed later in the text.

among big or small landowners. In some kuhls participation may have been low previously, while in others low participation may be a recent phenomenon.

Evidence from three kuhls, Kathúl, Pathan and Raniya, indicates that participation in khana has declined over time, but for different reasons. Kathul Kuhl, whose construction during the colonial period was paid for by two traders from the nearby town of Nagrota Bhagwan, carries water approximately 8 kilometers to the Villages of Paror and Kharot. It irrigates about 70 hectares. Laxman Das, the kohli for Kathul Kuhl, often decried the declining interest of farmers in kuhl maintenance and the increasing difficulties he and the kuhl committee, created in part to back up the kohli's decisions, faced in mobilizing adequate labor. As an example, in 1991, the khana for Kathul Kuhl was not completed all the way to the danga due to low farmer participation. As a result, irrigation water was available only from annual streams after the monsoon started. Due to the lack of water for field preparation and the insecurity of water supply, most farmers were forced to sow paddy using the lower yielding but less water intensive battar (dry seed sowing) method. The following year, after much brow beating by the Kohli and members of the kuhl committee, more than 90 farmers participated in khana and danga construction. Completing the khana work enabled utilization of water from the Neugal River and the mach (sprouted seed) method of paddy sowing. While khana was completed all the way to the danga in 1991, the ongoing difficulty of mobilizing enough labor for adequate kuhl maintenance raises questions about the ability of the current kuhl regime to maintain the physical and social integrity of the kuhl without reconstituting either its own operating rules or changing the nature of its relationship with the state.

Regional increases in nonfarm employment restrict the pool of labor available for khana. However several local factors mediate this meso-scale relationship and shed light on the kohli's difficulties. These include the fact that this kuhl irrigates primarily larh areas. As the opportunity costs of labor increase due to rising nonfarm employment, communal labor supplies will be scarcest for those tasks, such as irrigating larh areas, which yield less return. Overall dependence on Kathul Kuhl water is also relatively low because once the monsoon begins, water from annual streams can be diverted and used for irrigation. Furthermore, residents of the Village of Paror, through which the kuhl flows, no longer rely on Kathul Kuhl to provide hydropower for grinding grain or to meet other domestic water needs. Dependence on the water from this kuhl would have been much greater prior to the availability of public faucets for domestic use, and before electricity-powered mills supplanted the kuhl-powered mills (graths). The general weakening of the web of dependence on the water this kuhl provides, accounts for why Laxman Das has been having such a difficult time mobilizing labor to maintain the kuhl's physical infrastructure. Other indicators of system stress

include an increasing ratio of battar- to mach-sown paddy fields and shifts from paddy to maize production in some larh fields.[3]

Attendance registers for nearby Pathan Kuhl also indicate that the number of farmers participating in khana has declined in recent years. Pathan Kuhl was constructed by an influential member of the Pathan caste during the pre-colonial period when Kangra was under Mughal rule. It carries water approximately five kilometers from the Neugal Khad to the Villages of Paror and Kharot where it irrigates about 45 hectares. Table 5.1 shows the number of farmers that came for khana by day and by year between 1978 and 1991. The maximum number of farmers participating in khana on a given day declined from between 90 and 100 to between 30 and 40. The total number of workdays contributed for khana per year also declined during this period. While some of the variation may be attributed to yearly fluctuations in the labor requirements for kuhl maintenance, the declining maximum number of farmers who participate in khana on any given day, the declining number of workdays contributed per year, and Dhyan Singh Kohli's statements that fewer farmers now participate than earlier, suggest that participation in khana for Pathan Kuhl is declining.

Year	Number of Farmers									Total Days Called	Total Work-days
	10-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100		
1978	4	2	3	2				1	1	13	485
1979	9	3	2	1			1			16	389
1980	1	13	1	1	1		1			8	315
1983	4	1	1	1		1				8	226
1985		1	2		2					5.	215
1986	5	2	1			2				10	274
1987	5	2	2	1					1	11	328
1988	4	1	2		1	1				9	258
1989	6	2	1	1						10	213
1990	6	3	1		1					11	247
1991	2	2	3							7	189

Table 5.1 Number of Days called for khana, by number of farmers who came each day, Pathan Kuhl, 1978-1991 (Records for 1981-82 and 1984 missing).

What accounts for declining participation in Pathan Kuhl? A review of the kuhl committee's meeting minutes from 1978 through 1990 reveal a series of common conflicts that, when considered in conjunction with the effects of increasing nonfarm employment, shed light on the dynamics of declining

[3] Although I do not quantitative data on wealth distribution, assessments I made during fieldwork suggest that inequalities between households, either caste or class, are not extreme in Mauzas Lalla and Paror and that inequality does not account for the declining cooperation for khana and danga construction in this kuhl.

participation. One recurring theme is the complaint by the kohli as well farmers who reside in Village Kharot, that farmers who live in the adjacent and upstream village of Paror use water from Pathan Kuhl but do not contribute to its maintenance. Furthermore, they argue that the farmers of Paror take more water than they are entitled to based on the division of water rights specified in the Riwaj-i-Abpashi. Resolutions were passed directing the farmers of Paror to heed the kohli's call to come forward and contribute labor on the announced day, and declaring that excuses such as "I didn't hear the Kohli's call" are considered inadequate. Other conflicts noted in the meeting minutes are concerns by small landholders (those holding 2-3 kanals) that their holding are too small to warrant full participation in communal work parties, and a long litany of complaints lodged against the kohli in 1982 by Kharot farmers. These included allegations that the kohli receives payment in exchange for nighttime water deliveries to farmers not entitled to the kuhl's water, that he favors his own fields during periods of water scarcity, and that farmers had to seek a temporary water delivery from the kohli of an adjacent kuhl "bhai bundi se" (through brotherhood) because Dhyan Singh organized khana too late and an early monsoon cloudburst and flood destroyed the kuhl's diversion structure. The farmers of Kharot also stated that during times of water scarcity Dhyan Singh is reluctant to install the bamboo measuring devices (thellu) at each outlet because doing so would reveal the extent of water scarcity (and by implication the inadequacy of the kohli's management). Other conflicts noted in the minutes include grazing of livestock on the kuhl banks that causes erosion, destruction of the kuhl's danga by local fisherman, illicit removal of sand from the kuhl for cement making, and recalcitrant farmers who refuse to allow the kuhl to flow through their land. In response to these problems the kuhl committee has at various times recommended that the state government be approached to take over management of the kuhl, offered cash rewards for information leading to the apprehension of individuals harming the kuhl's channel, and instigated the rather large fine of Rs. 500 to be levied against individuals who do not follow the rules promulgated by the committee.

Given the litany of conflicts described in the minutes, it is not surprising that attendance registers record declining rates of participation in khana. What is perhaps more surprising is the fact that the kuhl continues to function at all. While a fuller analysis of the ways in which kuhl regimes are responding to these kinds of tensions is presented later in this chapter, suffice to say for now that most of the kuhl regime's social and ecological characteristics indicate that shared dependence on kuhl water is high. Pathan Kuhl irrigates only the highly productive rice growing har areas of both Paror and Kharot, alternative water supplies are unavailable, and the water intensive mach method is used for sowing paddy throughout the kuhl's command area. Inequality is not high in Paror, nor does it appear to be in Kharot. The records Dhyan Singh and the kuhl committee maintain are among the most complete and well

maintained of any I saw. Formed in the early 1950s, the kuhl committee is among the older committees in the basin. The committee facilitates the acquisition of government funds for kuhl maintenance and repair, and provides a forum for resolving conflicts that may arise among farmers or between the kohli and a farmer. Dhyan Singh has been kohli since 1971 when he retired from the army. His father served as kohli from 1940 to 1971. The kuhl appears to be organized with a degree of efficiency and organization that reflects Dhyan Singh's years in the military where he served as an officer responsible for training new recruits. The high degree of dependence on kuhl water and the tightly organized nature of the regime seem to provide adequate incentive for farmers to work through conflicts as they arise.

Examining the dynamics of khana in a third kuhl, Raniya, sheds further light on the diverse causes of declining participation. This kuhl, which brings water twelve kilometers from the Neugal River to the village of Saloh, was sponsored by the pre-colonial Katoch ruling family, as discussed in the previous chapter. The reasons for the decline in Raniya Kuhl differ from Kathul and Pathan Kuhls. Kishori Lai, the lower caste kohli for Raniya Kuhl, remembers that only ten years ago eighty to one hundred men would show up for the four days required to complete khana. In 1988, so few farmers turned out for khana that Kishori Lai called it off and instead collected money from the village to pay migrant laborers from Rajasthan to do the work. In 1993 only 21 individuals, many young boys under 15 or men over 55, came for khana.[4] Kishori Lai repeatedly expressed frustration at his inability to force the larger landowners to either contribute labor or to pay for laborers in their stead, and at the overall decline in farmer turnout.

Several factors seem to account for declining participation in Raniya Kuhl. Although the kuhl irrigates all the har areas of Saloh, alternative water supplies are available from a nearby annual creek following the onset of the monsoon. However, caste and land based inequalities between cultivators and tenants in Saloh seem to be the dominant reason behind declining participation for khana. In Saloh caste intersects with landownership - the three or four largest landowning families are Brahmins. Although I did not attempt to determine household land ownership, participant observation and informal interviews indicate that these families own most of the har land in the village. Their holdings exceed the current ceiling on land ownership size and are leased informally to tenants who give the owner half the production in rent. This share arrangement exceeds the legal share that owners may demand. Lower caste small landowners resent the discrepancy between landholding size, contributions for kuhl maintenance and repair,

[4]Kishori Lai Kohli noted that a young boy, while satisfying the requirement that a household contribute labor for khana, cannot do as much work in a day as a grown man. Similarly, Dhyan Singh, Kohli of Pathan Kuhl, notes in his attendance records if a household sent only a young boy. Dhyan Singh maintains the most finely graded attendance rosters I saw. While most kohlis only note if a farmer is present or absent, Dhyan Singh assesses the performance of those present with modifiers such as, "lazy", "good", "came late", "came empty-handed" i.e. without shovel or pick, or "boy".

and water use. In their view the large landowners contribute less labor for khana relative to the small landowners, yet use more kuhl water. In stark contrast to the tightly organized committee for Pathan Kuhl, the committee for Raniya Kuhl, which was formed in the 1950s, maintains no records. It does not support Kishori Lai, and it appears to represent the interests of the large landowners. The president of the committee is one of the oldest men in Saloh, a Brahmin, and the largest landowner in the mauza. When asked what the committee does, he said (paraphrasing) that "we formed the committee years ago and we made rules, but because the rules were not obeyed or followed, what is the point of having a committee at all?" at which point he threw his arms up in frustration and resignation.

Because of the difficulties in managing the kuhl, Kishori Lai and other village representatives traveled at their own expense to Simla, the state capital, to request the Irrigation and Public Health (IPH) Department to assume responsibility for managing their kuhl. The request was denied, partially because the large landowners of Saloh opposed the proposal due to concern that the government may impose an area-based water tax.

Participation for khana in Raniya, Pathan and Kathul Kuhls has declined. Yet the reasons for the decline vary from kuhl to kuhl. Declining dependence on kuhl water accounts for declining participation in Kathul Kuhl. The "pull" of nonfarm employment opportunities accounts for declining participation in Pathan Kuhl, whereas the "push" of inequality explains declining participation in Raniya Kuhl as low caste small landholders exit from a regime characterized by relatively high degrees of caste and land based inequality.[5] These three kuhls illustrate the different processes operating within kuhl regimes. Declining participation, while a common phenomenon, has different causes and effects.

Distribution of Responsibility for System Maintenance

The burden of kuhl maintenance has always had a tendency to fall more heavily on downstream users than on upstream users. The Riwaj-i-Abpashi acknowledges this inequality when it states that tailenders are responsible for maintaining and repairing the kuhl. While not always true, it is often the case that when a kuhl irrigates multiple hamlets, the upstream hamlets will be predominantly high caste and the downstream hamlets low caste. In these instances the general rule stated in the Riwaj-i-Abpashi reinforces the position of dominant social groups. This conforms to Bourdieu's analysis of the relationship between rules and action in which he suggests that rules tend to reflect the interests of powerful individuals or groups, or that particularly skilled or powerful individuals are able to manipulate rules to mask their own rule-breaking behavior (cited in Mosse 1997a:43). However, this stark statement of the privileges enjoyed

by upstream hamlets is considerably modified by numerous de facto rules that shift this responsibility back upstream. Rules such as the tup to tup rule for khana, and the common responsibility of all irrigators for danga construction and khana above the most upstream tup, soften locationally derived inequalities. Nevertheless, the declining dependence on agriculture and the consequent weakening of the bonds of interdependence between households has reduced the leverage these rules previously provided downstream users to influence the contributions of headenders for system maintenance, thereby strengthening the privileges of headend location. When caste differences intersect with locationally derived inequalities, the inequalities between head and tailenders are amplified.

These processes are evident in Buhli Kuhl. This kuhl was constructed sometime during the pre-colonial period by farmers from the seventeen hamlets that it irrigates. The kuhl's main channel is approximately 10 kilometers long and its command area, at 300 hectares, is relatively large. High caste Rajput hamlets are located at the headend of the kuhl and low caste households at the tailend. The kohli of Buhli Kuhl, Shri Vichitra Singh, is a Rajput from one of the headend hamlets. Prior to the increased availability of alternative economic opportunities, common dependence on kuhl irrigation water muted inequalities deriving from caste and position and provided the kohli necessary leverage to enforce the customary rules for allocating responsibility for kuhl maintenance and repair between head- and tailenders. However, as Kohli Vichitra Singh explained, "cooperation has disappeared because now people have money". Nonfarm employment opportunities have reduced upstream Rajput households' dependence on agriculture and by extension, kuhl water for irrigation, whereas the downstream lower caste households have been less successful at obtaining nonfarm jobs, and the jobs they do obtain are relatively low wage. The resulting fragmentation of common dependence on kuhl irrigation water combined with caste antagonisms have reduced the leverage rules and sanctions provided the kohli and downstream users to compel upstream farmers to contribute labor for the repair and maintenance of the kuhl. Consequently, despite the kohli's attempts to coerce upstream hamlets to contribute labor, Rajput contributions for kuhl maintenance and repair declined. The resulting inequalities increased to the extent that nearly the full burden of maintaining and repairing the kuhl fell on downstream households while upstream households, through whose land the kuhl flowed, continued to divert water for irrigation. In protest, in 1985, the downstream households withdrew from the kuhl. These households now divert water for irrigation from small nearby annual streams that flow only after the onset of the monsoon. With no pre-monsoon water supply for irrigation, residents of the downstream hamlets now sow paddy using the less productive dry

[5]Each kuhl highlights a different process. The dynamics revealed i.e. declining dependence, the pull of nonfarm employment, and the push of inequality, probably exist in most kuhl regimes but in different degrees. The

seed broadcast method - (battar) and rely on monsoon rains to replenish the nearby annual streams. While downstream households no longer bear the onerous burden of maintaining and repairing Buhli Kuhl, they now must contend with reduced rice and wheat harvests, and increased risk of crop failure from drought. The kohli who preceded Shri Vichitra Singh correctly foresaw the consequences of increasing conflict and the diminished authority of the kohli - he had predicted that when he was no longer kohli Buhli Kuhl would become defunct.

The preceding narrative demonstrates that the contraction of the command area of Buhli Kuhl is not a result of a general decline in social capacity for collective action. Instead it is the result of active decision making on the part of downstream low caste households and hamlets that refused to continue to participate in an increasingly unequal regime. The case of Buhli Kuhl is somewhat unique insofar as nonfarm employment opportunities increased inequality within the regime until eventually downstream hamlets withdrew their participation in protest. However, in many kuhl regimes nonfarm employment opportunities reduce the costs disadvantaged or marginal households who bear a disproportionate burden of kuhl maintenance incur by withdrawing from the regime because they can more easily find alternative forms of income. Mosse makes an analogous point in his discussion of the withdrawal of labor for tank maintenance and management by low caste groups as a form of social protest to challenge their subordinate status. He notes, "the abandonment of water management systems here is not the result of a passive process of decay or decline, but the result of active strategies to redefine social and service identities" (1997a:31).

To varying degrees, almost all kuhls and especially the larger multi-village ones, are characterized by tension between upstream and downstream, water users. This holds true even if the up- and down-stream villages are comprised of the same caste. For example, the committee meeting minutes for Pathan Kuhl which irrigates the adjacent Rajput villages of Paror (upstream) and Kharot (downstream) contain numerous references to the fact that the farmers from Paror do not participate in khana yet freely use the buhl's water for irrigation.

In some cases the tension can escalate into violent confrontations. One historical example of this with contemporary ramifications is the case of Sapruhl Kuhl. This kuhl was initially constructed by members of the Girth caste to irrigate the village of Kharot. Oral history recounts that the kuhl's path was surveyed by a Gaddi (nomadic herder) who lived in the Gaddi village of Kandi at the foot of the Dhaula Dar. The Gaddi, while grazing his flocks in the Dhaula Dhar above the valley, was able to determine from his vantage point the optimal route for the kuhl. After he marked the surveyed route with pulse seeds, the

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different meanings of declining participation between kuhls results from the relative strength of these elements.

Girths excavated the kuhl's channel using the path of sprouted grain to guide their work. The sponsors reportedly paid the excavators rice in equivalent volume to the stones, sand, and dirt they removed. The kuhl, approximately 15 kilometers long, conveys water from the adjacent Baner Khad and brings it to Kharot in the Neugal watershed. Initially the kuhl would not convey water. It was only after the sacrifice of a daughter-in-law by walling her into the kuhl that it flowed; she is still worshipped every year at a small temple erected near the diversion structure of the kuhl.[6] However, both oral history and Riwaj-i-Abpashi recount that upstream Rajput hamlets, through whose lands the kuhl flowed, coveted the kuhl's water. In order to gain rights to the kuhl, the Rajputs of the village Lahla murdered the Girths from Kharot and renamed the kuhl Bharuhl Kuhl to connote its abundant water flow. To help establish their ownership rights they also destroyed a rock inscription near the head of the kuhl that declared it to be for the Girths of Kharot. The water rights of Village Kharot were restricted to 16 days and nights of dol rights and later, during the colonial period, to only 8 days and nights. The Riwaj-i-Abpashi notes that at the time of its compilation one of the upstream villages was contesting the dol rights of Kharot and Paror and that the case was pending with District Commissioner. The commissioner must have rejected the argument of the upstream village, because the villages of Kharot and Paror still possess dol rights for eight days and nights. They also still refer to the kuhl by its original name, Sapruhl Kuhl, after the clan of Girths who initially constructed it.

Both downstream Girths and upstream Rajputs employed strategies to "naturalize" their contested claims to the water from this kuhl. By renaming it Baruhl Kuhl and destroying the rock inscription near the head of the kuhl, upstream Rajputs attempted to erase the history of Girth claims to the kuhl. The Girths, on the other hand, maintain the memory of their original rights to the kuhl by recounting the sacrifice of the daughter-in-law to ensure water flow in the kuhl and by annually remembering the incident by worshipping at the temple erected in her honor at the head of the kuhl. The phrase, "our blood is in that kuhl" used by the kohli to describe their'water claims, refers to the women's sacrifice and the rights of Paror and Kharot to the kuhl's water. Other stories establish the "naturalness", of the downstream villages rights to the kuhl. One story recounts an incident in which farmers from Paror and Kharot, contesting the rights to the upstream water users, worshipped at the sacrificed woman's temple. They prayed that if the kuhl belongs to the downstream villages then the upstream villages should not receive its water. Immediately afterwards a landslide blocked the kuhl's main channel. The upstream farmers were unable to clear the debris until the downstream farmers (the proven rightsholders) from Paror and Kharot offered to help repair the kuhl. The

[6] This incident is the topic of one of the songs members of the Doumna (basketmaker) caste sing during the month of Chaitre, the first month of the Hindu calendar. See Narayan (1996) for a fuller analysis.

story ends by stating that this is the manner in which the farmers of Paror and Kharot were able to gain back at least 8 days and nights of dol rights in the kuhl. A more secular piece of evidence downstreamers farmers point to in support of their water claims is the fact that the villages of Paror and Kharot pay the land revenue for a small patch of land at the kuhl's diversion structure (even though the diversion structure is approximately 15 kilometers from the boundary of either village). They argue that the small plot was purchased by the original sponsor of the kuhl when the kuhl was built and that this further legitimizes their original rights to the kuhl's water.

Conflicts between the downstream Villages of Paror and Kharot and the upstream Village of Lahla continue to this day. I walked the length of Sapruhl Kuhl with the kohli, Laxman Das (also the kohli for Kathul Kuhl) during the period of downstream dol rights. As we passed by the fields of upstream landowners (those whose ancestors had wrested control of the kuhl from the downstream Girths) the kohli noticed that several were illicitly using the kuhl's water for field preparation and mach. Rather than angrily confronting the farmer and shouting insults, Laxman Das continued to walk alongside the kuhl and, without pausing, loudly called out a reference to their illicit water use; whenever this happened the upstream farmer would remain silent and appear somewhat shamefaced. Laxman Das explained later that it was not worth risking bad relations and recriminations with the farmers of the upstream villages, especially when their rights to the water only lasted for eight days and nights. This reflected a general sentiment that neither the kohli nor the twelve pairs of farmers from Paror and Kharot who guard the kuhl during the time of their dol rights can entirely stop illicit water use by upstream Rajput villages.

Declining Kohli Authority

The inability of the kohli of Buhli Kuhl to enforce rules for distributing the burden of khana between head and tailenders reflects the general erosion of the kohli's authority. The topic was a common theme throughout many of my conversations with different kohlis. The declining authority of the kohli is tightly linked to increasing nonfarm employment opportunities and the declining salience of caste or ritual service-based authority systems. Households that have shifted their economies from subsistence agriculture to nonfarm market based activities are less bound by village rules and norms. Participation in wider economic systems, when it reduces dependence on local systems, weakens forms of authority that evolved within a context of mutual dependence on local natural resource endowments. The basis for regulating communal activities and the source of legitimacy for rules governing those activities was common dependence on local resource systems. The fragmentation of this dependence has weakened the legitimacy of rules and the ability of caste or service-based authorities to enforce them.

The declining authority of the kohli reflects these processes. Previously kohlis were respected; some were feared and associated with supernatural powers. Numerous farmers recounted how, when the demand for kuhl water peaked for paddy sowing and water supply was at its annual minimum, the kohli used to walk the kuhl overseeing water distribution and resolving water conflicts on the spot. His long turban and cane were adequate reminders of his authority and helped ensure that his word held. In some cases, his knowledge regarding the control, transport and distribution of water extended to supernatural realms. The kohli's role as officiant in the puja (religious ritual) to the kuhl's devi (goddess) and to Quaja Pir, reinforced his authority. Local stories recount how kohlis provided water for their kuhl during a drought by supplicating the kuhl's devi. The story "Never Argue With the Kohli" included in Appendix 2, illustrates the negative consequences of questioning a kohli's decision and the appeal he can make to supernatural forces to enforce his decisions. Often, the right to be kohli was a warisi, an inheritable right similar to that pertaining to property in land or a family's claim to hold a village office, which often stemmed from having played an important role in the initial construction of the kuhl.

In recent years the authority and respect accorded to the kohli have declined. The hereditary right to be kohli, in some cases, is now a liability rather than a privilege. Fifteen years ago the Brahmin clan, which held the hereditary right to the position of upstream kohli for Raniya Kuhl, relinquished their claim to that position. The last kohli from this clan stated that he quit because he could no longer resolve conflicts between farmers, and mobilize them for khana. In his words, farmers "no longer minded" him. Many current kohlis state that they would prefer their sons to get nonfarm jobs and not assume the responsibilities associated with what they consider to be the relatively thankless, difficult and poorly remunerated responsibilities of the kohli. Many kohlis also face increased difficulty in collecting their in-kind payments at harvest time. The meeting minutes of committee meetings are replete with admonitions stating the rates at which the kohli is to be compensated and the various sanction that would be applied to those who did not pay the kohli the agreed upon proportion at harvest time. Mosse (1997) describes the reluctance among farmers to compensate water tenders in the tank systems of Tamil Nadu as challenges to the social relations of production. Reluctance to pay the kohli his agreed upon share of the harvest likewise constitutes a direct challenge to the institution of kohli; those most reluctant to contribute to the kohli are most likely those who benefit least from the current water rights and distribution regime.

One of the most oft repeated complaints of kohlis are the frustrations associated with trying to accomplish khana with fewer men than previously. In some cases the work has been left undone. In 1988 Kishori Lai Kohli of Raniya Kuhl hired migrant laborers for the spring khana, and in 1991 the khana for Kathul Kuhl was never finished. Kishori Lai also described the difficulty he faces in collecting the

monetary payment a family is supposed to contribute in lieu of providing labor for canal cleaning. He stated that he will only go to the same house three times. If by the third visit payment is not forthcoming, then he will not return. To continue asking for payment would be an affront to his honor and self-respect. Kohlis and farmers alike mention the increasing difficulty with which the kohli is able to resolve water conflicts and ensure compliance with his decisions.

Changing Cropping Patterns

The example of Buhli Kuhl illustrated how and why the command areas of some kuhls have contracted. Analogous responses to the declining participation in khana and the increasing inequalities in the distribution of the burden of khana among farmers, include shifts in the method of paddy seed sowing, and location specific changes in the crops sown. These changes are due to increasing water scarcity in downstream portions of the command area of some kuhls and household labor shortages.

Most changes in cropping patterns are related to changing water availability. These changes include shifts from sprouted to dry seed paddy sowing, from sugarcane to wheat, and from paddy to maize. Farmers in Kangra Valley prefer to sow mach over battar because of the greater yield. But in the downstream portions of four kuhls the area sown using the dry seed method has increased while sprouted seed sowing has decreased. The increasing risks of water scarcity, especially in larh and tail end areas, offset the productivity advantage of sowing sprouted seeds.

A second shift in cropping patterns related to changing water availability is to substitute maize for paddy. Maize requires much less water than paddy. Usually only one initial irrigation is necessary prior to field preparation. This contrasts strongly with the heavy water requirements of paddy. Maize flour is used during the winter months to make a nourishing unleavened bread enjoyed with spinach or mustard greens topped with desi ghee (homemade clarified butter). The shift from paddy to maize has occurred almost exclusively in the larh regions of the command area of some kuhls. The shift from paddy to maize in larh areas is a response to reduced flows in the kuhl that result in less water delivered to the larh because it has a lower priority for irrigation than har areas.

A third cropping pattern change concerns the cultivation of sugarcane. The spatial distribution of sugarcane, given its heavy water requirements, would appear to make it a good indicator of changing patterns of water availability. Sugarcane has virtually disappeared from the tail end sections of kuhls and the larh areas of most villages. However, its cultivation has also declined substantially throughout Kangra Valley. The general decline of sugarcane is perhaps more strongly related to the availability of relatively inexpensive processed sugar and other sugarcane products grown in neighboring Punjab and Haryana, than to changes in kuhl water availability.

A final change in cropping patterns concerns whatNegi (1993) calls social fallow in which some farmers in Himachal Pradesh cease cultivating some formerly irrigated paddy fields.[7] These "abandoned" fields (from the point of view of cultivation) produce valuable fodder that is harvested for livestock feed. The decision to cease cultivating fields results from a combination of factors including increasing household labor shortages and water scarcity, as well as regional fodder shortages, especially during the winter months. In Kangra, fodder supplies during winter months are so inadequate that farmers from Punjab find it lucrative to truck crop residues to Kangra and where they are sold as fodder.

Kuhl Regime Responses to the Stresses Induced by Increasing Nonfarm Employment

The tensions arising from increasing nonfarm employment have differentially affected the 39 kuhls in the Neugal watershed. The diverse responses among kuhl regimes to these tensions reflect each regime's particular set of micro social and ecological characteristics rather than a common basinwide response to shared tensions and conflicts. Ten regimes persist relatively unchanged; these kuhls are informally managed without a kohli. Twenty kuhl regimes modified their organizational structure at both the operating level and the institutional level (Ciriacy-Wantrup 1969). Responses at the operating level include changes in remuneration rates for the kohli, reorganizing the mobilization of resources for kuhl maintenance and repair, and the degree of formality of kuhl management activities. Responses at the institutional level include the formation of kuhl committees, with their varied structures, functions, mechanisms of accountability, and degrees of effectiveness, and renegotiated relations between individual kuhl regimes and the state government. The day to day management of these kuhl regimes is the responsibility of generally one, but in a few cases, two or more hereditary or elected kohlis. The remaining nine kuhls collapsed in the late 1960s and early 1970s and are now managed by the Himachal Pradesh Irrigation and Public Health Department (IPH). The panchayats (elected village councils) of the areas these kuhls used to irrigate negotiated with the IPH Department for it to assume responsibility for kuhl management under the Himachal Pradesh Minor Canals Act.[8] The state government's management of

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[7] As Greenbefg (1997) points out, fallow land in Kangra has been and continues to be an extremely small proportion of total land use. Currently fallow land in Kangra comprises approximately only 1 to 2 percent of the total cultivated area (Swarup and Sikka 1986:12, quoted in Greenberg, 1997:205). Thus the decision to engage in social fallowing due to a combination of scarce labor and fodder supplies, also performs important ecological functions.

[8] The Himachal Pradesh Minor Canals Act of 1976 authorizes the Himachal Pradesh Irrigation and Public Health (IPH) Department to "assume the control and/or management of any canal [kuhl] if the owner[s] of the canal consents thereto...." The authority to manage the kuhl can be returned to the owners upon their request at any time. After six years of government management, the owners may request the government to acquire the kuhl under the provisions of the Land Acquisition Act of 1894. Doing so grants the government authority to "exercise all powers of control, n'anagement and direction for the efficient maintenance and working of such canal or for the due distribution of the water thereof." It also grants the government authority to levy a tax for the use of kuhl

these nine kuhls constitutes a direct and total subsidy because it has yet to assess or collect any water tax from the farmers whose land the kuhls irrigate.

The IPH Department's direct involvement in managing these nine kuhls, and the indirect involvement of other state agencies and departmentsthrough occasional grants for the repair of committee-managed kuhls, has been instrumental in preserving the overall viability of the kuhl networks within the Neugal basin. The reasons for the willingness of these state agencies to participate in irrigation management, although varied, are grounded in the ideology of the developmentalist socialist welfare state. More instrumentalist motivations within the IPH Department include increasing the department's power relative to other departments, and justifying an expanding budget. The expectation of political support in return for financial subsidies for kuhl repair is a less direct, but nevertheless significant motivation that informs the giving of subsidies by the civil administration and on occasion grants brokered by locally elected political leaders.[9]

The following sections explore the nature and effects of the operational and institutional changes instituted by the farmers of the 20 kuhl regimes mentioned above. This is followed by an analysis of the pattern of changes in all 39 kuhls in the Neugal watershed.

Kuhl Committees - Structure and Function

Fourteen kuhl regimes have formed committees, all since 1950. Local officers of the Punjab State Government organized the two earliest kuhl committees (Pangwan and Pathan Kuhls) in the early 1950s as part of a more general effort to form Agricultural Cooperative Societies to disseminate green revolution technology, subsidize agricultural inputs and improve access to rural credit. When these two committees were created and registered under the 1860 Cooperative Societies Registration Act, they were given a set of by-laws specifying the purpose of the committee, membership criteria, the committee's officers and their duties, the records it should maintain, and its general functions. Because they are registered, an officer of the Department of Cooperative Societies annually audits their account books. Of the fourteen kuhl committees in the Neugal basin, only these two are registered under the 1860 act.[10]

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water, "keeping due regard to the maintenance and operation charges for the system and the cost of collection of water rates" (Minor Canals Act 1976:sections 9, 28, 34-36). This water tax is separate from, and in addition to, the land revenue assessed on irrigated land.

[9] A test of this hypothesis, which I did not conduct, would be to track the numbers of grants given to kuhl committees in relation to election and non-election years. This hypothesized relationship is supported by the fact that large amounts of financial resources have been spent on the kuhls in Sulah, the home constituency of the previous Chief Minister, Shri Shanta Kumar. If a state agency competes with local user groups over resource access and use, rather than benefits from subsidizing local use of the resource, then of course the state/local dynamic will be much different than what obtains within the context of irrigation in Kangra.

[1] Registered kuhl committees are audited annually by an officer of the Department of Cooperative Societies. This audit ensures "proper" accounting of money the kuhl committee receives through government grants, membership

These two initial "cooperative irrigation societies" as they were originally called, constituted the corporate blueprint on which subsequent kuhl committees were modeled, though the irrigators themselves rather than government officers created the later committees. The corporate structure of committees is remarkably similar. Each committee consists of a governing head of elected officers that includes a President, sometimes Vice-President, Secretary and Treasurer. Nominations, followed by elections, are usually held once a year. The voting members of the committee sometimes are restricted to landowners within the kuhl's command area, and sometimes include non-landowning cultivators.

Kuhl committees were formed for three reasons. The relative importance of each of the three varies from kuhl to kuhl. Table 5.2 summarizes why and when the 14 kuhl committees in the Neugal basin were created. The most common reason to create a committee was to strengthen the declining authority of the hereditary kohli by providing alternative or supplementary bases for the kohli's authority and additional accountability mechanisms. In this regard committees fulfill three functions: they provide an arena above the kohli for resolving conflicts between farmers and for backing up the decisions the kohli makes, they create rules governing kuhl maintenance and repair, and they provide the means to monitor and enforce rules and to sanction rule violators.

Most committees support the kohli in a collaborative manner; they do not supplant the kohli's role. Unlike the tank irrigation systems in southern Tamil Nadu in which the nirppacci water distributors have challenged their low caste hereditary positions and the tradition of in-kind payments (Mosse 1997:32), the roles, responsibilities and remuneration of kohlis have not been so contentious. The reasons for the differences are illuminating. First, and perhaps most importantly, the position of kohli, while hereditary, is not restricted to a specific caste; kohlis of kuhl regimes in the Neugal basin come from different castes, high and low. The position of kohli was historically a desirable hereditary right awarded to a family or clan in recognition of their contribution to the construction or reconstruction of the kuhl. Contrary to the situation in southern Tamil Nadu in which the hereditary nature of the nirppacci water distributors was linked to their servile low caste status, the hereditary nature of the position of kohli ensured that the privilege of being kohli stayed with the original family or clan that had been awarded that warisi (hereditary right). Interestingly, all kohlis, regardless of caste, perform the annual puja at the kuhl's diversion structure - puja that is meant to benefit all the kuhl's irrigators. This often includes higher caste farmers than the kohli himself. Thus the position of kohli is unusual in its ability to float between castes. Secondly, while dissension occurs over the rate of remuneration of the kohli, the fact that the payment is in kind rather

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fees, contributions for puja, and fines. Additionally, many farmers feel that a registered kuhl committee has more standing with the district administration when applying for grants than an unregistered committee.

than cash is not a bone of contention nor a caste-based status marker. This also contrasts with what Mosse reports for southern Tamil Nadu. While it would not be correct to go so far as to say that the reverse holds true for Kangra, it is true that low caste landless or land poor laborers are paid in cash, not kind. Thus it seems that in Kangra the form of remuneration is not necessarily linked with the status of the position or the person who fills it.

	Bhradi	Bha-gotla	Kathul	Sap-ruhl	Pathan	Mak-rahl	Sam-ruhl	Pang-wan	Sonia	Gag-ruhl
Year Started	1970	1986	1970	1965	1952	1974	1950's	1954	1950's	1977-78
Why Started	D	L	L G D	L G	L G	L G	L	L G	L G	L
	Raniya	Taruhl	Cham-ruhl	Mas-anol						
Year Started	1952	1989	1989	1974						
Why Started	L G	L G	L G	L						

Table 5.2 Kuhl Committees of the Neugal Basin, when and why started, by kuhl. L = to increase legitimacy of kohli, G = to facilitate acquisition of government funds for kuhl repair, D = to defend against external threats to a kuhl's water supply.

Kuhl committees constitute a level of decision making authority one step removed and above that of the kohli. Neither do they compete with the kohli for authority, nor do they supplant his authority. The importance of a hierarchy of arenas for resolving conflict was articulated by nearly every farmer I interviewed. Almost without exception, farmers explained that a conflict between two individuals regarding water would travel up to higher arenas of conflict resolution until it reached the arena that had the authority arid enforcement capacity to match the strength of the conflict. Ranked in terms of enforcement capacity from less to greater, these arenas are the kohli, the kuhl committee, the panchayat, and the Sub-district Magistrate (SDM) and/or the police.[11] The minutes of committee meetings are replete

[11] The only examples I observed of panchayat involvement in water management and conflict resolution was for the jointly managed Mahang and Loharal Kuhls. There is no kuhl committee for this pair. The panchayat appoints the kohli (since the family holding the warisi to be kohli no longer claims the right) and resolves water conflicts if and when they arise. Panchayats generally do not assume the role of a kuhl committee for the following reasons, 1) panchayat boundaries are rarely coterminous with a kuhl's command area, 2) the politics of panchayat elections incorporate different forms of authority and interests than kuhl committee elections, 3) the motivations and benefits associated with being a panchayat member do not overlap with those associated with being on a kuhl committee. I heard of only one example of a conflict taken to the SDM or police station. This concerned an organized protest of several hundred farmers in the 1970's against the proposed IPH construction of a cement diversion structure at the head of the Neugal watershed. The proposal violated prohibitions against making a permanent structure and

with references to the multiple ways in which the kuhl committee backs up and reinforces the kohli's authority. There are many resolutions that reinforce the kohli's authority to block unauthorized water diversions and withhold water from those who steal or use it out of turn, especially during times of water scarcity. Take Sonia Kuhl for example. This kuhl irrigates 25 hectares in the Rajput village of Panapar located in the downstream portion of the Neugal basin. On July 20, 1987 the committee decided that due to water scarcity the kohli, with the help of a carpenter, would install the bamboo water measuring devices (thellu) at every diversion point beginning the next day. In anticipation of upcoming water conflicts the committee emphasized that water would be withheld from the fields of farmers who stole or misused water, and that they would be held responsible for any resulting damage to other farmers' crops. In anticipation of challenges to the kohli's authority, the committee stated that those who fought with the kohli would be referred to the Sub-district Magistrate in Palampur. Meeting minutes also sometimes reflect a committee's self-conscious realization of the limits of its own and the kohli's power. For example, on July 10, 1980 the committee for Gagruhl Kuhl, a small kuhl adjacent to Sonia Kuhl, declared that it would not be responsible for resolving night time quarrels over water. Committees also often reinforce the kohli's right to a specified share of the harvest of the kharif crop and, often in response to complaints by the kohli, resolve to help the kohli collect his share from recalcitrant farmers. Committees commonly pass resolutions that the cases of farmers who do not pay the agreed upon fines for not participating in khana or for water stealing will be referred to the village panchayat pradhan. Similarly, the committee for Gagruhl Kuhl requested the panchayat Pradhan to collect the overdue fees from farmers who had not paid their share of the stonecutter's fee for repairing a collapsed section of the kuhl.

The committee can also provide an arena for airing conflicts between the kohli and farmers dissatisfied with the kohli's work. In 1982 a group of farmers from Village Kharot lodged an extensive set of written complaints against Dhyan Singh, the kohli of Pathan Kuhl. These included various accusations of water mismanagement and inadequate organization for kuhl maintenance and repair. In addition to concerns about the how the kohli was managing the kuhl, the farmers who submitted the complaint also expressed their dissatisfaction with the kohli's attitude. They stated that the kohli does not understand his role, that he considers himself an important person, and that he does not understand how to "take work from farmers" referring to the mobilization of labor for khana, kuhl repair and danga construction. They also alleged that the kohli quarrels with and "abuses" (i.e. shouts and yells) at farmers. Describing an incident in which a farmer who had brought water through the kuhl to irrigate his own fields was unable to

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also potentially threatened downstream water supply. Despite the protest, a permanent diversion structure was constructed.

because the kohli directed the water to others' fields, the complaint questions the worthwhileness of continuing the kohli's grain payment. The minutes noted that at this point the kohli interjected that he had no need of their grain payment. The committee at least partially responded to some of these complaints by ruling that requests for water from those without formal water rights to the kuhl's water had to first be approved by the committee before the kohli could actually arrange for the water delivery. While it is not clear if and how the committee resolved all or most of the issues the farmers raised, it is probable that they reflect an ongoing set of dynamics. Several years later the committee noted that Dhyan Singh had pledged to work "honestly and sincerely". Among other things, the meeting minutes note that the kohli is not a dictator, and that neither flattery nor threats were acceptable ways of obtaining water from him. Such statements intimate that the kohli had been acting in a dictatorial manner and that farmers had been using flattery or threats to obtain water.

Committees also attempt to resolve conflicts between farmers. When a conflict appears intractable at the local level, it is referred to a higher level of authority. In April 1988 the meeting minutes for Pangwan Kuhl's committee refer to an ongoing conflict in which a Rajput farmer in the upper portion of the kuhl's command area blocked the water channel thus depriving 26 downstream farmers of water during the rabi season (when irrigation water is used for wheat and potato production). The group of downstream farmers submitted a written application to the committee, asking the committee members to resolve the issue. Despite multiple attempts, after a 15 day period the committee determined that it could not prevail upon the Rajput to allow the water to flow through the channel. It referred the issue to the panchayat, and asked the Sub-district Magistrate to also investigate the case. The same issue resurfaced in July of the same year when water scarcity prior to the monsoon is at its highest level. The committee visited the area where the kuhl had been blocked and noted that the channel that the Patwari (village revenue officer) had re-opened had been again blocked off. While the committee members were unblocking the channel the family members of the Rajput, Subash Chand, came and threatened the committee by saying they would kill anybody who opened the channel. The committee members were able to convince the family members to allow water to flow for 24 hours to save the paddy crop of the affected 80-90 downstream kanals. However, the committee also noted that if the channel was blocked again it would not take more action because of the danger of possible bloodshed.

In addition to resolving particular conflicts, or forwarding the conflict to a decision making arena with greater authority, committees also make decisions regarding general kuhl management. Such decisions are usually made when all the irrigation society members meet just prior to and/or during the hot season before the monsoon begins. This is the period when water is most scarce and reliance on kuhl water

for field preparation, mach, and hod is greatest. At these meetings members discuss current issues and conflicts (particularly those related to the upcoming irrigation season), prior rules are reviewed, new rules are sometimes developed, and committee officers make their reports. A common management decision made during the late spring meeting concerns setting the dates for khana or instructing the kohli to set the date and notify irrigators, often by beating the drum and calling out the announcement. Additional meetings are called as necessary throughout the kharif season. Meetings are often held in June to determine the order and conditions under which the kuhl's water will be rotationally distributed to farmers for field preparation. This form of turn-by-turn water delivery is known as dol. The committee will generally set the order (including date and time period) during which different secondary and tertiary channels will receive dol. Accompanying this decision are statements reiterating that only the kohli is authorized to guide the kuhl's water from channel to channel and that farmers who did not participate in that season's khana will not receive water unless they pay the determined fines. At these meetings committee members emphasize that it is the farmer's responsibility to finish their fieldwork during their dol turn and that neither the committee nor the kohli is obligated to provide more water if field preparation is not completed within the specified period. These meetings also are forums for discussing issues related to kuhl maintenance and repair, including problems with the quality of khana and suggested rule changes.

After the period of dol water distribution, kuhl regimes with low water flows, either because of less than average snowfall the previous winter, declining kuhl maintenance, water theft, or upstream diversions, will often shift to a regulated continuous flow water distribution system. Near the end of the period of dol water deliveries, a meeting will be held to discuss the installation of the bamboo thellu water measuring devices at every diversion point (tup) in the kuhl. The committee or the kohli may recommend installation of thellu to help ensure equitable water distribution and to reduce the inevitable conflicts between farmers that arise under these conditions. The kuhl committee will meet, generally approve the kohli's recommendation, and will authorize the construction and installation of thellu for each tup. The kohli supervises this process. If water scarcity worsens to the point that even with thellu installed, portions of the kuhl's command area are not receiving their share of the rationed water, then the kohli will suggest that rotational water delivery be substituted for continuous flow irrigation. If the committee agrees with the kohli, then they will, in consultation with him, determine the timing and order of the rotations. The irrigation schedule will be written in the proceeding book, and at the specified time and date the thellu will be removed and rotational water delivery begun. This practice is common to all the kuhl committees on the right bank from Pathan Kuhl through Gagruhl Kuhl. No instance of this emerged from any of the interviews conducted with left bank farmers and kohlis.

Perhaps one of the most important written records committees and kohlis maintain is the attendance register. Kohlis note in attendance registers which families provided labor for khana and which did not. Some registers, such as those for Pathan Kuhl (discussed above) illustrate declining participation rates while others, however, do not. For example, table 5.3, which summarizes information contained in khana attendance records for four kuhls, Masanol, Bhagotla, Gagruhl and Pangwan, shows that participation in these four kuhls has not declined in recent years. Each of these kuhls irrigates only har areas for which no alternative water sources are available. Each kuhl has a committee. The irrigator groups of all but one kuhl (Bhagotla) are multi-caste. However in no kuhl does land distribution appear to be as unequally distributed as in Mauza Saloh (Raniya Kuhl).

Year	Masanol			Gagrahl			Bhagotla			Pangwan		
	D	W	P	D	W	P	D	W	P	D	W	P
1974	2	51	58									
1975	4	60	41									
1976	4	93	52									
1977	4	90	47									
1978	11	205	40									
1979	6	159	59	5	97	30						
1980	6	126	' 37	13	243	29						
1981	9	278	51	13	164	20						
1982				16	211	21						
1983				13	276	33						
1984				7	149	33						
1985				7	124	28						
1986				2	63	49	1	30	65			
1987				3	49	38	1	30	65			
1988				7	185	41	4	69	60			
1989				8	134	26	1	15	34			
1990				1	27	42	1	17	37	13	240	25
1991	3	81	46	19	325	27	1	15	34	16	275-	23
1992	2	91	70	18	365	32	1	20	43	7	138	25
1993				33	355	17	1	15	34	16	381	29

Table 5.3 Average Participation Rates for Masanol, Gagruhl, Bhagotla and Pangwan Kuhls. D = number of days called for khana. W = total number of workdays contributed. P = Percent present. Between 1982 and 1987 Masanol Kuhl had collapsed. Prior to 1986 khana attendance records were not maintained for Bhagotla Kuhl. Attendance records for remaining data gaps were lost, misplaced or otherwise unavailable.

Table 5.3 does show that rates of participation are generally low, that they vary from year to year, and that except for Bhagotla Kuhl, they do not seem to be declining. The declining participation rate for Bhagotla Kuhl may be related to the creation of the kuhl committee and the election of a new kohli in 1986, the year attendance records were also started. I suspect that prior to 1986 attendance had declined, probably due to nonfarm employment. In response the irrigators created a kuhl committee and chose a new kohli. This temporarily increased participation for three years, after which it again declined. However, the

sparse data provide basis only for speculating about, not explaining, low participation rates. Have participation rates always been low for these kuhls? Did participation rates decline prior to the inception of attendance records? Would participation rates be lower without attendance records? If so, for which kuhls? The increasing rates of nonfarm employment, the assumption that attendance records would not have been instituted without a need for them, and statements by the kohlis of these kuhls that participation has declined suggests that, 1) without attendance records participation would be lower, or 2) if attendance records have not improved participation rates, they still provide leverage to the kohli and kuhl committee for assessing fines against farmers with high absenteeism.

Does low participation imply free riding? Are the same people absent each time khana is called, or are most individuals absent part of the time? Table 5.3 shows that participation rates for Pangwan Kuhl varied between 25 and 29 percent between 1990 and 1993. Analysis of the attendance registers for Pangwan Kuhl at the individual farmer level indicates that out of a total of 66 irrigators, other than three individuals, no farmer except the Kohli was present for more than half the announced work days. Thirty five irrigators came between twenty and fifty per cent of the announced work days, 12 came between ten and twenty per cent of the time, 11 came between five and ten per cent of the time, and 4 never came. Of the four individuals who never came, two are women from women headed households. There are strong proscriptions against women participating in khana. Unless there is a son in the family who can be sent, these households will be excused from khana. These attendance records show that low participation rates do not necessarily imply that a minority of farmers contributes the majority of the labor for khana. In Pangwan Kuhl most farmers participate in khana less than have half the days for which khana is called. Those that never or rarely come are fined by the committee.

The specific configuration of social relations among the irrigators of a kuhl shapes the meaning and effectiveness of structurally similar committees. Every kuhl regime that maintains attendance records also has developed some system for collecting fees from, or imposing fines on, households that do not contribute labor for kuhl maintenance. The money collected in fines is used to purchase materials and supplies for kuhl repair and maintenance such as shovels and cement. The issue of fines for absenteeism during khana is a common theme during committee meetings. A common de jure rule is that for every day a household does not contribute labor it must give the equivalent of a laborer's daily wage (Rs. 25-30). However, given that average participation rates in khana range from only twenty-five to fifty per cent (see table 5.1), implementing and enforcing this rule becomes extremely difficult and time consuming, if not impossible. The de facto solution to this problem is to only fine households which are very absent, i.e. who in a particular year never contribute labor, or perhaps only provide labor once or twice. The Pangwan Kuhl

Committee has created a rule that is feasible to implement. Rather than assessing the daily wage rate for every day of absence, a fine of Rs. 30 is levied for every six or seven days of absence. The effect of this rule is to encourage farmers to turn out for khana two or three times a year which is what most do anyway. And for those who are absent more frequently, a fine of Rs. 30 is not an unreasonable amount to pay.

In contrast to Pangwan Kuhl, the kohli for Raniya Kuhl, Shri Kishori Lai, neither maintains accurate attendance records nor even attempts to collect fines due to the high levels of conflict within Raniya Kuhl which is riven by caste and wealth inequalities and whose committee is controlled by a few large landowning families. In Samruhl Kuhl a fine system initiated in the early-1980s led to women from de facto women-headed households (a result of male out-migration) having to participate in communal work parties. This contravened the proscription against female participation in any communal aspect of kuhl management. In response, in 1983 the kuhl committee, which includes two women members, and irrigators of this kuhl resolved the issue by substituting a monetary fee based on the area a household cultivates (Rs. 1/kanal) in lieu of labor contributions (the fee was increased to Rs. 1.5/kanal in 1989 and to Rs. 2/kanal in 1990). These three examples illustrate the quite different functions played by structurally identical committees. The Pangwan Kuhl Committee's fine system effectively mitigates against the pull of nonfarm employment, the committee for Raniya Kuhl was a means (albeit unsuccessful) for local elites to maintain their threatened hierarchical authority, and the committee for Samruhl Kuhl was an effective vehicle for shifting from labor to monetary contributions for kuhl maintenance and repair. The institutional innovation of substituting monetary for labor contributions for khana, first instituted by the committee for Samruhl Kuhl in the early 1980s, had been adopted by several other kuhl regimes in the Neugal basin by the early 1990s. An additional note is that the Committee President for Samruhl Kuhl in the early 1990s was a woman. This was the only case of a woman-headed kuhl committee, past or present, of which I learned.

Apart from setting fines for failing to participate in khana, committees also levy fines and fees for other reasons. These include membership fees for the irrigation society (membership is open for both owner-cultivators and tenant-cultivators), and fees to cover expenses for kuhl repair (i.e. stonecutter fees and materials). Fees are sometimes based on a sliding scale, calibrated to land ownership. The committee for Gagrujil Kuhl decided in 1979 to charge twice as much of large landowners as it did for small landholders to cover the costs of repairing the danga. In Pathan Kuhl farmers with 4 kanals or less of land are exempted for khana altogether. Some committees levy fines for water stealing and the committee for Pathan Kuhl even established a reward system: if the danga is damaged by fishermen (or downstream water

users) a Rs. 50 reward is given to the person who identifies the responsible parties, and a reward of Rs. 10 is given to the person who reports on farmers who make illegal holes to allow water to flow into their fields.

Committees represent the common interests of the irrigation society to various branches and departments of the state in order to facilitate acquisition of monetary support for kuhl system repair and maintenance. This is the second most common reason for committee establishment. A kuhl regime that has a kuhl committee can more easily request government money for system maintenance and/or repair than a kuhl regime without a kuhl committee. The ability of a committee to acquire government funds derives from its accountability to government agencies and the ability of its officers to approach government officials. A block development officer or sub-district magistrate is more likely to authorize funds for kuhl repair if they are channeled through an organized committee that can be held accountable for the money, instead of through an individual kohli. A kohli may not have received higher secondary education, nor be skilled in the bargaining and negotiation that inevitably accompanies local level government funding opportunities. In most cases the officers of a kuhl committee will have those skills and be more successful than the kohli at acquiring government grants.

There are numerous examples of committees interacting with various branches of the state government. The committee for Samruhl Kuhl has successfully petitioned the Block Development Officer several times for funds to help rebuild portions of the main kuhl channel. The committee for Sonia Kuhl requested the Public Works Department to repair a bridge over a kuhl that had collapsed, thereby flooding adjacent fields. The Pangwan Kuhl committee has also successfully requested funds from the Block Development Office to repair sections of the main kuhl channel destroyed by floods.

Interactions with the state government are not just limited to requests for funds and support. The two cooperative irrigation societies, which are registered under the Cooperative Societies Registration Act, are also audited annually by officers of the Cooperatives Department. The audit focuses primarily on the societies' financial management. While financial accountability is important even within kuhl committees, it is less of a high stakes issue than in the case of agricultural cooperative societies, which provide loans and agricultural inputs at subsidized prices to its members.

Kuhl committees also defend against external threats to the kuhl's water supply. Two kuhl committees were primarily formed for the former purpose. Threats to a kuhl's water source usually derive from an upstream claimant. This may be an upstream village through whose land the kuhl flows, or it may be an upstream state-managed kuhl whose diversions threaten the water flows of its downstream neighbors. In the case of Bhradi Kuhl, the shareholders of the kuhl organized a kuhl committee to protect their water interests threatened by the state-sponsored construction of an adjacent upstream kuhl. The committee

mobilized financial resources from its members, and challenged the Department of Irrigation and Public Health in court. In 1988 the District Court decided the case in favor of Bhradi Kuhl, against the state of Himachal Pradesh. Creating a kuhl committee enabled the irrigators of Bhradi Kuhl to mobilize more resources, to be held more accountable for managing those resources, to have more standing in the District Court, and to more effectively represent their interests in the courtroom than if there was no kuhl committee.

Lastly, committees may constitute an institutional vehicle through which to coordinate inter-kuhl water transfers. For example the meeting minutes for Pangwan Kuhl, June 1989 note that the President of the adjacent downstream committee for Sonia Kuhl asked the Pangwan irrigation society to provide Sonia Kuhl with 48 hours of dol water because floods had destroyed the main channel of Pangwan Kuhl.

Kuhl Committees and the State

The rational, bureaucratic organization of the kuhl committees, as well as their formal rules of operation, reflect the imperatives of conforming to an organizational mold recognized and legitimized by the civil administration. The form of the committee certainly does not spring from local idioms of social organization, Instead it reflects the hegemonic imprint of the modern, bureaucratic nation state on local resource management organizations. The institutionalization of this organizational form within the modern Indian state accounts for the striking similarity in the corporate organization of every kuhl committee. The number of village level societies, cooperatives and committees has mushroomed since the community development initiatives of the 1950s. Government agencies organized many of these. If registered with the Department of Cooperative Societies, the Block Development Officer (BDO) or any other government agency, a committee must conform to the specified organizational structure. This explains the structural similarity between for example, women's village organizations in the nearby Changar region of the district and kuhl committees in Kangra Valley. The organizational structure of these local societies, cooperatives and committees that arose autonomously, i.e. without government involvement, conforms to the dominant organizational template.

The structural similarity of formalized local organizations is consistent with theories associated with "new institutionalism" within political science and sociology. Tolbert and Zucker (1983) argue that the institutional environment affects organizational structure primarily by legitimating a "new procedure, position, or element of structure," especially when hierarchically higher elements of the environment, i.e. regulatory agencies or institutions with the power to provide financial or technical support, establish implicit or explicit requirements that the organization must satisfy before support will be given. Tolbert and Zucker's analysis explains the relatively rapid diffusion of kuhl committees as a key organizational

response to a hierarchical institutional environment, the rational bureaucratic nation state, which legitimizes certain organizational forms. In order to successfully negotiate and interact with the civil administration, irrigators are subtly compelled to organize themselves in a manner consistent with the organizational norms of the institutional environment in which they find themselves.

To varying degrees the bureaucratization of kuhl management has enlarged the bases of authority for kuhl management from charisma, personality and local knowledge to also include literacy, wealth and demonstrated ability to negotiate with government bureaucracies. Under some conditions, especially where interaction with the state is a vital concern of the kuhl regime, this may have shifted authority for water management away from the hereditary position of watermaster towards the elected members of the committee. On the other hand, in some cases, kuhl committees function to back up or support the authority of the kohli to manage the kuhl, mobilize labor, and resolve conflict. In such cases the authority roles embodied in committees and based on literacy, wealth and the ability to successfully negotiate with the state, can be a complement to those of the kohli based on local knowledge and force of character.

Committees, structured in the image of rational bureaucracy, legitimize forms of authority that differ significantly from those of the watermaster. Committees validate forms of authority based on social and economic status and the ability to interact with and skillfully negotiate grants from civil administrative officers and local political representatives. Individuals who possess these characteristics are generally the more politically and economically influential members of the community, the local elite. These are the individuals who are most frequently elected to be the officers of a kuhl's committee.' In some kuhl regimes committee officers make decisions regarding water management, water distribution and conflict resolution that the watermaster previously made. In these instances the watermaster, rather than the autonomous authority regarding water management he previously was, now implements the committee's decisions. Whereas previously the watermaster was a hereditary position, now, in some kuhl regimes with committees, the committee and members of the irrigation society nominate and elect an individual to be watermaster for a specified term. These "temporary" kohlis do not have the stature of the permanent hereditary kohlis in the watershed, such as Kehar Singh of Menjha Kuhl or Dyan Singh of Pathan Kuhl. Instead they are viewed more as semi-skilled laborers for whom this is a way to increase their household's meager income.

Does the bureaucratization of kuhl management consolidate elite authority? The answer seems to depend on degree of inequality and latent conflict among a kuhl's irrigators. Where inequality in terms of landholding size and wealth is relatively high, bureaucratization further consolidates the authority of the local elite, as occurred in Raniya Kuhl. The committee for Raniya Kuhl, dominated by large landowning and high caste farmers, opposes rules governing labor contributions based on landownership and has

blocked moves by the watermaster and other fanners to petition the Irrigation and Public Health Department to take over management of the kuhl for fear that a tax based on landholding size would be assessed. Consequently large landowners within this kuhl now receive a disproportionate share of water relative to their labor contributions for kuhl maintenance and repair. Also, the watermaster for Raniya Kuhl, a low-caste stonemason, does not receive the committee's support for collecting fines from households that do not contribute labor for kuhl maintenance and repair. Consequently, free riding has increased. In situations of relatively unequal wealth distribution and manifest or latent conflict among irrigators, kuhl committees' consolidation of authority can exacerbate preexisting fault lines of conflict. In such cases the watermaster's authority may be undermined and the power of local elites strengthened.

On the other hand, the committees of kuhls whose irrigators are more homogenous in terms of caste and wealth inequalities are effective vehicles for formalizing water management rules and for negotiating with the district civil administration for small grants for kuhl repair and maintenance. However, even under these conditions bureaucratization tends to shift authority away from the watermaster to the committee because of the different basis of authority of the realms in which committee members operate. In the shift from relations based on status to those based on contractual forms of social relations, the role of kohli, when transformed from a permanent hereditary role to a temporary appointment, loses prestige.

Factors Shaping Institutional Change Within Kuhl Regimes

How can the various trajectories of institutional change within kuhl regimes, and the differential ability of kuhl regimes to persist, be accounted for? The framework presented below attempts to explain both the effects on kuhl regimes of increasing opportunity costs of labor associated with increasing nonfarm employment as well as the response of kuhl regimes to those effects. In particular, it seeks to account for the differences between kuhl regimes with regards to these effects and associated responses. The framework draws on three of the four strands presented in Chapter Two. These are the social and ecological characteristics of individual kuhl regimes, negotiated relationships with the state, and the effects of "regionally", i.e. the specific social, political and historical context of kuhl irrigation in Kangra, on the organization of irrigation institutions. The first strand addresses the dynamics of how farmers balance the risks and benefits associated with kuhl irrigation water against the costs of the collective action necessary to provide that water. The second strand explicitly addresses the potential role of the state in kuhl management. The state, for the purposes of this analysis, is conceived of as the totality of different agencies and bureaucracies, in short "officialdom", with whom irrigators may negotiate for a variety of benefits regarding kuhl management, seek recourse to for conflict resolution, or challenge in court when state claims to resources threaten local access and control of water. This strand involves analysis of the

nature and effects of the site specific interface between state institutions, local government (including village panchayats), and kuhl regimes. The last strand, "regionally", addresses the influence of the social, historical, and institutional landscape of kuhl irrigation on the pattern and nature of kuhl regime responses to the changing context of irrigation. This includes factors such as the precedents that the historical roles of both the pre-colonial and colonial states in kuhl construction and management established for contemporary state involvement in kuhl regimes, broader patterns of social relations of conflict and cooperation existing in other arenas besides water management that influence the social relations of irrigation, and the dialectical relationship between the construction of community and water management.

The first strand informs the analysis of the different effects of nonfarm employment on kuhl regimes. The degree of irrigators' reliance on kuhl water and the extent of socioeconomic differentiation among them enable differentiation of *kuhl* regimes by the effects of increasing nonfarm employment. Reliance on kuhl water and the socioeconomic differentiation of a kuhl regime's irrigators can be conceived of as two unidimensional summary variables which I shall designate "reliance" and "differentiation." These factors have both social and ecological components. "Reliance" is high when alternative water supplies are unavailable and the kuhl irrigates the fertile and productive har fields adjacent to the Neugal River, it is low when the reverse conditions obtain. "Differentiation" is high when a kuhl irrigates more than one village, the irrigators of the kuhl are comprised of multiple castes, and land distribution is relatively unequal, it is low when the reverse conditions obtain.

"Reliance" and "Differentiation" mediate the effects of nonfarm employment. Together, these two summary variables describe the dependence of irrigators on kuhl water and the potential for conflict among them. As nonfarm employment increases, the relative "reliance" and "differentiation" of a kuhl regime will influence the willingness of irrigators to continue to contribute labor and/or money for kuhl maintenance and repair. These factors also influence the degree of conflict between irrigators stemming from the fragmentation of common dependence on kuhl water. When "reliance" is high and "differentiation" is low, increasing nonfarm employment will minimally affect the kuhl regime. Under these conditions the low coordination requirements of the regime, the relatively equal distribution of incentive to contribute towards maintaining and repairing the kuhl, the high productivity of the land the kuhl irrigates, and the lack of alternative water sources minimize potential conflict among resource users.

When "reliance" and "differentiation" are both high, increasing nonfarm employment will lead to conflicts within the kuhl regime even though it irrigates productive har areas and post-monsoon alternative water sources are not available. Socioeconomic differentiation among the regime members diversifies members' discount rates for labor and time - those with access to nonfarm employment opportunities will

be less willing to contribute towards the provision of the collective good. Asymmetrical relations governing inputs as well as access to the benefits of the commons may be tolerated to the extent that the unequal status of the resource users is considered legitimate (O'Neil 1987:172-174). However, when access to nonfarm employment opportunities constitutes an increasingly available and attractive exit option (Hirschman 1970), the willingness to tolerate inequality may decline (Bardhan 1993a:91) as it did in Raniya Kuhl. The conflicts which result from differential discount rates and decreasing tolerance for unequal distributions of entitlements and responsibilities, when combined with the high coordination and resource mobilization requirements associated with large scale systems, will challenge the ability of kuhl regimes with high "reliance" and "differentiation" to maintain their integrity.

When "reliance" is low, and "differentiation" is high, the difficulties associated with mobilizing adequate labor for maintaining and repairing the kuhl and managing conflict will be greatest because the benefits are least and the difficulties greatest. The benefits of maintaining the kuhl are low because of the low productivity of the land the kuhl irrigates and/or availability of alternative post-monsoon water sources. The difficulties of maintaining the regime's integrity derive from the socially and economically differentiated resource user group that leads to greater conflict, and the high coordination costs of managing a regime that involves multiple villages and irrigates relatively large command areas. For these kuhl regimes internal stress will be highest and the incentives to remain within the regime will be lowest.

In the Neugal basin there are no low "reliance" and low "differentiation" kuhl regimes. By definition a kuhl long enough to reach a less fertile, upland larh area (low "reliance") will invariably pass through multiple villages and will have multi-caste irrigator groups (and therefore have high "differentiation"). Regardless, the "reliance" and "differentiation" framework does not make a strong prediction about the outcomes for kuhl regimes characterized by low "reliance" and low "differentiation" under conditions of increasing nonfarm employment. Low "reliance" suggests that because of the low productivity of the land the kuhl irrigates and/or the availability of alternative water sources, farmers are less likely to contribute towards the maintenance and repair of the kuhl. However, the regime's low "differentiation" suggests that the organizational requirements for managing the kuhl and the potential for conflict among farmers are minimal. Therefore some members may contribute adequate labor and other resources to maintain and repair the kuhl. Site specific factors not encompassed with the variables "reliance" and "differentiation" will determine the effects of increasing nonfarm employment on these kuhl regimes.

The processes that influence the tensions, conflicts and stresses within kuhl regimes also shape the responses to those tensions, conflicts and stresses. The degree of regime formalization, the extent of

negotiated state intervention in regime management, and the likelihood of regime collapse depend on the nature of reliance on the benefits the regime provides for the regime members and the degree of social and economic differentiation of the regime members. The high dependence on kuhl water, low coordination requirements and low conflict potential of high "reliance" and low "differentiation" kuhl regimes suggests that these kuhls will be informally organized with no kohli and managed independently of any state involvement. Irrigators of kuhls which deliver water to mostly high value crops and who are characterized by various social and economic differences (high "reliance" and "differentiation" kuhl regimes), will likely formalize their regime's management structure by creating a committee and formal management rules, and will negotiate with state authorities for grants for kuhl repair and maintenance. The organizational character of regime formalization will be influenced by exigencies emanating from the imperative to interact and negotiate effectively with "officialdom". Kuhls which deliver water to low value crops (low "reliance") and whose irrigators are divided by class or caste inequalities (high "differentiation") will likely show signs of potential collapse or be managed by the IPH Department. Indicators of potential collapse include shifts in methods of paddy sowing from the water intensive but higher yielding sprouted seed method (mach) to the less water intensive and lower yielding dry seed sowing method (battar), shifts from paddy to maize in the ridge and plateau areas and contractions in the command area of kuhls.

Observed Patterns of Kuhl Regime Response to Increasing Nonfarm Employment

The explanatory capacity of the framework presented above may be determined by classifying regimes according to their expected responses to increasing nonfarm employment, based on their degree of "reliance" and "differentiation". The extent to which expected responses correspond with actual responses reflects the degree to which the framework incorporates the key factors influencing kuhl regimes. A comparison of expected and observed responses, by kuhl, shows that the observed extent of formalization and state intervention in kuhl management and indications of potential collapse, matches the expected extent for 32 of the 39 kuhl regimes in the Neugal basin.

All 11 low "reliance" and high "differentiation" kuhl regimes are either under IPH management or show signs of possible system collapse. Three kuhl regimes (Ghran, Patnuhl and Ghughral Kuhls) are under IPH management that were not expected to be, and one kuhl (Menjha Kuhl) shows unexpected signs of potential collapse. The hamlets within the command area of both Ghran and Ghughrul Kuhls are undergoing rapid urbanization associated with the growth of the nearby town of Palampur as a district commercial center. Agricultural areas are being converted to residential and commercial uses. Rates of nonfarm employment are extremely high in the hamlets these kuhls irrigate, 88% and 85%, respectively. Given these unusual economic circumstances there was little opposition to the IPH Department's proposal

to takeover management of Ghran Kuhl when its diversion structure and main channel were subsumed by the by the large cement structure the IPH Department constructed for an adjacent cluster of IPH-managed kuhls. Similarly, Ghughrul Kuhl came under IPH Department because the intensification and diversification of competing urban and agricultural claims for water exceeded private conflict resolution capacities.

Patnuhl was also not expected to be under IPH management given its high "reliance" and high "differentiation". However, because less productive larh areas comprise approximately one-third if the kuhl's command area, and annual streams provide alternative post-monsoon water sources to portions of the har fields in the kuhl's command area, it would probably have been more accurate to classify the regime as having intermediate rather than high "reliance". The combination of unusually high indicators of "differentiation" (the kuhl has a relatively large command area (525 hectares), four kohlis, and irrigates portions of 25 different hamlets) and characteristics which suggest intermediate rather than high levels of "reliance" suggests that the incentives to maintain the regime's integrity were inadequate to overcome the substantial challenges to collective action required to maintain the kuhl.

Menjha Kuhl was not expected to show signs of potential collapse, yet it does; the ratio of paddy sown with sprouted to dry seed has decreased in the lower fertile areas, in the higher fields maize has begun to replace paddy, and the command area of the kuhl has contracted towards the headend. This is probably due to a combination of factors including the proximity of Village Menjha to the town of Palampur which may exacerbate the effects of increasing nonfarm employment, the fact that it does have substantial ridge and plateau top areas within its command area, and its relatively large command area (140 ha.) which may approach the maximum effective scale of management for committee-managed kuhls given the other social and ecological characteristics of this kuhl regime.

The expectation that high "reliance" and high "differentiation" kuhl regimes would formalize and continue to function without signs of potential collapse was confirmed by the observed outcomes; ten of the thirteen high "reliance" and high "differentiation" kuhls formalized their management structures. The three exceptions are Ghughrul, Menjha and Patnuhl Kuhls, all discussed above. In addition three kuhls (Masanol, Bhradi, and Bhagotla Kuhls), which were not expected to, did form committees.

Prior to the early 1970s Masanol Kuhl had neither a kohli nor a kuhl committee. Water was managed on an informal basis by the irrigators themselves. In the early 1970s Shri Phulli Ram returned from Rajasthan where he was a heavy equipment operator on a large government irrigation project. He was asked to be kohli for Masanol Kuhl, which a flood had destroyed several years previously, and had since been defunct. Phulli Ram agreed to be the first kohli for this kuhl. At the same time a committee was

also formed to help the kohli mobilize adequate labor to reconstruct the kuhl. The committee was able to secure a grant from the Member of the Legislative Assembly to purchase materials to repair the kuhl.

Bhradi and Bhagotla Kuhls also have committees despite their low "differentiation." As described above, the irrigators of Bhradi Kuhl had organized a committee to facilitate their court case against the IPH Department. The kuhl committee for Bhagotla Kuhl was formed in 1986 at the same time the present kohli was chosen. The previous kohli was from a small (less than ten households) upstream hamlet. Although caste and wealth were not divisive issues, the kuhl committee was formed to bolster the new kohli's authority in anticipation of water conflicts based on the locational asymmetries of the two hamlets.

The last class of kuhls, those with high "reliance" and low "differentiation," were expected to remain informally organized with minimal state intervention. Eleven of the fifteen high "reliance" and low "differentiation" kuhl regimes matched this expectation, while four kuhls discussed above (Masanol, Bhradi, Bhagotla and Ghran Kuhls) did not.

Three Classes of Kuhls

The composite factors "'reliance" and "differentiation" capture much of the variation among kuhl regime responses to the stresses resulting from expanding nonfarm employment opportunities under conditions of access to state assistance and subsidies, and state willingness to assume management of defunct kuhl systems. The seven kuhl regimes that did not respond as expected indicate a slight trend among kuhls to be more formalized and have greater degrees of state intervention than expected.

Three broad classes of kuhl regimes emerge from the analysis. The kuhl regimes observed in the high "reliance" and low "differentiation" category were informally organized. None have a kohli or a kuhl committee. All continue to be informally organized with few if any rules, sanctions and enforcement mechanisms. With the exception of Rein da cho, none have received any state assistance during the last five years. These kuhl regimes were negligibly affected by the potential stresses resulting from increased nonfarm employment because of the low potential for conflict among the irrigators, their relatively low organizational complexity, and the fact that they irrigate predominantly fertile paddy and wheat growing fields for which alternative water sources are not available.

The farmers of high "reliance" and high "differentiation" kuhls have formalized their management structures. All of these kuhl regimes have kohlis, and except for Mahang and Loharal Kuhls, have created committees relatively recently. None of these kuhls exhibits signs of potential. Each kuhl regime received at least Rs. 10,000 (US$330) from the Block Development Officer, District Commissioner, or the Forest Department for kuhl repair work. The tensions increasing nonfarm employment generated in these kuhl regimes were buffered by their high "reliance" characteristics - they are the only source of irrigation water

for highly productive and highly valued paddy and wheat fields. Regime formalization, e.g. creation of committees, formalizing monitoring and sanctioning rules, and instigating fine systems, enabled irrigators of these regimes to manage internal stress as well as to broker government grants.

All low "reliance" and high "differentiation" kuhl regimes have either been taken over by the IPH Department or they exhibit the signs of potential collapse mentioned above. The high "differentiation" of these regimes makes them particularly to increasing levels of conflict resulting from increased nonfarm employment because the irrigators of these kuhls were already riven by pre-existing fault lines of conflict. Additionally their low degree of "reliance" reduced the risks associated with withdrawing from the kuhl because of the availability of alternative post-monsoon water sources and/or the relatively low productivity of the kuhl's command areas. The combination of low "reliance" and high "differentiation" within these regimes generated high levels of internal stress and few incentives for investing the resources necessary for its management.

At the basin level increasing nonfarm employment opportunities initiated a sequence of responses that produced new patterns of authority and organization for water management. Some kuhl regimes persisted unchanged, some transformed their management structures and negotiated with state authorities for monetary grants, and other regimes collapsed. These differential patterns of change within individual kuhls have created a web of multi-jurisdictional, interconnected kuhl networks that would appear highly resilient at the basin level, especially with regards to the stresses associated with increasing nonfarm employment. The next chapter addresses kuhl regime response to the stresses associated with stochastic destructive floods and earthquakes.

Chapter Six

Networks of Interdependence

This chapter concerns the fourth strand of the explanatory framework presented in Chapter Two - the possible role of networks of physical and social linkages between kuhl regimes in enabling their persistence within a context of recurring environmental shocks such as floods and drought. A cursory glance at the evidence suggests that they do. For example, the vignette at the beginning of Chapter One describes the water sharing agreement negotiated in 1952 by the respective kohlis of Menjha and Patnuhl Kuhls following the bursting of a temporary landslide dam in the headwaters of the Neugal River. After farmers from both Patnuhl and Menjha Kuhls repaired Patnuhl Kuhl, water from that kuhl was diverted for three years into Menjha Kuhl until it too was once again operational.

Inter-kuhl coordination also emerges under conditions of drought. For example, in 1989 the monsoon rains were late, thus creating water shortages for some kuhl regimes in the lower reaches of Neugal watershed. On June 26 the President of the committee for Sonia Kuhl, Shri Jagat Ram Ohri, lodged a formal request with the committee of Pangwan Kuhl, the next upstream kuhl. Mr. Ohri noted that the farmers of Sonia Kuhl were unable to continue with field preparation and paddy sowing due to the fact there was little or no water in the kuhl. He asked the committee of Pangwan Kuhl to direct the kuhl's water flow into Sonia Kuhl for a period of 48 hours to allow the farmers to complete their field preparation and paddy sowing activities. The committee agreed; they directed the kohli to notify the president of the Sonia Kuhl Committee that the full water flow of Pangwan Kuhl would be diverted to Sonia Kuhl for 48 hours.

To what extent does coordination between kuhls reduce the vulnerability of individual kuhl regimes to the risks and stresses associated with environmental shocks such as floods and droughts? To explore this question; I focus on inter-kuhl irrigation networks. Networks are conceptualized as presenting "vehicles of action" (Hanf and O'Toole 1992:171) through which coordination is organized and problems solved, rather than as an analytical construct which "describes the context of, and factors leading to, joint decision making". Using this approach,. I describe the network of interconnectedness the pattern of overlapping kuhl systems creates at the watershed level. To do this, I employ the perspective of the "net thrower" to describe the pattern and linkages which constitute the watershed level kuhl irrigation networks, rather than the perspective of a "net rider", e.g. someone such as Mr. Ohri who is located on a particular network "node" (LaPorte 1994b). I then examine the interconnectedness of individual kuhl regimes and explore the extent to which interkuhl coordination is related to kuhl interconnectedness. Lastly, I consider the extent to which network density promotes regime persistence.

Tables 6.1 and 6.2 show the pattern of overlapping kuhl networks for the revenue villages and kuhls on the right and left banks, respectively, of the Neugal River. The tables provide basis for differentiating between sets of kuhls that are more or less tightly interconnected. From the multi-kuhl villages perspective (reading rows from left to right by village), the tables indicate that most villages are engaged with upstream kuhls that irrigate their upper area and with downstream kuhls that irrigate their lower area. For example, on the right bank Sapruhl Kuhl (no. 5) irrigates the upper fields of Village Kharot, while Pathan, Rai and Makruhl Kuhls (no.'s 6, 7 and 8) irrigate the village's lower fields. The same pattern may be observed from the multi-village kuhls perspective (reading columns from up to down by kuhl). Both tables indicate that generally kuhls irrigate lower and then upper areas of different villages as they flow downstream. For example, on the left bank Diwan Chand Kuhl (no. 2) irrigates the lower fields of three upstream villages and irrigates the upper fields of two downstream villages.[1]

Table 6.1 Mauzas (by name) and Kuhls (by number) of the Neugal Basin, Right Bank.

H=Harh, L= Larh.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Kandi	H	H													
Bhagotla			H												
Lalla				L	**H**										
Paror				L	L	H									
Kharot					L	H	H	H							
Panapar							H	H	H	H	H	H			
Gaggal							H					H	H*		
Dhera							L							H	H*
Nora							L								
Purba							L H								

Kuhls are arranged upstream to downstream as follows: 1) Bhradi, 2) Chanogi, 3) Bhagotla, 4) Kathul, 5) Sapruhl, 6) Pathan, 7) Rai, 8) Makruhl, 9) Samruhl, 10) Pangwan, 11) Sonia, 12) Gagruhl, 13) Majettli, 14) Bal, 15) Natyrya. * Indicates the kuhl is independent of others in the same mauza.

[1] At the watershed level the pattern of overlapping kuhl networks conforms closely to Thompson's (1967:54) concept of sequential interdependence in which the parts of an organization are serially related to each other. He further defines sequential interdependence as a set of conditions in which the parts are not symmetrically interdependent, and the order of their interdependence can be determined. Thompson predicts that sequential interdependence gives rise to coordination "by plan" which involves "the establishment of schedules for the interdependent units by which their actions may then by governed" (1967:56). The informal nature of these "schedules" matches the kinds of interkuhl coordination shown in Table 6.3 and discussed below.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bandla	H*	H	H	H	H	H																		
Ghugar		H	H		H	H	H																	
Sidhpur Rani						L	L	H	H	**H**	**H**	H	**H**											
Sidhpur Sarkari			L					L	**H**	**H**	**H**	H												
Khlet		H	H	H		H																		
Menjha								H				H	**L**	**H**										
Battu Palam			L					H		**H**	**H**													
Jasun Samola			H					H				H		**H**										
Raipur			H	H		H	H					H		**H**										
Henja				H																				
Aria			L			H																		
Saloh			L				H																	
Sulah												L			**H**	**H***	**H***	**H***	**H***	**H***	**H***	**H***	
Paror															**H**									
Garla Sarkari			L									L		**H**										
Garla Dei			L											**H**										
Bhawarna						L																		
Ninaon														**L**									**H**	
Daroh		L		L																			**H**	**H**
Ghar Jamula						L																		
Mundi		L				L																		**H**
Bandahu						L										**r**								

Table 6.2 Mauzas (by name) and Kuhls (by number) of the Neugal Basin, Left Bank. H=Harh, L=Larh.

Kuhls are arranged upstream to downstream as follows: 1) Ghran, 2) Diwan Chand, 3) Mia Fateh Chand, 4) Dai, 5) Ghughrul, 6) Kirpal Chand, 7) Raniya, 8) Mahang, 9) Loharal, 10) Taruhl, 11) Chamruhl, 12) Patnul, 13) Menjha, 14) Sangar Chand, 15) Masanol, 16) Spein, 17) Sulah da Cho, 18) Saldian, 19) Macchlena, 20) Kami, 21) Rein da Cho, 22) Bouru da Cho, 23) Upperli, 24) Buhli.

* Indicates that the kuhl is independent of others in the same mauza.

The number of kuhls per village can be used as a proxy indicator of the degree of interconnectedness between kuhl regimes. This indicator is based on the assumption that a kuhl that irrigates a village that no other kuhls irrigate will be less interconnected than a kuhl that irrigates a village irrigated by several other kuhls. For example, on the right bank Bhagotla Kuhl (no. 3), is the least interconnected. It irrigates only one village and it is the only kuhl that irrigates that village. In contrast to Bhagotla Kuhl, Sapruhl Kuhl (no. 5), also on the right bank, is more interconnected because from one to three other kuhls irrigate each of the three villages Sapruhl Kuhl irrigates.

Interconnectedness refers to the density of irrigation networks with which a particular kuhl is engaged. The degree of interconnectedness is primarily influenced by the elevational distribution of a village's arable land - a kuhl which irrigates a village whose arable land is dispersed across several elevational niches tends to be more interconnected than one which irrigates a village whose arable land is more concentrated in one niche.[2] Interconnectedness, measured as the extent of interkuhl linkage, provides opportunities for coordinating water management between kuhl regimes. Interconnected regimes are more able to coordinate amongst themselves for joint water management than regimes that are not interconnected. If coordination enables regimes to reduce their vulnerability to environmental shocks, then it is likely that all else being equal, interconnected regimes are more likely to persist than regimes that are not part of an inter-kuhl network. Interconnectedness can also lead to conflict between kuhl regimes due to competition for scarce water supplies (see below). Inter-village caste affinities, kin and marital ties, and the value of maintaining positive social relations based on generalized norms of reciprocity mitigate against inter-kuhl conflict. In his study of tank irrigation in Tamil Nadu Mosse (1997:17-18) also noted that interconnectedness tended to promote coordination more than competition.

Table 6.3 shows the various kinds of inter-kuhl coordination I observed and the kuhls that engaged in them. There are five types of inter-kuhl coordination: 1) sharing the same diversion structure, 2) having a joint watermaster for both kuhls, 3) joint water guarding during periods of water scarcity, 4) water sharing under conditions of drought or when kuhls are damaged by a flood or earthquake and 5) water sales. Water sharing arrangements between kuhls were the most common form of coordination. During the period of field research three clusters of from two to seven kuhls shared water and one pair of kuhls had recently shared water. Water sharing arrangements between kuhls typically involve temporary water transfers from an upstream kuhl to a flood damaged downstream kuhl for the duration of the repair work. For example, during the 1993 monsoon the Neugal River flooded and washed out the shared diversion structure and cliffside section of the main channel for Mahang and Loharal Kuhls. The watermaster for Mahang and Loharal Kuhls arranged a water sharing arrangement with the watermaster

[2]In other words, a village with only lower fields will be engaged with only one kuhl while a village with both lower and higher fields will be engaged with multiple kuhls.

of the next upstream kuhl, Raniya Kuhl. Throughout the 1993 summer agricultural season water from Raniya Kuhl was diverted into a gully that carried it to the main channels of Mahang and Loharal Kuhls. By the end of the year the repairs were still not complete and the water sharing arrangement with Raniya Kuhl continued.

Interkuhl water sharing arrangements occasionally also emerge during drought or during the hot and dry, pre-monsoon season. Shri Ranvir Singh, a former kohli of Pangwan Kuhl who is now President of the Kuhl Committee, described how, during his tenure as kohli, a severe water shortage combined with upstream diversions left no water in the Neugal River. In order to receive the minimum water necessary for pre-monsoon field preparation, Ranvir Singh was able to negotiate with the watermasters of the next five upstream kuhls to not divert water for a twenty-four period. On the designated day all five kuhls were shut down; water flowed downstream in the Neugal riverbed to Pangwan Kuhl where the readied diversion structure diverted it to the fields for a single flood irrigation.

Kuhl Name	Type of Interkuhl Coordination					Interlinkage Measure
	Water Sharing (gifting)	Shared Diversion Struc.	Joint Water Master	Joint Water Guarding	Water Sale	
Bhradi (r)						2/1 (H)
Chanogi (r)						2/1 (H)
Bhagotla (r)						0/1 (L)
Kathul (r)				x_1		3/2 (M)
Sapruhl (r)				X_1		6/3 (H)
Pathan (r)	X_1					5/2 (H)
Rai (r)*	x_1				X_1	10/6 (M)
Makruhl (r)	X_1					8/2 (H)
Samruhl (r)	x_1				x_1	5/1 (H)
Pangwan (r)	X_1					5/1 (H)
Sonia (r)	X_1					5/1 (H)
Gagruhl (r)	x_1					6/2 (H)
Majettli (r)						1/1 (L)
Bal(r)						1/1 (L)
Natyrya (r)						1/1 (L)
Ghran(l)*		X_1				1/1 (L)
Dewan C. (1)*	X_2	x_1				16/5 (H)
Mia Fateh (1)*						30/11 (H)
Dai (1)*						15/5 (H)
Ghughrul (1)*						8/2 (H)
Kirpal C. (1)*						26/10 (H)
Raniya (1)	X_3					17/4 (H)
Mahang (1)	X_3	X_2	X_1			21/5 (H)
Loharal (1)	X_3	X_2	X_1			12/2 (H)
Taruhl (1)		X_3	X_2			15/3 (H)
Chamruhl (1)		X_3	X_2			15/3 (H)
Patnuhl (1)*	X_4					26/7 (H)
Menjha (1)	X_4					10/2 (H)
Sangar C. (1)*						15/6 (H)
Masanol (1)						1/2 (L)
Spein (1)						1/1 (L)
Sulah (1)						1/1 (L)
Saldian (1)						1/1 (L)
Macchlena (1)						1/1 (L)
Karni(l)						1/1 (L)
Rein(l)						1/1 (L)
Bourn (1)						1/1 (L)
Upperli (1)*						3/2 (M)
Buhli(l)	X_2					5/2 (H)

Table 6.3 Degree of Interlinkage and Nature and Extent of Interkuhl Coordination for the Kuhls Originating From the Neugal Khad. (r) and (1) = right and left bank respectively. * = currently managed by Irrigation and Public Health Department. X_n identifies which kuhl clusters are engaged in the interdependent relation. Interlinkage measure for kuhl "a" = ratio of the number of other kuhls which irrigate each of the villages "a" irrigates to the number of villages "a" irrigates. When the ratio (y) < 1 interlinkage = low (L), when $1 \leq y < 2$ interlinkage = medium (M), when > 2 interlinkage = high (H).

Coordination implies interdependence. LaPorte's definition of interdependence as "an exchange relationship of at least one resource between at least two persons" is useful (1975:7).[3] He distinguishes between three types of interdependent exchange relations that may obtain between two individuals or groups (a,b). In the first, group A may be dominant over group B, in other words B depends on A for a necessary resource. Second, groups A and B may be mutually dependent on each other for the provision of a resource both need. And third, group B may be dominant over group A.

At first glance interkuhl water sharing arrangements appear to conform to the first type of interdependent relationship (A dominant over B). An upstream kuhl (A), is dominant over the downstream kuhl (B), because until kuhl B is repaired it depends on kuhl A for water. For example, Pangwan Kuhl was dependent on the actions of upstream kuhls in order to receive even a minimal supply of water. However, when a longer time frame is used to analyze interkuhl relations, the structural positions of dominant and subordinate kuhls can shift back and forth. Because the occurrence of floods and their effects, in terms of which kuhl(s) will be damaged and to what degree, is random and unpredictable, there is no assurance that a kuhl which at time *t* is requested to temporarily provide water to a damaged downstream kuhl, will not at time *t+1* itself be damaged by a flood and forced to request a water transfer from the next upstream kuhl.[4] In order to preserve its future option to request water from an upstream kuhl, it will likely agree to a water transfer request from a downstream kuhl in the present. In this manner the structural positions of dominant and subordinate shift over time in an unpredictable manner. This shifting dependence encourages cooperative responses from kuhls that occupy a temporarily dominant position.[5]

Introducing time into the analysis of interkuhl water transfers helps to explain why an upstream kuhl would share water with a temporarily damaged downstream kuhl with no possibility of direct reciprocation. Scharpf acknowledges the importance of time and the broader structure of interorganizational relations when examining a specific interorganizational interaction. He writes,

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[3]This definition of interdependence is consistent with and follows from Cook's definition of exchange that emphasizes resource transfers through voluntary transactions by two or more actors (1977:64). It is more restrictive than Levine and White's definition of exchange, which encompasses "any voluntary activity between two organizations (1961:120).

[4]In this respect the kuhl environment conforms to Emery and Trist's (1965) definition of a turbulent environment in which unpredictable phenomena over which the focal organization has no control reduce the capacity of the organization to achieve its goals.

[5]In order for past actions to affect present inter-kuhl exchanges and for present inter-kuhl exchanges to affect the possibility for future inter-kuhl coordination, a long term and collective memory of the past is a necessary condition. This condition is more likely to be met in settings with stable communities and populations than in other organizational settings with less historical continuity. Within kuhls the institutionalization of the position of kohli (watermaster), i.e. the formal position is continuous through time and independent of any particular individual (Zucker 1987:455), increases the likelihood that past events will influence present decisions and that future ramifications, even if subsequent to an individual's tenure as kohli, will influence present choices.

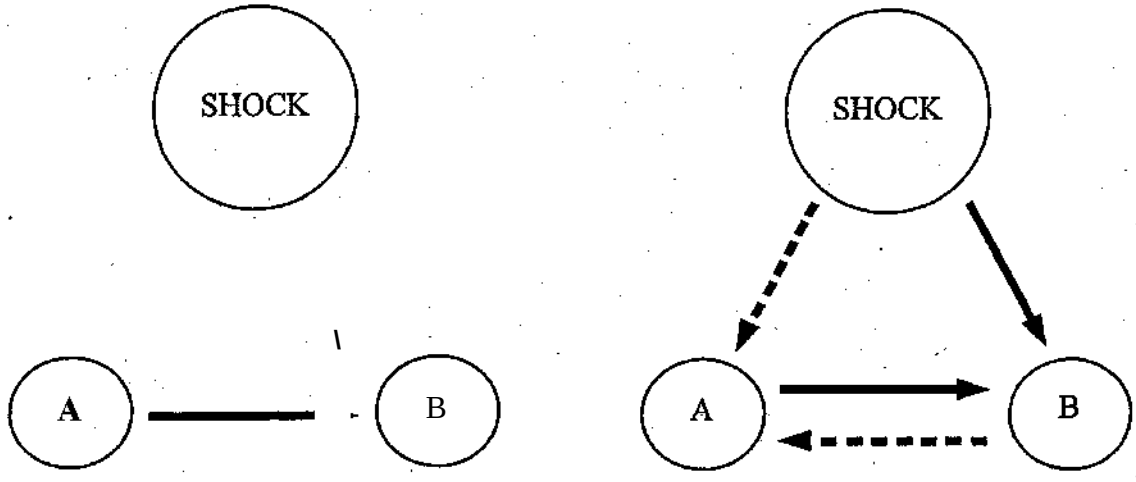
> Many interactions (interorganizational), however, are not of a one-shot nature. They occur in the context of more stable relationships with their past histories and their expectations of future transactions. Within this broader context, individual interactions which, taken by themselves, would be disadvantageous to one party might still be acceptable (1988:353).

Although the structural relationship between two kuhls may conform to unilateral dependence (A dominant over B), their observed behavior more closely approximates that expected from organizations engaged in a mutually dependent interorganizational relationship. Over time, within a context of shared environmental vulnerability, unilateral dependence can become mutual dependence. Figure 6.1 illustrates how structural unilateral dependence can display the behavioral characteristics of mutual dependence when the context of past relations and potential future relations is considered. Diagram 6.1a shows kuhl A dominant over kuhl B when B suffers an environmental shock at time *t* without considering the broader context of past exchanges and potential future exchanges. Diagram 6. lb takes into account contextual relations - the dashed lines indicate that A has been or could be vulnerable to the same environmental shock as B, in which case it may depend on B for resources. The common environmental vulnerability of both A and B to similar environmental shocks thus transforms unilateral into mutual dependence.[6]

Insert the figure here

Sharing the same diversion structure between two or more kuhl regimes is another form of coordination between kuhl regimes. When aflood or earthquake destroys the diversion structure and cliffside channel section of adjacent kuhls, joint, rather then separate, headworks and channel sections may be erected in their place. In some cases two adjacent kuhls will share a joint diversion structure to maintain adequate water flows. Mahang and Loharal Kuhls are adjacent kuhls. The construction of Mahang Kuhl was sponsored by a Rajput and named after his clan. Loharal Kuhl, just downstream of Mahang was sponsored by a clan of Brahmins and named after their clan. The Brahmin clan later requested permission from the Rajput clan to relocate Loharal Kuhl's diversion structure upstream of Mahang Kuhl so that sufficient water would flow into the kuhl's channel. While the Rajputs refused the request, they did agree to share their diversion structure. This information was recorded in the 1918 version of the Riwaj-i-Abpashi. Mahang and Loharal Kuhls continue to share a diversion structure and cliffside channel section. The farmers of both kuhls jointly repair and maintain the kuhl upstream of the point where the main channel bifurcates to feed the command areas of the different kuhls.

6Wellman reports an analogous dynamic in his analysis of networks of personal communities in Toronto, Canada. Using the concept of "network balance" (1988:170), he shows that general reciprocity at the network level always exceeds that between two network ties (nodes). He attributes network balance to the structural embeddedness of ties, and the tendency for reeiprocal relations between individuals to reach an equilibrium at either high or low levels of exchange. In his analysis, network balance emerged by expanding the spatial scale of analysis, among kuhls network balance emerges by expanding the temporal scale of analysis. In either case the result is the same: "Do unto others as you would have your network do unto you" (Wellman 1988:171).



6. A one shot view of an interkuhl exchange. & 1b A multi-shot view of an interkuhl exchange.

Figure 6.1 A diagramatic illustration of how structural unilateral dependence can display the behavioral characteristics of mutual dependence when the context of past relations and potential future relations is considered. The diagram on the left shows kuhl A dominant over kuhl B when B suffers an environmental shock at time twithout considering the broader context of past and future relations. The diagram on the right takes into account contextual relations - the dashed lines indicate that A has been or could be vulnerable to the same environmental shock as B, in which case it may depend on B for resources. The common environmental vulnerability of both A and B to similar environmental shocks thus transforms unilateral into mutual dependence.

In a similar manner Taruhl and Chamruhl Kuhls, which are adjacent to and upstream ofLoharal and Mahang Kuhls, also have a joint diversion structure and cliffside channel section. The Riwaj-i-Abpashi notes that although they originally had separate diversion structures, they were subsequently combined (presumably following a flood or earthquake). Since that time these two kuhls have shared the same diversion structure. Approximately .5 km below the headworks the single common channel splits into the two original channels; at this point the water is divided into two equal parts. Each of these pairs of kuhl regimes also engages in other forms of joint water management. A panchayat (village council) manages Loharal and Mahang Kuhls. This is the only example within the Neugal watershed of a panchayat-managed kuhl. The panchayat appoints a "temporary" kohli to manage both kuhls.[7] Taruhl and Chamruhl Kuhls, jointly managed by a single committee, are also managed by one kohli.

Joint water guarding is the fourth type of inter-kuhl coordination for water management. A primary example of this is the coordination between Kathul and Sapruhl Kuhls for guarding, maintaining, and repairing the shared twelve kilometer main channel section during the eight day period when the Villages of Paror and Kharot have dol rights to the water in Sapruhl Kuhl. The period of dol is from 16 to 24 Jeth. This correlates with late June - a period characterized by relatively high water scarcity and high water demand. During this time of dol 24 farmers divide into twelve pairs. Eight pairs from Paror and four from Kharot patrol the kuhl's channels for eight 24 hour shifts. Each pair of farmers carries staves, food, and bedding with them. They guard the kuhl's water against water diversions by upstream farmers who have no right to the kuhl's water during the period of dol. They also watch for breaches in the channel. The guards repair small breaks; for large breaches reinforcements are called for from Paror and Kharot. In 1992 more than 90 men from these two villages assembled to repair a large nighttime breach. A similar number helped repair a large breach the following year. Laxman Das, the kohli for both kuhls, remarked that previously the water guards used to be able to take shelter in the more than two dozen graths that Sapruhl Kuhl powered. However, as the graths no longer operate, the men must simply sleep along the bank of the kuhl. He also noted that aside from their physical presence at strategic spots susceptible to water stealing, water guards are relatively limited in the sorts of sanctions they can apply against illicit water users. Physical violence was not worth it he said, especially as the dol rights were only for eight days but the negative effects on relationships were long-lasting.

A fifth form of interkuhl coordination is the sale of water rights. Only one example of this was found among the kuhl regimes of the Neugal basin. It is described in the Riwaj-i-Abpashi. The sale involved the transfer of water rights pertaining to Samruhl Kuhl from Village Panapar to the farmers of the downstream Village Naura. The construction of Samruhl Kuhl was sponsored by a member of the

[7] The kohli is referred to as temporary because the family that holds the warisi to be kohli has not relinquished their hereditary right to the position, although currently none of the male family members want to be kohli.

Rathi caste during the period of Sikh rule in Kangra (1809-1845). The first edition of the Riwaj-i-Abpashi (1868) notes that the farmers of Village Naura purchased Samruhl Kuhl by paying Rs. 92 and 9 topa of paddy.[8] Unfortunately, the Riwaj-i-Abpashi does not mention to whom the payment was made, e.g. whether it was made to a descendent or the clan of the kuhl's sponsor, or to the village as a whole. To this day, prior to the 24th of Jeth (early June), the total flow of the kuhl is directed into Rai Kuhl, which delivers water to Naura, approximately 15 kilometers downstream. After the 24th of Jeth, the farmers of Panapar can use as much of the kuhl's water as they need. Although not mentioned in the Riwaj-i-Abpashi, the farmers of Naura apparently only purchased water rights in the kuhl prior to the 24th Jeth, (or that water transfer condition was negotiated at a later date). Rai Kuhl has been managed by the Irrigation and Public Health Department since the late 1970s. Prior to the government takeover of the kuhl, farmers from Naura and the adjacent downstream village of Dhera used to participate in the annual repair and maintenance of Samruhl Kuhl. Since then full responsibility for all kuhl repair and maintenance work has rested with the farmers of Panapar, despite the fact that they do not benefit from kuhl water prior to the 24th of Jeth. As Panapar, Dhera, and Naura are all predominantly Rajput villages, it is quite likely that caste based affinities (marital, kin, etc.) linked these villages and facilitated the sale of rights to the kuhl. The sale of a permanent, yet seasonal, water right, rather than a one time sale of a quantity of water, presents an interesting contrast with other regions of India, e.g. water sales between indigenous tank irrigation systems in Tamil Nadu (Mosse 1997:19) and farmer to farmer water sales in Bihar (Shah and Ballabh 1997).

Table 6.3 gives a quantitative indicator of the kuhl interconnectedness. The indicator, a rough measure of the density of the interkuhl network each kuhl is embedded within, is the ratio of the number of other kuhls which irrigate each of the villages the kuhl irrigates to the number of villages the kuhl irrigates. The ratios were grouped into three categories representing different network densities; ratios less than one indicate low density, ratios greater than or equal to one but less than two indicate medium density, and ratios greater than or equal to two suggest that the kuhl regime is embedded in a relative dense network.

Not surprisingly, all but three examples of inter-kuhl coordination occurred between kuhls regimes engaged with relatively high density irrigation networks. Of the nineteen different kuhls regimes engaged in one or more forms of inter-kuhl coordination, sixteen are highly interconnected, two are moderately interconnected, and one is minimally interconnected. All five of the kuhls which were/are involved in two or three kinds of interdependent relations are highly interconnected. The one minimally interconnected kuhl (Ghran Kuhl, left bank no. 1) shared a diversion structure with the next downstream

[8] One topa = 50 thimbi. A thimbi is a volumetric measure of grain, equivalent to a approximately 18 kilograms of dry paddy (unhusked rice).

kuhl (Diwan Chand, no. 2). This, however, was a short-lived arrangement. Following a relatively brief period during which the diversion structure was shared, separate structures were again constructed. Many, if not most, forms of inter-kuhl coordination are ephemeral. Therefore, the examples listed in Table 3 are undoubtedly a small sample of the incidents of inter-kuhl coordination that have occurred in the Neugal watershed. However, the examples do illustrate the point that dense interdependent kuhl networks enable inter-kuhl coordination.[9]

Explaining The Coherence of Network Structure

Understanding how and why networks of interkuhl relations cohere over time requires not only examining interkuhl networks as "emergent phenomena" (Benson 1975); it also involves exploring their cultural and historical components (Scott 1983), their social embeddedness (Granovetter 1985), and the extent to which the technical characteristics (LaPorte 1994b) of gravity flow irrigation systems constitute the basis for interkuhl exchange and coordination.

The technical constraints of gravity flow systems, in conjunction with the topographic variation found within most villages, produced the dendritic pattern of main kuhl channels within the Neugal watershed (Figure 6.2). The network of kuhl channels constitutes an ecologically and technologically conditioned template of interconnectedness that offers the possibility for interdependent interkuhl exchange relations to emerge. Figure 6.3 illustrates how the dendritic patterns of kuhl networks differ in four watersheds adjacent to the Neugal watershed. In the Awah watershed the pattern of multi-kuhl networks is relatively dense and thus, like the Neugal, provides a template of physical interconnectedness that could be the basis for various kinds of interkuhl interdependent relations.[10], In contrast to the kuhl network found in the Awah basin, those of Maud and Poon basins are much less dense, and in Chahan Khad, it is virtually absent. In these watersheds truncated patterns of kuhl networks created by the

9Raipur and Sulah Villages, (left bank) are irrigated by tightly interlinked kuhls but for which I do not have examples of watersharing arrangements. Most of the kuhls in Sulah are very small, irrigating five hectares or less and are informally organized with no watemnaster. Water sharing may occur between these small kuhls, but it may be so informally organized as to be almost invisible to an outsider. Alternatively, water sharingmay not occur because the kuhls are so small that repairing them after a flood may be easier than coordinating a water transfer between them. My fieldwork in Raipur was less intensive than elsewhere in the study basin because I focused most of my research attention on nongovernment kuhls and all but one of the six kuhls in Raipur has been managed by the Irrigation and Public Health (IPH) Dept. since the 1970's. Resource dependence theory predicts that coordinated strategies between the kuhls in Raipur should exist. This may have been the case prior to IPH control, however the IPH Dept. generally takes a kuhl by kuhl approach to water management in Kangra, so it is unlikely that long term water sharing arrangements would exist between these kuhls. If water sharing does occur in Raipur, it will be coordinated by employees of the IPH Dept., not the farmers themselves. Farmers do not have the right to distribute water within or between IPH managed kuhls.

[10]This assumes that similar network patterns will exhibit similar behavioral characteristics, an assumption espoused by the formalist school within structural analysis (Wellman 1988:25).

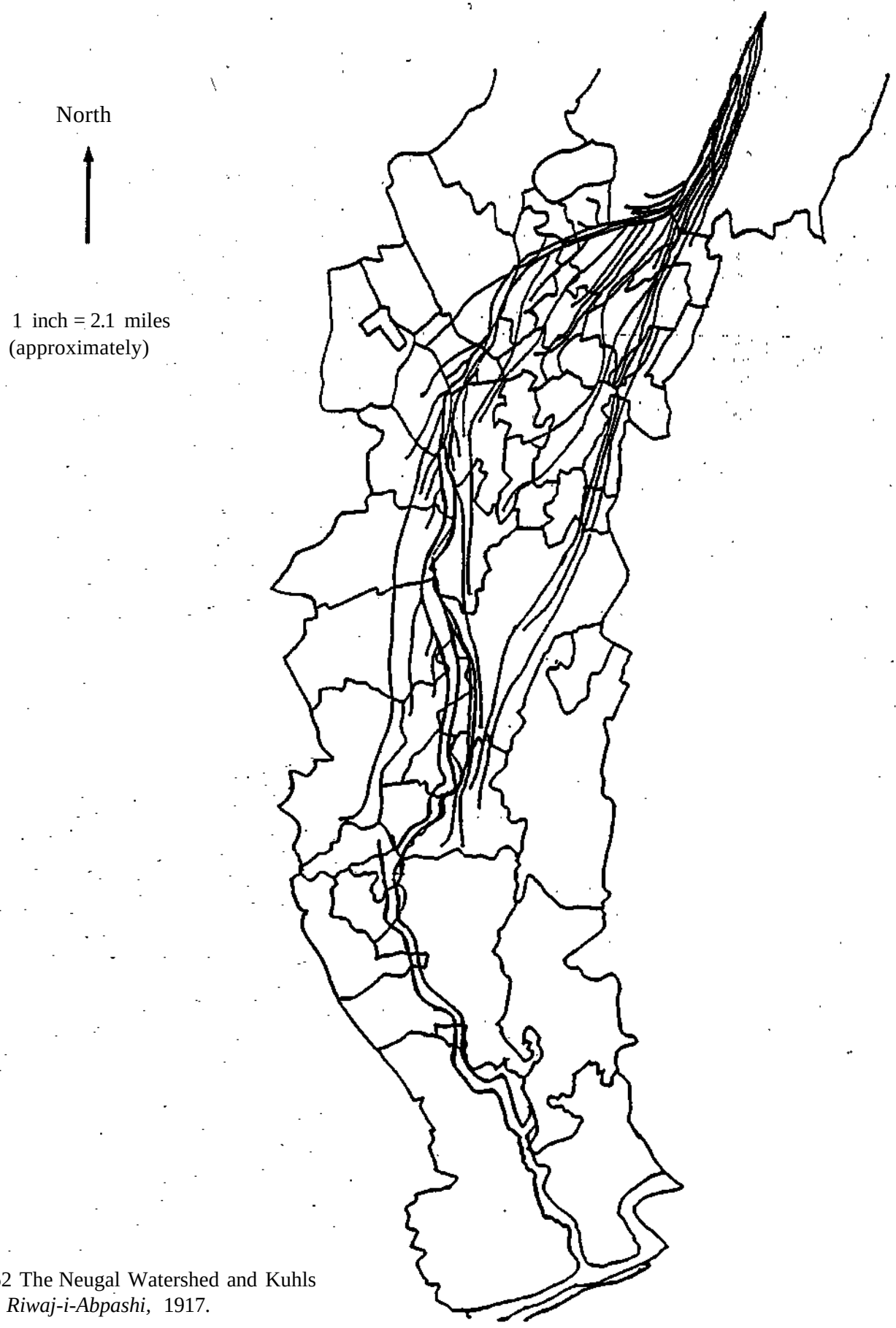
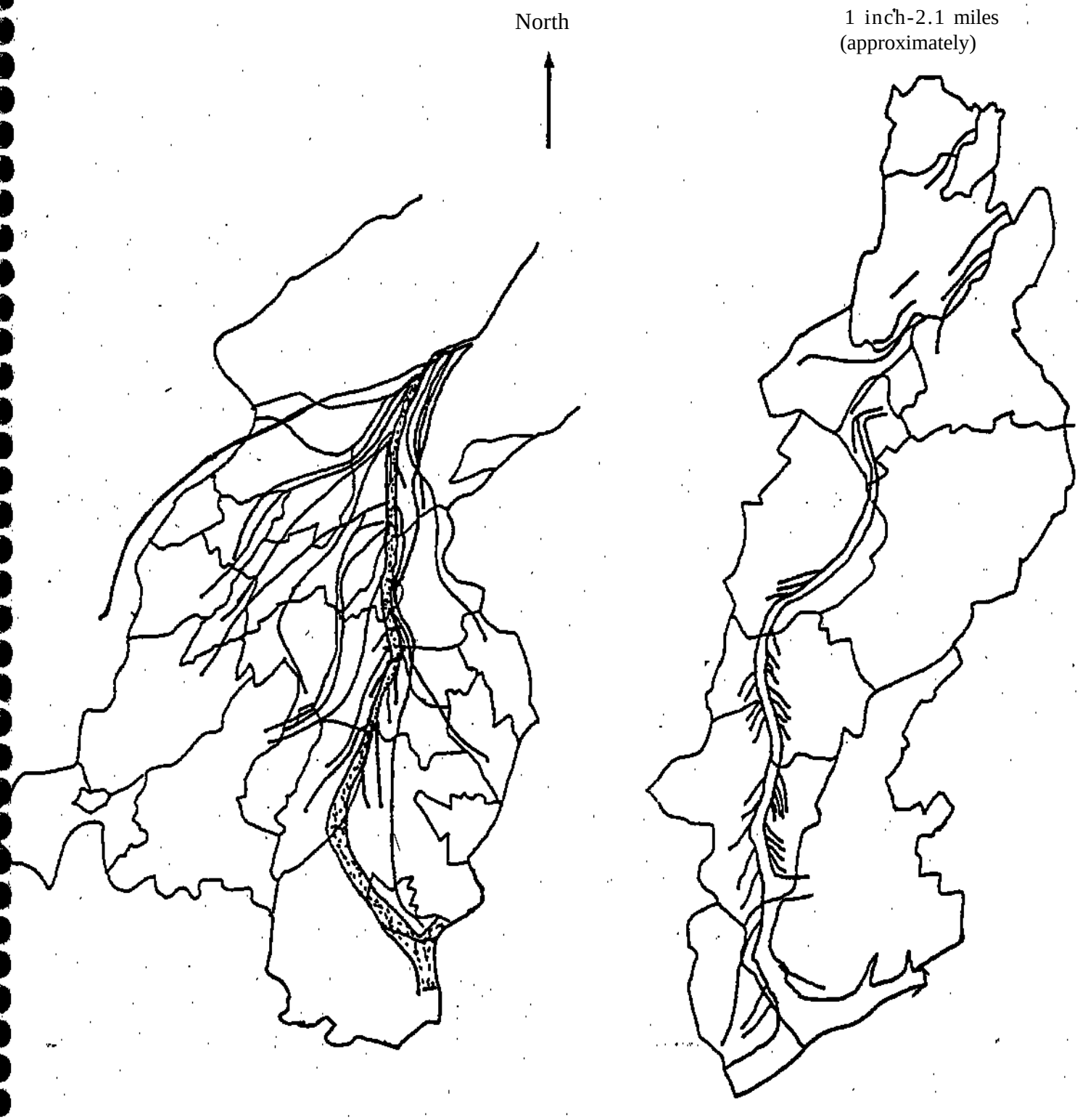


Figure 62 The Neugal Watershed and Kuhls
Source: *Riwaj-i-Abpashi,* 1917.



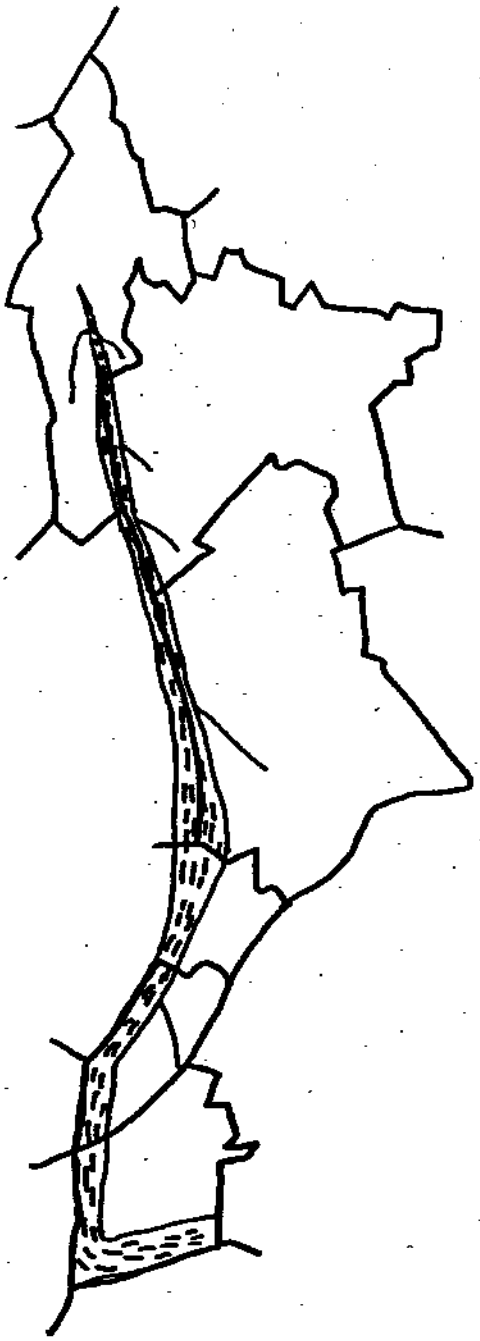
6.3 a. Awah Khad Watershed

6.3b. Mand Khad Watershed

Figure 43 Four watersheds of Kangra Valley Illustrating different patterns of irrigation networks ranging from most dense (3a Awah) to least dense (3d Chahan). Eachdiagram shows the stream running from north to south, the irrigation systems which divert water from the stream, and the boundaries of the villages (revenue) within the catchment basin. Source: *Riwaj-i-Abpashi,* 1917.

North

1 inch = 2.1 miles
(approximately)



6,3c. Poon Khad Watershed

6.3d. Chahan Khad Watershed

irrigation. Conversely, Ghran Kuhl is much smaller than Dewan Chand Kuhl. It carries water 5 kilometers and irrigates 60 hectares in Gaddi (settled nomadic herders) dominated hamlets, Dewan Chand Kuhl transports water more than 25 kilometers to irrigate 185 hectares in a Rajput dominated area. The kuhls have separate watermasters and are managed independently. Neither are these two groups of irrigators bound by other shared allegiances such as marital alliances or material exchange networks. The lack of shared interest combined with the asymmetries between the irrigators of these two kuhls suggests that, in contrast to the other two pairs of kuhls, they are not engaged in a dense network of shared social relations. Consistent with the embeddedness argument, interkuhl coordination between Gran and Dewan Chand Kuhls was not sustainable whereas it was for the other two pairs of kuhls. Following the 1905 earthquake separate diversion structures were constructed for Ghran and Dewan Chand Kuhls; Taruhl and Chamruhl and Mahang and Loharal Kuhls continue to jointly manage their shared diversion structures.

Normative and cognitive frameworks also contribute towards the coherence of interkuhl exchange networks. The influence of norms and values on interorganizational coordination is a common theme throughout much of the literature on interorganizational relations. Although Selznick (1957) was one of the earlier theorists to emphasize the importance of norms and values in understanding organizational behavior, more recent contributions focusing on interorganizational relations include Aldrich (1976) who argues that "perceived cooperation" positively affects interorganizational coordination and suggests that values and sentiments be integrated into the resource dependence model. Similarly Astly and Van de Ven argue that over time mutually beneficial patterns of interorganizational behavior assume the character of general norms which "take on the character of autonomous social forces, directing and regulating collective action" and thus structure relations within symbiotic networks (1983:263).[13]

[13]Other theorists who acknowledge the importance of norms in interorganizational networks include Benson (1975) and Pfeffer and Salancik (1978:147). One particularly forceful norm in Kangra is the prohibition against women participating in any communal aspect of kuhl management. The example of Samruhl Kuhl illustrates an institutional transformation that occurred as a result of violating this norm. In the early 1980's the kuhl committee for Samruhl Kuhl initiated a system of fines in an attempt to slow declining absenteeism for kuhl repair and maintenance. The system was quite unpopular because in a few women-headed households there were no males to contribute labor. The women had no alternative but to contribute their own labor for communal kuhl cleaning. This contravened the strong taboo against female participation in any communal aspect of kuhl management and created adequate incentive for changing the mobilization of resources for kuhl maintenance from a labor to a cash based system. Rather than contribute labor, each household is now required to contribute cash in a fixed proportion to their cultivated land. This money is kept in a fund to pay local laborers to clean and repair the kuhl as required throughout the year. Although women do not participate in the communal portions of kuhl management, they do manage kuhl water and maintain irrigation channels on their own land. Furthermore powerful women can be members of the kuhl committee - two presidents of different kuhl committees were women.

In Kangra norms of diffuse reciprocity are institutionalized within demarcated social spheres. Reciprocal relations are strongest between members of a sub-clan living in the same house cluster.[14] Blood ties combined with proximity lead to frequent interaction and generate joint interests (Parry 1976:136-139). During elections an entire sub-clan will often form a political faction, or a sub-unit of a faction composed of the whole clan, which votes as a block. All the households in a single house-cluster will send a representative to join the marriage party of a groom of the clan when it leaves to bring the bride to the groom's natal village. Sub-clan members also participate collectively in the preparations for, and ritual exchanges associated with, major live cycle rituals such as birth, marriage and death.

Activities within other social spheres also serve to reproduce reciprocal relations between sub-clan members. At major life cycle rituals such as marriage and death, communal work parties are organized to fell, split, and transport the wood required to cook food for the meals at which large numbers of guests will be fed over a three to five day period. Those who contribute labor during these events receive a free meal, and most importantly, the right to call upon communal labor at some unspecified future time.

Sharing water between kuhls "bhai bandi se" is also rooted in the notion that the merit achieved through gift giving accrues only when nothing is received in return.[15] A striking example of unilateral exchange in Kangri culture is the tradition *ofkany a dan* ('the gift of a virgin'). Although prevalent across all castes, this mode of exchange is most developed in the tradition of hypergamy between the hierarchically structured Rajput clans. Parry (1976:208) demonstrates that social prestige and religious merit accrue to the wife-givers only when the family receives no material compensation from the wife-takers.[16] While the tradition *ofkany a dan* is a more extreme example of unreciprocated exchange than that which occurs between kuhls, it does indicate the centrality of asymmetrical reciprocity to social

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[14]In Kangra corporate multi-caste villages are much less prevalent than in, for example, the Indo-gangetic plains. Most settlements consist of single-caste house clusters *(narar),* which after their founding by a common ancestor, partitioned and increased in numbers through patrilocal marital arrangements.

[15]The phrase *"bhai bandse "* (through brotherhood) was invariably used by watermasters and farmers in discussions of informal interkuhl water sharing arrangements. The term implies that there is no expectation of direct reciprocity, nor even an assurance of compensation in the future. It implies a sense of community, "brotherhood", that binds those engaged in watersharing within a common ethical order.

[16]The ideology *ofkany a dan* extends the obligation to give to the wife-taking family without receiving any material compensation to not only the natal households of the wife and mother, but also to those of the father's mother's brother and mother's mother's brother. The asymmetrical flow of gifts from the wife-giver's family to the wife-taker's family often continues for three generations. The belief that receiving any form of compensation will cancel the merit accrued by giving the gift prevents the wife-giver from ever accepting food in the wife-taker's house, and at the top of the Rajput hierarchy has resulted in the forbidding of other forms of marriage exchange that do not conform to this "unilateral ideal" (Parry 1976:209). Although the practice *ofkanya dan* tends to be more rigidly adhered to among higher castes, as ideology it is all pervasive. See Bodeman (1988:208) for an analogous example from southern Italy in which familism operates primarily within upper class families but is nevertheless an important ideological construct across all classes.

relations in Kangra and thus helps explain the cultural basis for the coherence of interkuhl exchange networks.

The ritualistic elements of kuhl management which puja embodies also strengthen and reproduce the group of irrigators as a community.[17] The two main objectives of kuhl rituals are to ensure that adequate water will flow into the kuhl during the dry season, and to protect the kuhl from destructive floods during the monsoon. As described in Chapter Three, the feminine deity who inhabits the kuhl is propitiated to ensure adequate water flow, and Quaja Pir is worshipped to ward off destructive floods.[18] Both of these rituals involve offering prasaad to the deity and then distributing, sharing and consuming the blessed offering among all the irrigators present. Sharing and consuming the blessed offering simultaneously marks, makes and strengthens the community of irrigators. The production of community continues as the watermaster, while walking home after performing the puja, shares prasaad will neighbors and others whom he encounters on the way. Thesymbols, actions, and relationships which kuhl puja employs are those repeated in daily domestic rituals, at every trip to a shrine or temple, and at all life crisis ceremonies. The constitutive aspect of puja exemplifies the point made by the new sociological institutionalists (Meyer and Rowan 1977, Scott 1983, 1994, Zucker 1987, Powell and DiMaggio 1991, Meyer et al. 1994) that institutions reflect and embody cognitive as well as normative elements of their environments. Scott argues that "cognitive elements include widely held beliefs and taken-for-granted assumptions that provide a framework for everyday routines...."(1994:81). The cognitive elements embodied within kuhl puja contribute towards the social construction of actors as community members, and the various components of kuhl puja are (re)enactments of broader "institutional scripts" (Meyer et. al. 1994:10) which play out in a variety of everyday contexts and thus serve to increase the institutionalization of kuhls.

The coherence of interkuhl networks can therefore be attributed to the presence of an ecologically and technologically determined template of interconnectedness embedded in broader networks of social relations, and grounded in mutually reinforcing cognitive and normative structures of identity and reciprocity. Actions or policies that weaken the basis for interkuhl coordination reduce the resiliency of the irrigation network. For example, since the mid-1970s the Irrigation and Public Health (IPH)

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[17]If the puja to the kuhl's deity was effective, if adequate snow fell on the Dhaula Dhar the previous winter, and if the monsoon is not delayed, then puja to the kuhl's deity will be done only once every year. If however, water scarcity threatens the paddy crop, then another puja to the kuhl's deity will be performed at the diversion structure. As before, the watermaster will preside, but rather than *offer prasaad* of a sweet dish, a goat will be sacrificed, offered to the deity, cooked on the spot and distributed to all those present. The kuhl's irrigators will make voluntary contributions to cover the cost of the goat. Stories abound of past watermasters with unusual powers, who, during times of great water scarcity were able to bring more water into their kuhls after performing this puja.

[18]In some cases the object of the puja is more personalized. In the case of Raniya di kuhl, (queen's kuhl, left bank no. 7), the local hill queen who provided the funds for constructing the kuhl in the late 18th century is herself propitiated. *Pir* is a Muslim saint. *Quaja* is also probably a Persian term and thus helps establish the link between Kangra and the peoples and cultures to the northwest and into Central Asia.

Department has managed nine of the most socially complex and longest kuhls which irrigate mostly higher elevation, less fertile land. The IPH Dept. has adopted a kuhl by kuhl approach to water management. Managing each kuhl as an autonomous unit without considering the network of interkuhl relations it was previously embedded within has reduced interkuhl coordination between IPH and village managed kuhls and has eliminated it among IPH managed kuhls. While this may make little difference to the persistence of these systems during periods of non-stress, when environmental shocks do occur, the weakened basis for interkuhl coordination will reduce the network's ability to buffer the effects of the shock. With fewer possibilities for interkuhl water exchanges following a destructive shock, kuhls that sustain severe damage are less likely to be rebuilt; they also become increasingly dependent on state resources for their repair and maintenance.

How does network density affect the ability of kuhl regimes to maintain their integrity despite periodic shocks such as earthquakes and floods? The answer, not surprisingly, is it depends. Networks provide resources, e.g. water, water management skills, or an expanded pool of labor for repair and reconstruction. The value of network density for regime persistence is directly related to the regime's dependence on the resources networks provide, and to the availability of alternate sources for those resources. If dependence on network resources is directly related to scale, then network density will be more important for large scale regimes than for small scale regimes. Networks matter less for small scale regimes than for large scale regimes. Many small scale kuhl regimes characterized by low network density maintain their integrity despite destructive floods and earthquakes. This is primarily because they have relatively low labor requirements for kuhl repair and maintenance and, given the fact that these kuhls irrigate mostly har areas, farmers have been motivated to provide the labor necessary to repair them. However, not all small scale, low density kuhl regimes have persisted. . For example, Masanol Kuhl was destroyed by a flood in the 1970s and remained defunct for many years. It was not until the current kohli was able to organize a kuhl committee and successfully solicit financial assistance from the local Member of the Legislative Assembly that the kuhl was reconstructed and once again used for irrigation. Had Masanol Kuhl been part of a dense network of interkuhl relations, the kuhl's irrigators may have been able to immediately draw on network resources such as water and labor for irrigation and kuhl reconstruction; instead the kuhl went defunct due to the lack of such resources. Other isolated kuhls have also gone defunct. In the headwater region of the Neugal basin signs of abandoned kuhls which previously irrigated riparian areas are visible amongst the boulder strewn floodplain - it is quite likely that these small, isolated kuhls were destroyed by floods and never reconstructed.

Network density seems to be particularly important for medium to large scale kuhls that experience pulses of intensive resource requirements, particularly water and labor, following destructive shocks. A dense network provides opportunities for regimes to meet short duration but intensive resource

requirements that cannot be met from within the regime itself. In the absence of alternative sources for those resources, interkuhl coordination may play a crucial role in preserving the integrity of individual regimes and by extension, the network itself. Based on the discussion of the current role of the state in kuhl management in the prior chapter, it is clear that to a certain degree it has become a provider of the resources that hitherto were available only through interkuhl networks. Thus on one hand the state has weakened interkuhl networks by constituting another source for those resources while on the other it extends resources to kuhl regimes, as it did in the case of Masanol Kuhl, which do not benefit from a dense network. Thus it helps to restore defunct regimes and prevent low network density regimes from becoming defunct.

This chapter has analyzed the ways in which interkuhl networks provide the possibility for kuhl regimes to coordinate amongst themselves, thus acquiring resources otherwise not available. It must also be observed that under some conditions interconnectedness can lead to interkuhl conflict. Thus under conditions of water scarcity, networks of interconnected kuhl channels make possible interkuhl water transfers. However if water scarcity becomes severe then the same networks can also become the basis for quarrels between kuhls over water distribution. One of the only references to the direct involvement of the colonial government in kuhl management concerns the intervention of the District Collector during a drought in 1914 to supervise the distribution of water between the densely interconnected upstream and downstream kuhls of Baner Khad so that the downstream kuhls would receive a specific volume of water. In this case, interkuhl conflicts based on inadequate water supplies required the colonial administration to intervene.

Norms of reciprocity, based on kinship relations and residence in the same hamlet, do contribute to network coherence. On the other hand intra-clan and familial conflicts, often over access to land, can be among the most contentious in the region. These sorts of conflicts can affect the management of kuhls. For example, the July 7, 1987 meeting minutes for Sonia Kuhl describe the attempts of the committee to adjudicate a conflict between a father and son in which the son, who owned land upstream of his father, was blocking the flow of water into his father's fields. Although the committee determined that the father had a valid right to the kuhl water, the son still refused to release the water. While this conflict concerned water distribution within a kuhl, such conflicts can extend to inter-kuhl relations as well. This is perhaps exemplified most dramatically by the murder of downstream Girth farmers whose clan had constructed Sapruhl Kuhl by upstream Rajputs who wanted to claim the kuhl for themselves. As described in the preceding chapter, the rights of the downstream villages of Paror and Kharot to the water from this kuhl have been restricted to eight days of dol. The coordination between the irrigators of Kathul and Sapruhl Kuhls for guardingtheir eight days of dol rights constituted one of the examples of interkuhl coordination discussed in this chapter. Conflict occasionally begets coordination.

Some adjacent kuhls do jointly manage shared diversion structures as described above for Mahang, Loharal, Chamruhl, and Taruhl Kuhls. However in some instances adjacency leads to conflict, not coordination. For example, a flood in 1977 washed out the diversion structure and upstream channel section of Rai Kuhl, a long kuhl (20 km) that irrigates 820 hectares in 28 different hamlets whose construction the pre-colonial state sponsored in 1775. Since the 1970s the IPH Department has managed the kuhl. However, the IPH Department did not reconstruct the portion of the kuhl destroyed in the 1977 flood. Instead IPH workers responsible for managing the kuhl draw water through pipes placed, without permission, in the upstream portion of Pathan Kuhl, which is just upstream of Rai Kuhl. During the late 1980s the kohli for Pathan kuhl, Dyan Singh, wrote numerous letters protesting this action, both to the IPH Department and to his Panchayat Pradhan. He described how the siphoning of water from Pathan to Rai Kuhl created water shortages for the irrigators of Pathan Kuhl from 15 May until the monsoon arrives. By 1993 the IPH department finally responded by reconstructing the damaged upstream portion of Rai Kuhl.

Conclusion

Negotiated exchange relations between kuhl irrigation systems for coordinated water management can reduce the risks and uncertainty associated with recurring environmental shocks. Interconnectedness between kuhls is not a problem to be managed or a liability to be controlled, but rather constitutes a resource which can facilitate kuhl persistence in the face of destructive environmental shocks. When interconnectedness between common property resource management regimes leads to coordinated resource management strategies, e.g. those described in table 6.3, it may reduce the risk and vulnerability associated with perturbations in the natural environment.

This formulation of the relationship between interdependence, coordinated exchange through networks, and reductions in risk and vulnerability, differs significantly from other work which emphasizes the role of collective action in risk reduction and management, i.e. Wade (1988). First, the scale or social arena of interaction differs significantly. Wade and others seek to explain the emergence and stability of village or community level, public collective action institutions in terms of the level of risk with which villagers must contend. This chapter, by contrast, has shifted the focus away from individual common property resource management regimes to the nature and effects of relations between individual regimes. Implicit in this is the assumption that important factors that influence the effectiveness of common property resource management regimes may be external to the regime itself. Thus, two common property resource management regimes may be similar with regards to their internal formal and informal structures, rules, norms, and sanctions, yet, because of different interdependent relations with other regimes, have quite different capacities to absorb the destructive impacts of environmental shocks. Second, this approach suggests that in some cases the dependence of a regime on

state support may vary with the density of its potential exchange relations with other regimes. Thus, under conditions of environmental vulnerability, a solitary, independent regime will be more dependent on state resources following a destructive flood, earthquake or other environmental calamity, then a regime which is embedded in a dense network of horizontal exchange relations which, through coordinated resource management strategies and the joint mobilization of labor and otherresources, provides the regime the resources it needs following an environmental shock.

Physical networks connecting individual common property resource management regimes provide other benefits besides helping individual regimes rebound from environmental shocks. In addition to risk reduction functions, networks make possible water sales and water transfers from one system to another, thus increasing the overall profitability and social benefits of, in this case, water (Mosse 1997).[19] Inter-system irrigation networks can also provide the means for achieving finely tuned basin-level irrigation coordination regarding landscape level timing and sequencing of agricultural activities. In some cases this has important implications for water consumption efficiency, pest control, and overall agricultural productivity (Ambler 1989, Lansing 1991).

[19] However, water transfers from one interlinked regime to another may have negative distributional consequences if there is an unequal allocation of the costs and benefits associated with the transaction, i.e. when a water transfer negatively impacts a water user or group of water users who receive no benefit from the transaction.

Chapter 7

Conclusion

This has been a study of the ability of communally-managed irrigation regimes to endure over long periods of time despite relatively frequent environmental shocks such as floods and earthquakes, despite the political changes associated with pre-colonial, colonial, and post-colonial forms of political authority and statecraft, and despite the relatively recent economic changes associated with increasing rates of nonfarm employment. The story of the kuhls of Kangra is not, however, one of continuity amidst a sea of change, nor does it constitute a homogenous narrative of change and adaptation in which one master script accounts for the various trajectories of change taken by individual kuhl regimes. Rather, the story of the kuhls of Kangra is comprised of a diverse variety of regime-specific encounters with and responses to forces of change and environmental shocks. The nature and outcomes of these encounters varies dramatically among kuhl regimes. This study has sought to identify and account for patterns within this diversity. In order to elucidate the stories of individual kuhl regimes, and to account for the larger pattern they collectively represent, I adopted a multi-strand framework which integrated relationships and factors all too often been relegated to the status of "exogenous" or "contextual" elements. These include 1) horizontal networks of exchange and coordination which link individual irrigation systems across ecologically and socially differentiated landscapes, 2) mutually constitutive relations between state authorities and individual kuhl regimes, and 3) the extent to which kuhl regimes both inform and are informed by regional social formations such as caste, community, hierarchy, and social identity. Starting with a more conventional analysis of the effects of internal regime characteristics on the potential for collective action and common property resource management, I expanded the warp and weft of the analytical framework to incorporate these three other elements.

Kangra is a particularly rich place in which to explore these themes. From a physical geography standpoint, the extent of arable land and the potential scope for irrigated agriculture is unusually large for mountainous regions. The broad alluvial valleys at the base of the Dhaula Dhar mountains, the snowmelt that flows across the alluvial deltas that comprise the valley, and the temperate climate create opportunities for irrigated agriculture at a scale virtually unknown throughout the rest of the Himalayan region. On the other hand, this same topography has prevented the construction of large scale state-financed and managed canal irrigation systems found throughout the relatively flat plains to the south. This ecologically-based restriction on the scale of irrigation systems constrained the nature and extent of state intervention for promoting irrigated agriculture, and rendered mute the possible threat of large scale state-financed irrigation systems to pre-existing locally managed regimes. Ecology influenced the story of Kangra kuhls in at least two other aspects as well. First, micro-scale differences in soil type, recognized and given meaning through the local differentiation of har from larh soils, play important roles

in the farmers' labor allocation and crop choice decisions, especially within a context of increasing opportunity costs of labor. They strongly influence the spatial impacts and consequences of increasing nonfarm employment. Secondly, the hydrological impacts of the towering Dhaula Dhar massif combine with monsoon weather patterns to generate relatively frequent periods of intense rainfall. Given the steepness of the upper watersheds and the geological instability of the Himalayas, this creates optimal conditions for destructive landslides and flooding. A second recurring environmental shock, one that is related to the seismic and geological instability of the region, is destructive earthquakes. The shared vulnerability of kuhl regimes to these various environmental shocks strongly conditions the nature and function of coordination across interlinked kuhl networks.

Several general conclusions have emerged from this exploration of the kuhls of Kangra Valley. First, regime institutionalization, relations among regimes and between regimes and supralocal authorities influence regime ability to respond to environmental shocks and environmental change in predictable ways. Secondly, the impacts of environmental shocks on regime persistence differ from the impacts of environmental change. Thirdly, characteristics that influence regime ability to respond effectively to shocks differ from those that influence ability to respond to change. Fourthly, persistence is relative, while a particular regime may have "collapsed" and is now state managed, the integrity of the larger network of multi-kuhl villages and multi-village kuhls has remained intact.

Relations between regime scale and institutionalization

Regime institutionalization refers to 1) the extent to which core cultural practices and norms both inform and are informed by kuhl regimes, and 2) the relatively recent formalization of the institutional structures of kuhl regimes through the spread of the corporate organizational model of the kuhl committee. Regime scale strongly influences the formality of institutionalization. In smaller kuhls the reproduction of core cultural constructs such as reciprocity within the regime, and their embeddedness within broader networks of kinship relations, enables effective informal management. Kuhls that irrigate 25 hectares or less, are less than one kilometer long, and irrigate one village generally have no kohli, do not maintain kuhl management records, and do not use rules to determine the distribution of responsibility for system maintenance and repair among the kuhl members. In this case, the absence of explicit, formal rules does not indicate a collective action failure, but rather that informal social relations between farmers and mutual dependence on kuhl water provide adequate incentive for farmers to coordinate in the repair, maintenance and management of the kuhl whose water they share.

As scale increases, so does the formality of regime institutionalization. Kuhls that irrigate 25 to 150 hectares, are between one and ten kilometers long, and irrigate between two and ten villages have historically had one or more kohlis. However, in response to increasing nonfarm employment most kuhls in this size class have created committees, maintain a variety of written records regarding various aspects

of kuhl management, formalized the rules regarding the distribution of responsibility for system maintenance and repair, and established systems of fines and sanction to enforce the rules.

Studies of common property resource management regimes tend to equate the attributes of formal organization, e.g. written rules, fines and sanctions, elected positions, and written records, with the ability of a CPR regime to manage a commonly held resource. Consequently, it is assumed that a regime without the attributes of formal organizations is less able to resolve conflict and mobilize resources than a more formalized regime. The formality of organizational structure may be associated with resource mobilization requirements (Martin 1986:219). However, when temporal rather than spatial comparisons are made across the same set of CPR systems, the degree of organizational formality, and the process of regime formalization, may be related to changes in the degree of internal system stress within the systems, rather than to changes in the amount of resources that must be mobilized to manage the system.. In Kangra, regime formalization is one response to the internal stress and conflict resulting from increased participation in the nonfarm employment sector.

For many large-scale regimes the stress and conflict associated with increasing nonfarm employment exceeded conflict resolution capacities. Kuhl regimes that irrigate more than 150 hectares, are greater than ten kilometers long, and irrigate more than ten villages had difficulty managing the high levels of internal stress resulting from environmental change. Kuhl regimes in this size class show signs of internal stress such as contracting command areas, shifts in cropping patterns due to increasing water scarcity, ineffective kuhl committees, and high conflict levels, or they are now managed by the Irrigation and Public Health Department.

Choices regarding regime management structures balance organizational complexity against the scale and scope of coordination required for regime management. As the rate of environmental change increases the effective scales of organizational arrangements for kuhl management decrease. As the degree of reproduction of core cultural practices and relations increases within kuhl regimes, the effective scales of organizational arrangements increase. For example, informally organized kuhls with no explicit rules or formal structures are feasible only because they draw upon and reproduce core practices and relations such as reciprocity and duty to structure individuals' behavior. If kuhls were not institutionalized, even small-scale regimes would require formal structures and explicit rules, sanctions and monitoring mechanisms. However, the stresses rising nonfarm employment causes weaken the capacity of informally institutionalized practices and relations to structure behavior. Creating kuhl committees and formalizing rules compensate for the decreasing influence of core practices and relations on individuals' behavior. The effective scale of informally organized regimes consequently decreased.

Networks of coordination and exchange

Networks comprised of interlinked kuhls provide opportunities for exchange, water sharing, and coordination between kuhls. These networks can provide short-term pulses of resources (e.g. labor, water) during moments of crisis following destructive floods or earthquakes or during a drought. The resources networks provide for individual kuhl regimes constitute a reservoir or "reserve bank account" which helps reduce vulnerability to environmental perturbation. Not surprisingly, network density is positively correlated with the frequency of inter-kuhl water exchanges and coordinated water management. Where networks linking kuhls are sparse, thin, or non-existent, often due to topographical and landscape features, individual kuhl regimes are denied access to the resource reserve networks provide for interlinked kuhls. Without this buffer to reduce vulnerability to a capricious nature, during times of crisis these regimes must either 1) mobilize adequate resources from within the regime, e.g. to repair a flood-damaged diversion structure and channel, 2) negotiate with supra-local authorities for resources, e.g. capital, to subsidize the repair costs, or 3) temporarily or permanently cease functioning. Within the kuhls of the Neugal watershed all three of these outcomes have occurred.

As discussed in Chapter 6, extensive coordination and exchange between community-managed kuhl regimes still occurs. However, the advent of government management of some kuhl regimes, particularly the longest and largest ones, in the 1970s, changed the pattern of authority for kuhl management at the basin level and weakened the role of networks as resource providers during times of crisis. This happened because the Irrigation and Public Health Department does not participate in inter-kuhl water and/or labor exchanges or coordinated water management strategies. Government-managed kuhls have been taken out of circulation with respect to the interkuhl networks in which they were previously embedded. The state government's willingness to provide the necessary financial support for continued operation of the IPH kuhls and also to provide, upon request, grants to community-managed kuhls for repairing flood and earthquake related damage has, to some extent, mitigated the negative consequences of weakened interkuhl networks. In essence, the state has partially substituted resources networks used to provide with its own. This process is not entirely wrinkle free for a couple of reasons. First, had the state government not been willing to assume management responsibility for those kuhls, some would have gone defunct or at least experienced significant command area contractions. They would thus have been less able to participate fully in the forms of interkuhl coordination and exchange discussed in the prior chapter. Even without state intervention networks would have weakened. Secondly, since the spate of IPH takeovers that occurred in the late 70s through early 80s, the Himachal Pradesh government, despite numerous petitions and requests, has been unwilling to assume responsibility for managing additional kuhl systems. This is primarily because state management of kuhl irrigation constitutes a 100 percent subsidy for farmers; irrigators pay no water taxes on the water

government workers deliver to their fields. State level financial considerations have created friction or stickiness in the shift from local to state responsibility for kuhl repair, maintenance, and management. Weakened network capacities to provide resources during moments of environmental vulnerability have not been entirely supplanted by state resources, thus increasing the vulnerability of individual kuhl regimes to environmental perturbations. Within the context of continued state unwillingness to provide financial inputs for kuhl management, there could be an increasing need for the resources networks used to provide. Whether or not they will be able to do so is an open question.

Expanding the ambit of inquiry to explicitly incorporate the role of networks in accounting for the persistence of kuhl regimes has important implications for the study of common property and community-based resource management regimes more generally. Within the context of other "traditional" enduring CPR systems, it suggests that during moments of environmental vulnerability otherwise latent relations with other adjacent resource management systems and communities may constitute important sources of the resource pulses necessary to absorb the short-term crisis-induced stress. While perhaps operating on a much different spatial and temporal scale from the relatively short-term period of most field research, latent network relations may occasionally assume crucial salience during moments of crisis.

Other studies of locally managed irrigation systems have addressed the importance of intersystem - linkages. Lansing's study of Balinese subaks is a marvelous account of the ways in which decentralized religious authorities effectively coordinate water transfers and planting cycles between numerous individual subaks across large landscapes. The outcome is a sophisticated and efficient system of agricultural production that maximizes water use efficiency and minimizes the likelihood of crop pest outbreaks. In some instances the salience of individual subak "systems" is significantly diminished as one adopts the landscape-scale perspective of inter-system water use and coordination. Similarly, Mosse's research on the tank irrigation systems of southern Tamil Nadu also includes analysis of inter-tank linkages, primarily coordinated water sales and transfers. In addition to providing coordination opportunities, the evidence from Kangra suggests that intersystem relations can provide significant risk reduction benefits in the face of severe environmental shocks.

State involvement in kuhl management - continuity and change

This study has elucidated the role of the state in kuhl management across three historical periods, pre-colonial, colonial, and post-independence. Both continuities and changes across these three periods have been articulated. While the underlying rationale for state involvement in kuhls varies across these periods, there has nevertheless been a remarkable continuity of practice with regards to the varieties of state intervention in kuhl systems. Whether it is a pre-colonial ruling lineage sponsoring a kuhl's construction, a colonial administrator mobilizing military labor to help repair kuhls destroyed by the 1905 earthquake, or a current District Commissioner sanctioning a grant for repairing a flood-destroyed kuhl,

there has been a relatively supportive political climate for kuhl regimes over the last three hundred years. This has helped to produce a type of negotiated complementarity between local and extra-local involvement in kuhl management. Several factors have contributed to help create the conditions necessary for this negotiated complementarity. Perhaps one of the most important is the continuous flow of direct and indirect benefits that state regimes across all three historical periods receive from kuhl irrigation systems. This flow of benefits influences the relatively supportive role of the state in kuhl management. During the precolonial period, and consistent with prevailing south Asian models of political authority based on the exchange of entitlements for political support, precolonial Katoch rulers received political support and consolidated their authority by sponsoring the construction of kuhls, especially when their sponsorship was linked with the support of a local temple. They also benefited from the higher taxation rate assessed on irrigated as compared to unirrigated cultivated land.

During the colonial period the expansion and support of kuhl irrigation systems was consistent with broader colonial policies promoting agricultural expansion during the latter half of the 19th century. The colonial administration benefited from the expansion of kuhl irrigation through the higher assessments levied on irrigated land and by the contribution of agricultural production towards food security, an increasingly important policy concern during the late 19th century. The lack of scope for larger scale canal irrigation systems fostered a generally supportive attitude towards kuhl irrigation within the colonial administration; it was not feasible to supplant them with the large "modern" canal systems that were constructed on the Indogangetic plains to the south. Furthermore, unlike many other regions in India, in Kangra there was no zamindari system, no group of ruling overlords that the colonial administration sought to weaken, usurp, and generally supplant. In other areas, e.g. southern Tamil Nadu and southern Bihar, zamindars functioned as feudal overlords. They played central roles in the construction and on-going repair, maintenance, and management of the gravity flow irrigation systems in those regions. As their authority waned under colonial rule, the irrigation systems under their jurisdiction also declined (Mosse 1987, Sengupta 1980). In Kangra, by contrast, the gravity flow irrigation systems were never so dependent on extra-village resources and political patronage. Being primarily village-based provided kuhl regimes a measure of autonomy from fluctuations in the wider political landscape. This factor helped provide the basis for the negotiated complementarity between village and extra-local authorities during the colonial period.

Since independence the state has intermittently traded financial support for kuhls in return for electoral support at the polls. This was particularly true during the 1970s and early 80s when the state government sanctioned the IPH takeover of several kuhls at the request of the panchayats located within the kuhl's command areas. This process is somewhat analogous to the pre-colonial exchange of entitlements to water for political support. However, since the early 1980s the Himachal Pradesh

government has denied requests that the IPH Department takeover other kuhls, primarily due to the financial burdens associated with kuhl management. The unwillingness of the state government to assume responsibility for managing more kuhls, in combination with weakened interkuhl networks, has increasingly challenged the ability of the larger community-managed kuhl regimes to mobilize adequate labor and financial resources to maintain the integrity of the kuhl. Grants from various state departments and administrative divisions such as the Public Works Department, Forest Department, Block Development Office, and Office of the Sub-Divisional Magistrate are sanctioned on an as-need basis and certainly help meet the resource mobilization requirements of community managed kuhl regimes. These regimes are nevertheless acutely aware of the stark inequalities in levels of public funding provided for IPH and community managed kuhl systems.

A second element concerning the interaction between kuhl regimes and the post-independence state has been the bureaucratization of many kuhl regimes through the creation of managing committees. To some extent this does constitute the supplanting of "soft" informal organizational forms embedded in traditional patterns of authority and power with "hard" formal and corporate organizational models. Only two of the 14 committees in the Neugal basin were state directed; regime members themselves, independently of any state intervention, formed the other 12 committees. Clearly in most of these cases regime members felt that the higher transaction costs associated with these more formal structures were warranted by the increased internal accountability and conflict resolution capacities as well as access to state grants that committees facilitated - otherwise farmers would not have formed committees.

There has been a remarkable continuity of resource flows from extra-local authorities to kuhl regimes across the historical period examined in this study. For the various reasons discussed above, and unlike other regions of India, colonial state administration and policies did not undermine local water management capacities in Kangra. Across all three historical periods kuhl regimes have been relatively successful at negotiating with extra-local authority for resources perhaps otherwise not available. It must also be emphasized that the overall magnitude of extra-local involvement in kuhl management and extent of support for kuhl regimes is comparatively low when compared to other "traditional" irrigation systems in India. Thus dependence on extra-local support in Kangra was less than for other regions where the zamindari or analogous extra-village form of political authority played important roles in irrigation management.

Basin Level Patterns

Increasing nonfarm employment opportunities initiated a sequence of responses (regime formalization, command area contractions, collapse, IPH takeover, no change) that at the basin level produced new patterns of authority and organization for water management. When these differential patterns of social change within individual kuhls are laid over the matrix of interdependent kuhls Tables

5.2 and 5.3 illustrate, the result is a web of multi-jurisdictional, interconnected'kuhl networks that would appear highly resilient at the basin level because each kuhl is able to find its own equilibrium point of state/local authority and management structure given a particular type and rate of environmental change, and its own configuration of social and ecological variables. The existing basin level pattern of authority and organization for water management suggests that while specific organizational forms, operations, and scales of regime management did not persist in the sense of remaining unchanged, the overall pattern of kuhl networks within the basin transformed in order to endure.

Under current conditions the result is a situation in which many farmers, especially on the left bank where the majority of the IPH managed kuhls are located, receive water from an IPH kuhl for their larh landholdings, contribute towards the management of a multi-village kuhl with a committee to irrigate some of their har holdings, and, along with their house cluster neighbors, informally manage another kuhl to irrigate har plots in a third location. On the right bank the scenario differs only in that instead of receiving water from an IPH kuhl for their larh holdings, farmers switched to rainfed maize production.

Except for the friction associated with bureaucratic change, this multi-jurisdictional pattern of kuhl management could conceivably flip flop if the value for an agricultural product well suited for larh conditions should dramatically increase. If this happened, farmer incentive for controlling water deliveries to larh areas might provide adequate motivation to assume responsibility for managing kuhls with lowhar/larh ratios currently under IPH jurisdiction. Under these conditions we would expect state intervention to recede in kuhls with high larh command areas. The subsistence ethic, and associated aversion to buying rice, is still strong enough that I doubt IPH intervention would substantially increase in high har/larh ratio kuhls.

While the value of a larh-adapted agricultural crop may or may not rise, the point illustrates the potential ebbs and flows of state and local responsibility for water management, and the flexibility inherent in the present system. Micro-level adaptability is a key element in explaining the system's resilience. A basin level organization that in any way imposed a uniform approach to water management could jeopardize the system's responsiveness arid resilience. While there may be an appropriate role for a basin level organization, for example to rationalize the distribution of government funds for kuhl repair, a basin level organization could easily do more harm than good if it expanded its authority into other arenas of water management.

By broadening the scale of analysis to include factors more often considered exogenous, I developed a framework that specifies: (1) the mechanisms through which shocks and change affect regimes; (2) the variables that determine how and why regimes respond to shocks and change; (3) the thresholds beyond which particular organizational configurations for CPR management are no longer

feasible. This analysis provides the basis for predicting when, how and why CPR regimes will persist, or not, in response to environmental shocks and change.

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APPENDIX I (a): Characteristics of Kuhl Regimes of the Neugal Basin, Right Bank, Upstream to Downstream.

Name	IPHor Communal	Command Area (Ha.)	Channel Length (km.)	# Tikas Irrigated	Interdepen-dence Measure+	Har/Larh (Mauza-wise)	Core or Periphery ++	Altern-ative Water	#of Kohlis	Kuhl Committee	Single or Multi Caste
Bhradi	C	67	3.5	4	2/1 (H)	1/0	C	N	1	Y	S
Chanogi	C	90	3	4	2/1 (H)	1/0	C	N	1	N	S
Bhagotla	C	15	2.5	2	1/1 (L)	1/0	C	N	1	Y	S
Kathul	C	70	7.5	3	3/2 (M)	0/2	p	Y	1	Y	M
Saprahl	C	70	15	3	6/3 (H)	1/2	p	Y	1	Y	M
Pathan	C	45	5	2	5/2 (H)	2/0	C	N	2	Y	M
Rai	IPH	820	20	28	10/6 (M)	4/3	p	N	-	-	M
Makruhl	C	20	3.5	2	8/2 (H)	2/0	C	N	1	Y	M
Samruhl	C	15	1	1	5/1 (H)	1/0	C	N	1	Y	M
Pangwan	C	60	1	1	5/1 (H)	1/0	C	N	1	Y	M
Sonia -	C	25	1.5	1	5/1 (H)	1/0	C	N	1	Y	M
Gagruhl	C	27	3	2	6/2 (H)	2/0	C	N	1	Y	M
Majettli	C	5	.5	1	1/1 (L)	1/0	C	N	0	N	S
Bal	C	23	1	1	1/1 (L)	1/0	C	N	0	N	S
Natyrya	C	.5	.5	1	1/1 (L)	1/0	C	N	0	N	S

+ Interdependence Measure: the measure of interdependence for kuhl 'a' = the ratio of number of other kuhls that irrigate the mauzas kuhl 'a' irrigates to the number of mauzas 'a' is engaged with. If the ratio ≤ 1, the kuhl has low interdependence. If the ratio > 1 x < 2, the kuhl is moderately interdependent. If the ratio ≥ 2 the kuhl has high interdependence.

++ Core or Periphery: when larh = 0, then C; when larh = 1, then C/P; when larh > 1 then P. C = Core. C/P = Core and Peripheral. P = Peripheral.

APPENDIX I (b): Characteristics of Kuhl Regimes of the Neugal Basin, Left Bank, Upstream to Downstream.

Name	**IPH** or Communal	Command Area Ha.	Channel Length (km.)	#Tikas Irrigated	Interdepen-dence Measure+	Har/Larh (Mauza)	Core or Periphery ++	Alterna tive Water	#of Kohlis	Kuhl Committee	Single/ Multi Caste
Ghran	IPH	?	5	9	1/1 *(L)*	1/0	C	N	_	_	S
Dewan C.	IPH	185	25	24	16/5 *(H)*	3/2	P	Y*	_	-	M
Mia Fateh	IPH	256	20	23	30/11 (H)	5/6	P	Y*	_	_	M
Dai	IPH	257	25	22	15/5 (H)	4/1	C/P	Y*	_	_	M
Ghughrul	IPH	128	5	5	8/2 (H)	2/0	C	N	_	_	M
Kirpal C.	IPH	1713	33	62	26/10 (H)	5/5	p	Y*	-	_	M
Raniya	C	545	12	10	17/4 (H)	3/1	C/P	Y	2	Y	M
Mahang	C	?	?	8	21/5 (H)	4/1	C/P	N	1	N	M
Loharal	C	?	?	6	12/2 (H)	2/0	C	N	1	N	M
Taruhl	C	65	6	7	15/3 (H)	3/0	C	N	1	Y	M
Chamruhl	C	65	6	7	15/3 (H)	3/0	C	N	1	Y	M
PatnuM	IPH	526	11	25	26/7 (H)	5/2	p	Y*	_	_	M
Menjha	C	140	8	3	10/2 (H)	1/1	C/P	N	1	Y	M
Sangar C.	EPH	324	26	16	15/6 (H)	5/1	C/P	Y	-	_	M
Masanol	C	40	4	4	*1\2 (L)*	2/0	C	N	1	Y	M
Spein	C	15	1.5	1	*1/1 (L)*	1/0	C	N	0	N	S
Sulah	C	4	1	1	1/1 (L)	1/0	C	N	0	N	S
Saldian	C	2	1	1	1/1 (L)	1/0	C	N	0	N	S
Machlena	C	15	1	1	1/1 (L)	1/0	C	N	0	N	S
Karni	C	4	.5	1	1/1 (L)	1/0	C	N	0	N	S
Rein	C	40	2	1	1/1(L	1/0	C	N	0	N	S
Bouru	C	9	.5	1	1/1 *(L)*	1/0	C	N	0	N	S
Upperli	C	?	?	18	3/2 *(M)*	2/0	C	Y	1	N	M
Buhli	C	300	10	17	*5/2 (H)*	2/0	C	Y	1	N	M

+ Interdependence Measure: for kuhl 'a' = the ratio of number of other kuhls that irrigate the mauzas kuhl 'a' irrigates to the number of mauzas 'a' is engaged with. If the ratio <_1, the kuhl has low interdependence. If the ratio > 1 x < 2, the kuhl is moderately inderdependent.; If the ratio ≥ 2 the kuhl has high interdependence.

++ Core or Periphery: when larh = 0, then C; when larh = 1, then C/P; when larh > 1 then P. C = Core. C/P = Core and Peripheral. P = Peripheral.

* Indicates that alternative water sources are available for a portion of the kuhl's command area, but not the whole c.a.

APPENDIX II (a)

"Brahmins Don't Do *Begar*"

The Rajas of Kangra mobilized the labor necessary to construct the kuhls they sponsored through the institution of *begar,* or compulsory labor service. *Begar* was also used for other purposes. Barnes identifies three forms of *begar* (1855:67). The most burdensome *waspund begar* which entailed carrying loads of timber, stone and other materials required for public works. This onerous duty fell upon the agricultural castes. Other forms of *begar* included carrying letters and parcels, and providing wood and grass for the camps of government officers on field tours. Brahmins and Rajputs were exempted from all forms of *begar*. Shyam Lai Sharma, "Pita-ji", recounted this story about the consequences of violating the norms protecting Brahmins from doing *begar* for the construction of Kirpal Chand Kuhl.

Kirpal Chand, brother of Raja Bhim Chand who ruled Kangra State from 1690 to 1697, built the kuhl which immemorialized his name. Originating in the headwaters of the Neugal River, Kirpal Chand Kuhl meanders southwards through verdant valleys and along pine clad ridgetops for over thirty kilometers. Along its way, the kuhl irrigates hundreds of hectares of prime agricultural land within the boundaries of over sixty hamlets. Pita-ji recounted that constructing the branch leading to the Thural area was particularly difficult at Garh, below Daroh. There, the kuhl had to pass across two ridges. The only way to convey the kuhl's water between the two ridges was to construct a massive stone and earth embankment that equalled the height of the ridges and over which the kuhl's water could flow. It took twelve years of continuous work to construct the embankment. Near the end of that period, the Raja's officer approached , two Brahmin brothers who lived in Garh, and asked them to come for *begar* the next day. This contravened the proscriptions against Brahmins and Rajputs having to do *begar*.

On the appointed morning both brothers arose and did their usual.lengthy morning prayers and ablutions. After finishing their spiritual practices, each brother uprooted a large tree and fashioned it into a massive forked implement. Using the uprooted tree trunk as a type of broom, they started to roll two huge boulders, each the size of a two story house, towards the construction site in the same manner as one might sweep the dust off the floor. The Raja's officer chanced to come upon this wondrous sight. Seeing the brothers nonchalantly sweeping the two huge boulders, he immediately realized their great spiritual powers. The officer promptly forgave both brothers of their *begar* duties and invited them to please return home. The two boulders were left at that spot and can be seen there to this day.

APPENDIX II (b)

"Never Argue With The Kohli"

The kohli (watermaster) is crucial to the functioning of the kuhl. The kohli organizes and supervises the cleaning of the kuhl's channels (khana), he measures and distributes water to each of the kuhl's outlets (tups), he controls the flow of water to different villages according to their shares, he guards against water stealing during the hot season, he resolves conflicts that flare up between farmers over water use, and during times of acute drought, he appeals to the supernatural forces to relieve the farmer's distress. . hi the spring he officiates in rituals to the feminine deity of the kuhl, appealing to her to flow abundantly through the kuhl. At this time, or sometimes at the beginning of the monsoon season, he also does puja to Quaja Pir.

, Quaja Pir, an Urdu term, is the destructive manifestation of the rivers draining the southern slopes of the Dhaula Dhar massif. Quaja Pir comes when unusually heavy and sustained monsoon rains cause landslides which create temporary dams in the narrow canyons of the lower Dhaula Dhar. When the dam eventually bursts, a wall of water, boulders, trees and mud hurtles downstream causing great destruction and often changing the course of the river. In the Neugal River, this occurred most recently in 1944 and 1952. Village elders describe the deafening roar of the water, and the thundering and sparking of the boulders crashing against one another as the engorged Neugal River hurled them downstream. The power and ferocity of Quaja Pir is difficult to imagine. The kohli prays to Quaja Pir and supplicates the deity to bypass the kuhl in its destructive fury and leave it undamaged.

Given all that the kohli is responsible for, it is perhaps not surprising that he, especially in previous times, was held in great respect and reverence by the communities he served. The ability of the kohli to influence natural forces is renown, and celebrated in more than one Kangri story. The following story, recounted by Pita-ji, illustrates the power of the kohli and the consequences of questioning his authority.

On the left bank of the Neugal Khad, across from Bhagotla Village, dangas (diversion structures) divert water into the four kuhls, Loharal, Mahang, Taruhl, and Chamruhl, that irrigate Mauzas Sidhpur Rani and Sidhpur Sarkari. Being of medium length and irrigating the same mauzas, only one kohli has traditionally been responsible for managing these kuhls. As the person who inherited the right (warisi) to be kohli is away doing military service, the local panchayat has arranged for another to fulfill the function. The rightful kohli's great great grandfather, Gurdyal Kohli, is remembered as a kohli of great distinction and power. He had a long flowing beard and many considered him almost a saint. During the months of May and June, when water is scarce and demand is high, Gurdyal Kohli used to position himself on a knoll in Bindraban Village that afforded a view of all four kuhls. He stayed there on a charpoy (wood frame cot)

day and night directing the distribution of water through the tups of each kuhl. Neighbors and family members brought him food so that he could remain on the spot until the monsoon rains began.

Once, in an altercation over water distribution, a farmer struck Gurdyal Kohli. In dignified silence Gurdyal Kohli turned from the farmer and went straight to the kuhl's danga. There, he struck his head three times against the sacred rock where for generations his ancestors had worshipped the kuhl's mother deity. At the same time he cried, *"Mata-ji, insaafkaro"* ("Mother Goddess, do justice"). Suddenly, from the narrow canyon where the Neugal Khad issues forth, a deafening roar was heard. Quaja Pir came thundering and raging down the canyon. Flames and sparks leapt up from the water. Huge boulders tumbled against each other as if they were mere marbles. The destructive might of Quaja Pir washed away the dangas of all four kuhls, and obliterated the upper portions of the channels that clung to the riverine cliffs. Despite years of work to repair the damage Quaja Pir did, the four kuhls never again flowed as freely and abundantly as before the day a farmer struck Gurdyal Kohli.