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Water in Nepal

Dipak Gyawali

East-West Center

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An Interdisciplinary Look at Resource Uncertainties, Evolving Problems, and Future Prospects

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by

Dipak Gyawali

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Dipak Gyawali was a research fellow at the Environment and Policy Institute, East-West Center, from July through September 1986.

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FOREWORD

Since the start of the Environment and Policy Institute's program in water resources management in 1982, one of the objectives has been to gain a better understanding of the water resources problems and opportunities in specific countries of the Asia-Pacific region. To this end, EAPI has supported studies and undertaken collaborative research on specific water resource management problems in several countries including Thailand, the Philippines, Indonesia, and China. EAPI has also commissioned country-wide surveys by leading experts in other countries such as India.

This monograph by Dipak Gyawali on the water situation in Nepal is the most recent survey. The initial draft of this report was written by Mr. Gyawali during his residence as a Research Fellow at the East-West Center from July through September 1986. As reported in the Preface, the manuscript has been extensively reviewed and revised since then, following Mr. Gyawali's return to Nepal.

This monograph casts a broad net, extending far beyond the conventional treatment of water resources in terms of supply and use. It uses water as an illustration of major problems and issues that arise during the course of development in a small nation rich in water resources but with limited capital and social infrastructure. The report dramatizes the difficulties that arise when well-intentioned expatriate donor and technical assistance agencies dominate the development process, sometimes at the risk of leading the country along an unsustainable development path. In calling attention to these important problems and issues associated with development, Mr. Gyawali makes an important contribution toward improving our understanding of the pitfalls and dangers, as well as the opportunities associated with the development process, especially as related to water resources. We are pleased and honored to publish this monograph as a contribution to the EAPI Occasional Paper series.

Maynard M. Hufschmidt
Senior Consultant

PREFACE

This is essentially a monograph on development. Much has already been written on this new religion of our times--for religion it is, with dogmas, prophets, rituals, and acolytes. Much more will continue to be written in the years to come, because its messianic fervor is picking up greater momentum as the wave of the future. The last word on development and its practice is not in yet. There is no universally accepted creed, and the debate rages more furiously than ever as better hindsight reveals a plethora of development disasters born of the myopic certitude of yesteryears.

In the lush jungle of development literature, this monograph justifies its plea to be heard by its slightly unconventional approach. It does not use the traditional breakdown of chapters to describe the phenomenon of water in Nepal, nor does it start from a grand theory and work its way down to the mundane. Rather, it starts from a tangible phenomenon like water in a developing country and sees which of the theories and hypotheses explain the acts of omissions and commissions. In that sense, it is also not adding another narrow disciplinary brick to the edifice of modern scientific knowledge. Rather, its purpose is to look at the whole problem from a new perspective that will allow asking the right questions before struggling with the wrong answers.

If truth is the whole apple, it can be split in many different ways. Although traditional methods of slicing may be convenient, they may not necessarily reveal the worm or even the core. An unconventional approach may also miss the hidden truth; but, I hope, it cannot be faulted for failing to search. If such an attempt provokes others into trying newer cross-sections--one of which will ultimately hit a rich vein--then this effort will have been amply rewarded. After all, wisdom does not fall as manna from heaven: it is created in the process of societal debate with the intermingling and clashing of ideas. If we should ever fail to find the right wisdom in developing Nepal's water resources, it shall be because we were too timorous to explore our hunches.

The audience for this monograph is the Nepali intellectuals and the expatriate development experts. The Age of Foreign Aid is drawing to a close. Shattered lies the belief that an inflow of capital from abroad can painlessly bring about the nirvana of development without discomfiting internal structural changes. Through this monograph, I hope to provoke all thinkers of goodwill into looking afresh at development in general, and Nepali water resources development in particular.

If there are any insights of greater depth in this monograph, it is because I have been hoisted aloft by giants. First, I want to thank Dr. Maynard M. Hufschmidt, then the acting director of the Environment and Policy Institute (EAPI) at the East-West Center, who provided me a research fellowship at the Center in 1986. That fellowship allowed me the time and freedom to complete the basic research for shaping the ideas in this monograph. But for his constant encouragement and patience with my slow ways, it might never have seen the light of day. Facilities at the EWC, as well as the atmosphere at the EAPI, helped greatly in the endeavor.

I owe an intellectual debt to the professors and graduate students at the Energy and Resources Group (ERG) of the University of California at Berkeley where many of my unconventional ideas were first tested in its high-voltage cerebral crucible. In the years that I worked for the Ministry of Water Resources in Nepal, I had accumulated many observations and qualms regarding water and energy development. Over many a pizza did that tribe of inveterate theorizers spin and demolish hypothesis to explain my experiences. ERG fits Robert Bellah's (1970:xvii) contention that "Berkeley evinces the intensity, the immediacy, the openness, and the precariousness of an emergent social order."

The ideas in this monograph have been presented at four seminars: at the East-West EAPI, Hawaii, on September 17, 1986; at the Integrated Development Systems, Nepal, on August 26, 1987; at the Society for International Development (Nepal Branch) on October 9, 1987; and at the Swiss Association for Technical Assistance, Nepal, on November 27, 1987. I have benefited greatly from the discussions that

followed. The questions and comments by participants have allowed me to clarify or buttress my arguments.

This monograph has been through several drafts, and several reviewers have provided very valuable comments and criticisms. Listing them (in no particular order) is my inadequate attempt to express my thanks: Dr. Binayak Bhadra of CEDA/Tribhuban University; Prof. Yadu Nath Khanal, visiting scholar at IDS/Nepal; Mr. Richard B. Woodford and Mr. Eric Cruickshank, resident and deputy resident-representatives, respectively, of the World Bank in Nepal; Grace and Paul Terrell of Overseas Bechtel Inc. at the Karnali Project in Kathmandu; Mr. Jan Sharma of Depthnews in Kathmandu; Drs. Mahesh Banskota and Anis Dani of ICIMOD; Drs. Indra Jung Thappa and Chaitanya Mishra from IDS; Mr. Andrew Cohen of ERG/University of California, Berkeley; and reviewers at the East-West Center--Drs. Norton Ginsburg, John Dixon, Toufiq Siddiqi, Kirk Smith, Donald Alford, A. Terry Rambo, and Lawrence Hamilton.

My special thanks to Helen Takeuchi, EAPI editor, whose red pencil--like a surgeon's knife--is more skilled at lopping off literary warts and deformities than most of us writers who dote on our hideous creations care to admit.

The review reactions were basically of two types: the first related to more in-depth coverage of this or that topic. There is no doubt of the need for that; but because this is an interdisciplinary work, there are limits to how thick one can make the volume. I have decided to tackle them in my subsequent disciplinary forays. The second set of criticisms related to matters ranging from typos to concepts fuzzily expressed. I have attempted to address all of these in the monograph and can only hope I have succeeded.

I must, however, take the formal opportunity of this preface to absolve all the previously mentioned learned thinkers and institutions, as well as the many authors quoted herein, of any guilt by association, since many of them have strongly held views of their own quite different from mine.

Dipak Gyawali

1. INTRODUCTION

In recent years Nepal's water wealth has begun to attract international attention as a resource of world-class proportions. Indeed, with a theoretical hydroelectric potential billed at 83,000 MW (H.M. Shrestha 1966) and an established inventory of feasible sites totaling about one-third of the above figure (MWR 1981), Nepal's rivers hold the promise of abundant energy that very few places in the world can match. When one adds to this electricity bonanza the prospect of irrigating one of the world's most fertile areas--the northern Gangetic plains--for second and third crops, the vision of an overflowing cornucopia, seen from the vantage point of pure engineering, can be overpowering.

Initial expectations from Nepal's water resources were based on an analysis that saw falling water from a physicist's perspective, which then fueled both publicity and political hopes regarding the nation's future.[1] Subsequently, the evolution of complex problems involved in harnessing the cascading waters of the Himalayas began to cast doubts on the viability of quick development. There were physical uncertainties regarding the quantity and nature of Nepal's water. Very little was known about the riverbeds and hills upon which gigantic engineering structures were to be built, and what became known was generally unfavorable to large structures. There were also incongruities between the vision of full-scale water resources development and larger social realities. These difficulties have taken the romantic euphoria out of Nepal's water and have left an uncomfortable hiatus in public debates regarding this physical asset.

This monograph is an attempt to step back and re-scan the horizon. It is an interdisciplinary effort at slicing anew the whole that is Nepal and her water resources, and synthesizing the various strands of social and physical concerns that bear upon Nepali water (D. Gyawali 1983c). This essay does not propose to delve deeper and deeper in the analysis of any individual element pertaining to water, although there exist both the need and scope for narrow and highly

focused studies of water in its many manifestations. Indeed, for the specialists in the different disciplines, the treatment of their favorite subject in this monograph may seem to be hopelessly brief and almost callous. It is because the task set forth is to pick out only the essence of the various elements and to see how it weaves into the fabric.

Together with the narrow disciplinary studies that are being conducted aplenty, there is an equally great need for a study such as this to look at how various elements fit together and what the entire mosaic of Nepali water, its evolving problems, and future prospects look like. It is an effort at synthesis that is necessary before any policy formulation. The conventional wisdom, for example, is that the engineers study the technical problems, economists analyze the economics, sociologists examine the social aspects, and then the decision-maker, having received the input from this stream of specialized experts, puts all the relevant pieces together and makes a rational policy decision.

That is not the reality. Experience tells us that this omniscient being is a mythical abstraction about as idealized as the "free market." The decision-maker is probably some harried politician with little time and less capacity for synthesizing myriad concerns into a formula for action based on long-term views. Real-life politicians quite often have no way of synthesizing analytical concerns into a wise policy for action. They mostly have to rely on sheer instinct for short-term political gains. Plato's "philosopher kings" are an exception rather than the rule.

This exercise of weaving the broad picture must also be done by scholars so that a nation's decisions on long-range issues are not crippled by a lack of thought at the outset. A sweeping synthesis may be a more formidable task than narrow analysis, but decisions are ultimately based upon it. Rather than let crucial decisions emanate only from a politician's instincts, academic pundits should carry out this nature of intellectual inquiry to elevate the quality of decision-making by bringing in ignored, overlooked, or misperceived concerns.[2]

Nepal is in the initial stages of water resources development and has not been irreversibly locked into any one of the various possible paths of future evolution. For example, she still has the option of choosing between a centralized "large dams" approach and a decentralized "small dams" path of future evolution. This fact justifies a broad reconnoitering before rushing headlong with projects and programs. To draw on a metaphor, it is like choosing a restaurant. Once one has decided to go to, say, a Chinese restaurant, one has already limited one's choice of dishes. The lack of proper synthesis at the outset before prescribing a policy for action could later lead to sour regrets.

It is hoped that the end result of this effort--both this published text and the debate it is intended to provoke--will enlarge the scope of our lateral thinking and help us as a society acquire the wisdom needed to choose a sensible future course of action.

NOTES

1. For an idea of the hopes inspired for speedy development through the use of water resources, see MWR 1985 and MWR 1981. The quote on the first page of the latter, signifying state policy, is instructive in this regard: "One of our chief resources in Nepal is water which, if harnessed and managed properly, holds a magic key for all-round development of our country. Used properly, not only can our rivers generate electricity but also provide water for irrigation abundantly. More than that, it can also act as a catalyst for multiple forms of development, including energy as an alternative to our forest wealth."

2. For example, conventional wisdom says "Nepal has an acute shortage of qualified technical manpower" and explains away most of the shortcomings of development. The reality is that there are presently 400 unemployed engineers in Nepal (see B.P. Shah 1987).

Similarly, it is accepted as an object of faith that Nepal lacks capital for development, although evidence of blocked and inefficiently used capital abounds. Interdisciplinary synthesis would seek to put even such unpalatable truths into the broth.

2. INTERDISCIPLINARY WATER

Like political frontiers and administrative delineations, the boundaries set by academic disciplines are also man-made, and water does not respect their integrity. It passes through not only diverse districts and contentious states but also seemingly unrelated subjects such as anthropology and civil engineering. It is used by humans directly for various purposes (e.g., irrigation, power production, or religious rites) and indirectly through the use of goods and services provided by the ecosystem that depends on water.

In addressing issues related to water, one is forced to cross academic boundaries and deal with problems generally studied in greater depths by others. Water, like energy, is not a single discipline but the focal point or intersection of several disciplines. It is a subject of engineering when its regime is modified by hydrotechnical structures. When the costs and benefits of such modifications are discussed, it becomes a subject of economics. When its climatological origins are examined, it is a subject of applied physics. If one wishes to understand how a society uses water, it is an object of anthropological inquiry. However, when one wishes to do something with it, what is required is an interdisciplinary study dealing with the different disciplines that study water, with the fuzzy areas between disciplines, as well as with the areas ignored by most disciplines (such as the realm of values and its subterranean influences on the base assumptions of disciplines). Such a study is understandably inhibiting, but there are compelling reasons to make it.[1]

The hydrobiological system exhibits the synergistic character of complex systems. When one is tinkering with such a complexity--as all water resource development projects propose to do--there is more than an even chance (from the law of large numbers and the myriad of elements involved) that something will go wrong somewhere in a completely unanticipated manner. A policy formulated from an interdisciplinary perspective reduces that probability somewhat by

virtue of the fact that more of the elements will have been considered in themselves and in their interactions, and the conclusions will be more sensitive to the concerns and uncertainties inherent in the disciplines.

Interdisciplinary studies are different from those of multidisciplinary.[2] The latter is what interdepartmental commissions and task forces usually do, generating in the process more heat than light. A multidisciplinary group does not necessarily result in an interdisciplinary inquiry. In a multidisciplinary research program, experts contribute with the application of theories and methodologies of their individual disciplines. They would apply their professional skills only to that sliver of the problem where their tools are applicable and ignore other aspects. This approach may seem reasonable, for why should anyone strive to project one's punditry into realms where one does not have the training or skills? This line of thought, however, would be valid only if disciplines were water-tight compartments having no linkages with others, and if there were capable decision-makers skilled in synthesizing various disciplinary solutions into a coherent policy. A purely disciplinary approach would downplay or even ignore the whole gamut of problems that lie in the penumbra of linkages.

Unlike disciplinary analyses, interdisciplinary inquiries strive to use the concerns of other disciplines to restructure the arguments of one's discipline. Although the former have well-established bodies of knowledge, the latter do not; and the emphasis of an interdisciplinary inquiry, such as this one, is first on evaluating questions, and then only on suggesting answers. An interdisciplinary study strives to restructure the debate by looking at the problem from different vantage points and is especially needed in a situation where an enlightened public debate has ceased and too many questionable assumptions remain unchallenged. Such is the case in Nepal today regarding water resources development.

Water is one aspect of the whole that is the Nepali society and her resources. Breaking the whole into components is akin to slicing

an apple: one ends up seeing only one cross-section and is left with the lingering doubt as to whether one has not missed a vital element that fell in some other cross-section. Breaking a whole into components is essential for analysis: this act describes the problem (which is one whole) in its different avatars. Having done so, one would wish to do something about it (i.e., prescribe a policy for action to solve the problem). In this sense, if policy is defined as a formula for the use of power, an interdisciplinary study is a policy study that synthesizes various aspects of a knotty problem into a coherent formula for action.

In slicing an apple, although it can be done in an infinite number of ways, the questions to be kept in mind are whether that particular slice can reveal any new insights, and whether the parts so isolated will enable us to intervene in their functioning so that a desirable overall effect is produced. This monograph on Nepali water will split the whole into two parts: the social system (sociosystem), which encompasses phenomena that originate from human initiatives, and the physical system (physicosystem), which exists with or without humans and upon which human activity is directed. The two interact with each other, sometimes enhancing and at other times limiting their potential for further development (see Norgaard 1984).

To make such a split is sensible because there are two types of uncertainties in our analysis, and they must be dealt with differently. First, uncertainties of a physical nature can be reduced by better scientific investigations using known tools of the relevant sciences. Uncertainties regarding evapotranspiration, for example, can be reduced by better meteorological and climatic studies. Second, uncertainties of a social nature are not as amenable to amelioration through the ready application of an iron-clad body of knowledge as their physical counterparts. These uncertainties are exacerbated because few aspects of a society's behavior can be studied "objectively" without the intrusion of covert values.

Laws that govern social behavior (including political, group, or institutional) are "soft" laws more important in the context of

dynamic interactions than in their mechanical rigidity. The nature of these "laws" for a historically unique society like Nepal's is a subject of investigation in itself. Physical water, in its interaction with human society, acquires a social personality. The basic idea in this monograph is to capture the essential elements of the overall social climate and to make inferences regarding contemplated actions of intervention into the physical regime of naturally flowing water through the construction of large hydrotechnical schemes.

When we talk of water resources development, we willy-nilly imply changes in both the physicosystem and the sociosystem, although the debate tends to be concentrated on the former. Social and physical systems drag each other through a complex pattern of mutual interactions. Splitting Nepali water into these two parts would allow some measure of insight into which system needs some tinkering if the natural resource is to be used for human well-being. Only a fortuitous combination of the two would make falling water a social asset, which can be termed "water resources."

NOTES

1. The value of lateral thinking, as well as interdisciplinary analysis, is described by many, but such advocates tend to be quickly marginalized by an academic atmosphere that rewards disciplinary contributions. Baran (1969) and Churchman (1982) are remarkable survivors--the first in economics and the second in business management.

2. A compelling advocacy of interdisciplinary analysis is found in Webber (1985) from which some of the arguments are paraphrased. One polemic against what has been propounded is of fools rushing in where angels fear to tread. The counter argument is that, no matter how intricate a situation, politicians and decision-makers

have been going ahead with action programs anyway; and an academic interdisciplinary analyst entering the fray can only enhance the quality of decision-making by forcing a reasoned consideration of a wider range of factors.

PART I

WATER AS A PHYSICAL RESOURCE

Whenever water resources are mentioned, the physical side of things is generally emphasized. Water manifests itself as a tangible material phenomenon with features of its own. Therefore, it should not be surprising if popular imagination links the idea of "resource" with the existence of physical abundance. After all, one does not associate "water resources" with the Sahara desert, although whatever moisture exists is probably a resource more valuable than gold. Similarly, at the other extreme, the lush fields of the Bengali lowlands are considered blessed in water resources although much money, material, and manpower resources must be spent every autumn for rehabilitating the aftermath of this "blessedness."

Despite the popular preconceptions equating "water resources" with the physical phenomenon of cascading abundance, very little is known of the important properties of Nepali water that would allow it to be a meaningful resource. The process of harnessing a physical phenomenon to serve human needs requires at the very outset an understanding of its natural characteristics. Hydrotechnical structures can be wisely planned and effectively operated only with a sound knowledge of the extreme (not merely average) behavior of rivers. The larger and more complicated the structures, the more detailed and sophisticated must be the database. A look at the physical side of Nepal's water resources is therefore in order.

In assessing Nepal's water as a physical phenomenon, we need to know: What is there? Where and when is it there? In what form is it there? Finally, most important, how do we know what we think is out there? These nested questions ask us to spell out the quantity of water, its spatial and temporal distribution, its various pathways through the territory of Nepal, as well as the uncertainties in its mensuration.

This part of the monograph describes the physical characteristics of Nepali water. The underlying thesis is that the nature of the

hydrology of these Himalayan rivers, the uncertainties and gaps in knowledge, as well as the geological setting, militate against an easy or even effective harnessing of this endowment to the extent envisaged by modern hydrotechnical engineers.

3. WATER BALANCE

The first task in acquiring a total perspective on the nature and property of water is to set up an annual water balance. This exercise is not easy to conduct because no measurements have been made to determine the magnitude of important elements of an aggregate water balance for Nepal.

The inflows in such a water balance would consist of precipitation in the form of rain and snow from the atmosphere, and surface flows imported from the northern reaches of the basins that lie in China. Some measurements of rain in the lowland valleys exist and are more fully discussed later. Measurements of snow cover and depth, and the study of snow hydrology in general, have not been conducted in any systematic way.[1] The amount of water flows imported into Nepal (from the upper stems of Arun, Bhote Kosi, Trisuli, and the Humla Karnali) has never been physically measured. For Arun, water flows are assumed to be about 10 percent of the average annual flow. The net result is that, based on crude estimates, one can say that about 220 billion m^3 of precipitation occurs in the territory of Nepal, indicating that serious uncertainties exist about the inflow of water in the overall water balance.

The outflows consist of the most visible river discharges amounting to about 160 billion m^3, evapotranspiration into the atmosphere, human consumptive use, and seepage into deep groundwater. Most of the major rivers of Nepal have flow gauging stations at the point where the river debouches onto the Tarai. However, there are no measurements near the border before the river enters India; therefore, the contributions of the Tarai tributaries have to be estimated. Also, no published records of measurements are available on the smaller rivers originating in the Siwaliks and flowing into India before meeting the major rivers. On some of them, major barrages for irrigation (on the Banganga, the Kamala) or major bridges (Tinau at Butwal) have been constructed. Their designs seem to have been done based on point measurements. The practice of keeping systematic,

long-term hydrological flow measurements does not seem to have been continued upon termination of the concerned foreign-aid project. It is assumed that these smaller rivers form less than 1 percent of the total outflows (C.K. Sharma 1983:136).[2]

Evapotranspiration estimates for some of the meteorological stations have been made (LRMP 1984) but extrapolating them to the climatologically diverse areas (especially the highlands) would not give meaningful results. Consumptive use by human societies includes large withdrawals for traditional, nongovernment developed irrigation about which studies have only recently begun (Martin and Yoder 1986; Coward and Levine 1986). Water use for drinking and sanitation, although a small percentage, is an important need about which data are scant.[3] Similarly, the inflows into the groundwater table and storage therein are quantities largely unknown.

Between inflow and outflow in the overall water balance for the country lies the stock in residence. The volume of this stored stock of water--in reservoirs of snow and ice, lakes and ponds, strata of groundwater pockets, and in soil moisture during various seasons--is also a physical characteristic of Nepali water that is largely unknown. The residence time of this stock along the various pathways is important because of the short- and long-term consequences for human activities based on their exploitation.

Setting up a water balance for the country, although an essential task necessary at the very outset of any plan for massive remolding of the regimes of nature, is not easy for Nepal because of the paucity of primary data.[4] These scientific uncertainties are not very conducive to intelligent planning and design of major hydrotechnical structures that must be constructed based on a firm knowledge of extreme events: the duration and volume of flood peaks and the lowest flows during a once-in-ten or once-in-twenty-year drought.

Water balance exercises should be conducted basin-wise. The fact that the watershed basin is the most intelligible unit of study from a physical viewpoint has been adequately emphasized in theory but not very well in practice (Goodman 1984:18; Saha and Barrow 1981:2;

Hamilton and King 1984:81; Rawat 1985:427). The natural flow of water within it is an environmental service and can be duplicated only at tremendous costs. The service provided by this movement is used by the diverse elements of the ecological system and traditional human societies. The natural flow of water in a basin (barring small distortions in groundwater movement) makes it easier to set up a water balance within it than within a boundary defined otherwise.

In Nepali river basins, this is easier said than done. The scientific measurements that need to be made to reduce uncertainties can be generated only with the financial resources and patronage of the state and its enlightened statesmen. Where penury in national economics or poverty of vision among the leaders of society prevails, efforts at collecting primary data will neither be fruitful nor of good quality.

The poor quality of data is probably best illustrated by the 35 percent difference in the figures for Nepal quoted by eminent authorities and institutions.[5] The territory of the country is one figure that can be expected to be reasonably constant, since the last major war was fought more than a century-and-a-half ago and because a country's area is such a sacred item. If there is so large an uncertainty in this basic parameter, the chilling thought to be kept in mind is, how accurate are the other numbers we shall shortly be using to describe the various facets of Nepal's water?

NOTES

1. The only high altitude glacial and snow precipitation studies in Nepal to date seem to have been done by a research team from Nagoya University based on a year-long observation in the Langtang region of the Upper Trisuli catchment in 1985-86 (see Fukushima et al. 1987).

2. Shanker (1985) estimates it at 10 percent. From the viewpoint of precipitation, Shanker is closer to the truth; but, because of the gravelly bhabhar nature of these river beds and sustained low flows during most of the year, Sharma could be correct. However, there are no scientific measurements to clinch the debate.

3. Experience of author while serving as member of HMG's Water Supply and Sewerage Service Situation Study Committee, February-May 1987. Even for World Bank-funded water supply projects in the twelve major urban areas of the kingdom, production records are not available. See PRIL (1986) for descriptions of Nepal's water supply.

4. Most of the physical data in Nepal is generated for specific donor-interested aid projects. The unique anthropological ritual of "feasibility studies" that precede the actual construction brings together a collage of enthusiasts eager to justify the venture. The phenomenon is replete with what econometricians would call "intrinsic biases." Graphic descriptions of this phenomenon occurs in publications from the environmental movement. (See Alexis 1984; Blackwelder 1983; Goldsmith and Hildyard 1984b, 1984c, 1986; Shook 1983; Williams 1983.)

5. Some recent and august publications list the area of the country (in thousand km^2) as follows: WB (1986:141), ADB and HMGN (1982:142), C.K. Sharma (1983:136, 145), MWR (1985:147), LRMP (1986:147), Rao (1975:64, 190). The LRMP figures are probably more reliable because of the use of satellite imagery and aerial photography. An unpublicized border-straightening agreement was also concluded between Nepal and China around 1984. The thrust of this book's argument is that the main motive power for the quest for accurate data comes not from the Nepali nation-state but from another nation-state (Canada) with consultants and contractors active in developing Nepal's water.

4. PHYSIOGRAPHY, CLIMATE, AND PRECIPITATION

The climate of Nepal is strongly determined by its physiography. The country lies on the southern flanks of the Himalayas in roughly an east-west direction with the contours rising from the low-lying Tarai in the south through the Chure hills and the Dun valleys to the mountains in the north. Figure 1 depicts the position of Nepali rivers within the context of the larger Ganges-Bramhaputra megabasins of South Asia, whereas Figure 2 shows the physiographic features of the country.

In physiographic terms, the country has three main zones: the low-lying plains next to the Indian border called the Tarai from 60 m above sea-level (at Jhapa in the East) to approximately 500 m; the hills of Nepal from 500 to 2500 m; and the mountains between 2500 m and 8848 m. The Tarai is sometimes subdivided into two: Tarai proper south of the low Siwalik ranges and the inner Tarai or Dun valleys between the Siwaliks and the Mahabharat ranges. The latter can be very large valleys like the East Rapti valley in Chitwan, the West Rapti valley in Dang or the Surkhet valley. The mountain zone also includes what is called the trans-Himalayan zone north of the high Himals like the Manang valley and the Mustang valley.

As seen from the mechanism of plate tectonics under the Himalayas depicted in Figure 2 and the typical physiographic cross-section of Nepal depicted in Figure 3, the features of concern are (1) the steep profiles that are inherently unstable and bound to come down in mass wasting and (2) the major deep seismic faults along the length of Nepal. Besides these transverse faults--called the main boundary thrust along the northern edge of the Siwaliks and the main central thrust north of the Mahabharat ranges and south of the high Himalayas--there are several longitudinal faults. Some of the more notable ones are the Thak Khola fault along the Kali Gandaki and the Barun fault along the Arun. They divide Nepal into blocks. There may be any number of faults as yet unknown because the sciences of geology and seismicity are new in Nepal, and not many studies have been done.

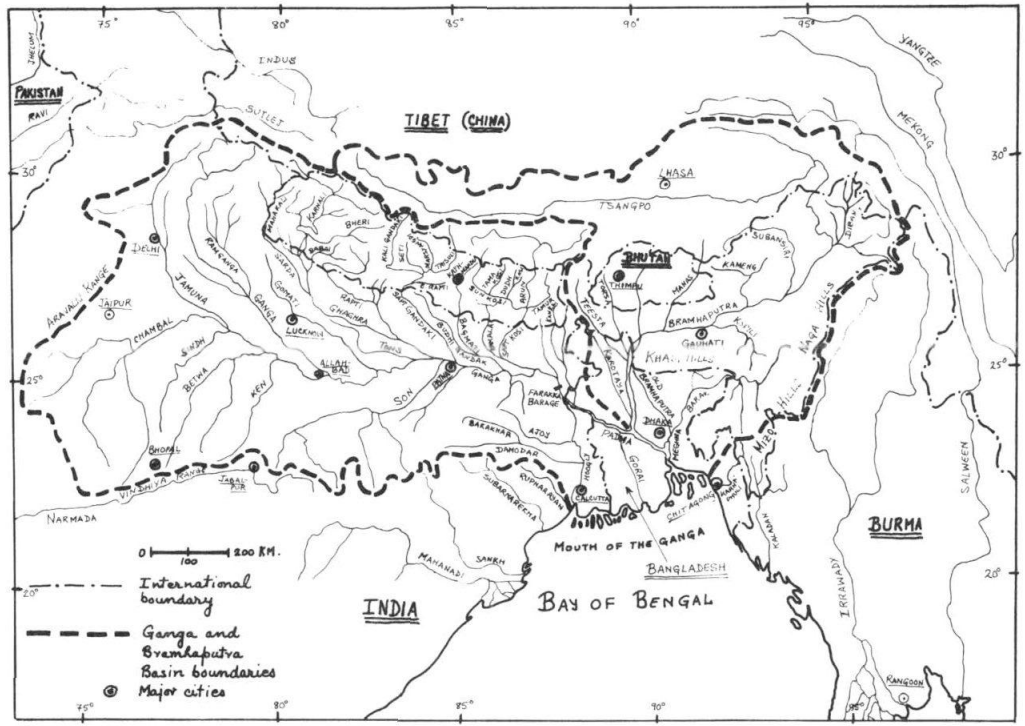

Figure 1. Nepali rivers and Ganga Basin.

Source: Drawn roughly to scale from HMG Survey Department Publications.

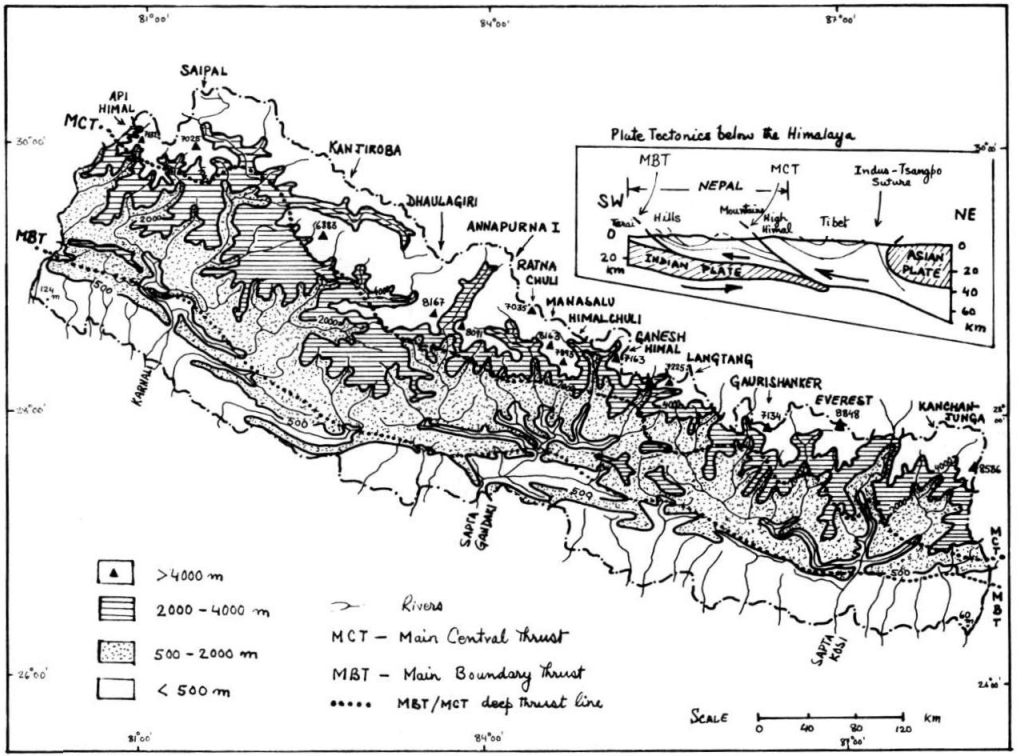

Figure 2. Physiographic features.

Source: Drawn roughly to scale from HMG Survey Department Publications. Insert adapted from Valdiya (1985) and Gansser (1967).

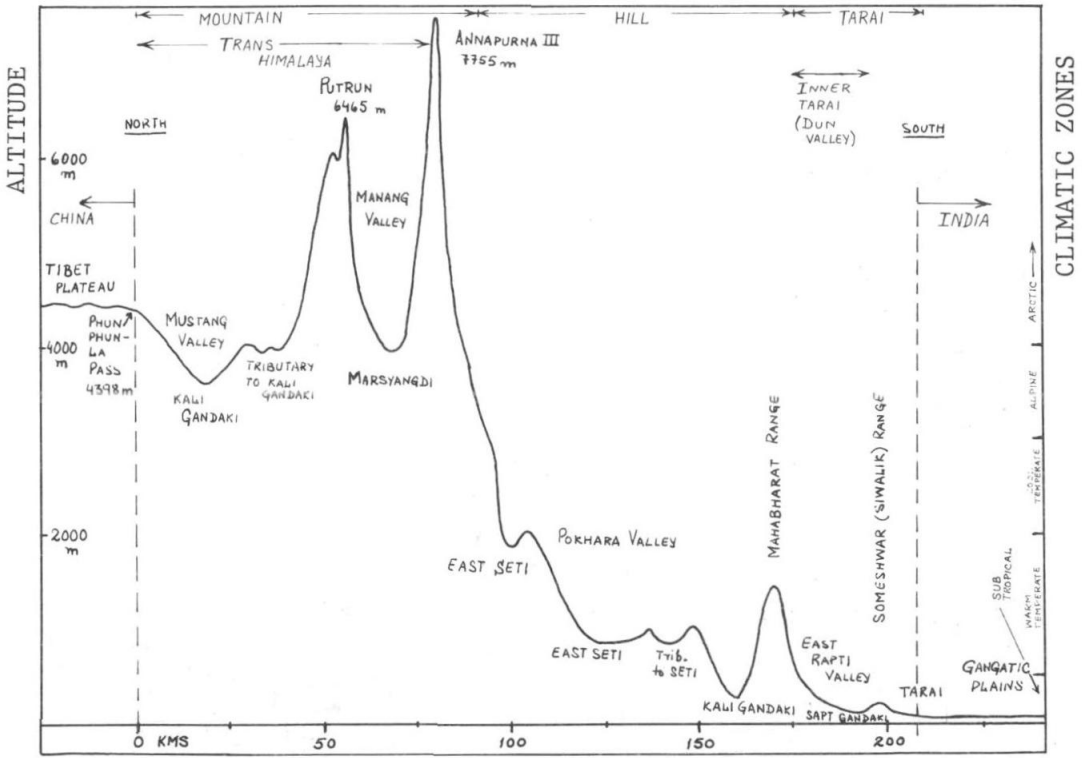

Figure 3. Physiographic profile at 84-degree longitude.

Source: Drawn roughly to scale from HMG Survey Department publications.

What little evidence comes out makes the economics of the construction of large dams less attractive.

Table 1 summarizes the land-use pattern in Nepal. Almost one-fifth of the country is under ice and barren rocks, a little over one-fourth under farming, one-tenth grazing pasture, and about four-tenths under forest cover. Less than one-tenth of a percent comprises urban environment. Nepal Himalayas have a paucity of large natural lakes, possibly an indicator of seismically unstable geology.

The climate, like the physiography, is diverse. The lower altitudes of the Tarai and the Dun valleys are subtropical, whereas the hills are warm temperate. The Siwalik ranges are mostly subtropical but warm temperate in the higher spurs. Similarly, the hills, generally warm temperate, are subtropical in the river valleys and cool temperate in the higher ridges. The mountains between 3000 and 4000 m are alpine, and above 4000 m they are arctic. The tree line in the Nepali Himalayas occurs at about 3900 m; and the snow line varies between 2500 m in January and 5000 m in July (LRMP 1984:7-17). Because of the sharp change in elevation within short distances and the alternating undulation of valleys and ridges, differences in climate can occur within a few kilometers. This results in various microclimatic pockets and ecological niches.

The seasons can be divided basically into three: the wet between June and September, the winter between October and February, and the dry between March and May. The feature that dominates Nepal's climate is the monsoon regime from June to September. It is an anomaly in the global pattern of wind movements, created as a result of a low pressure system in May over the Punjab-Rajasthan plains, which reverses the normal direction of trade-wind movement from the northeast to southwest.[1] In moving from the equator northward, the monsoon traverses the Indian Ocean and the Bay of Bengal, reaches the eastern Himalayas by mid-June, and deflects westward by early July. In its progress westward, the monsoon loses intensity, resulting in about 1000 mm less precipitation in the west than in the east. The

Table 1. Land use patterns in Nepal (ha)

Physiographic region	Agriculture		Graze	Forest		Ice	Rock[1]	Others[2]	Total	%
	Flat	Slope		Heavy	Degraded					
High Himalayas	7,771	1,700	884,356	154,370	67,088	468,940	1,763,317	1,718	3,349,260	22.7
High mountains	26,738	363,797	509,883	1,629,147	183,904	37,376	206,212	1,103	2,958,160	20.0
Mid mountains	224,340	1,665,054	292,768	1,803,246	398,794	0	54,366	4,977	4,443,545	30.1
Dun	177,369	915	15,533	153,252	3,031	0	39,733	790	390,623	2.7
Siwaliks	81,626	54,817	5,130	1,294,196	27,860	0	33,078	138	1,496,845	10.2
Tarai	1,368,664	219	36,030	590,023	1,534	0	99,324	14,279	2,110,073	14.3
Total	1,886,508	2,086,502	1,743,700	5,624,234	682,211	506,316	2,196,030	23,005	14,748,506	100.0
%	12.8	14.2	11.8	38.1	4.6	3.4	14.9	0.2	100.0	

Erosion, water bodies, and urban areas (ha)

	Landslides	Ponds	Lakes	Urban
High Himalayas	91		1,696	23
High mountains	1,760		1,036	67
Mid mountains	2,973		837	4,140
Dun	0		0	790
Siwaliks	751	138	0	0
Tarai	0	7,761	53	6,403

Source: LRMP (1986).

[1] Includes landslides

[2] Include ponds, lakes, and urban areas

Tarai, which is humid in eastern Nepal, is classified as subhumid in the mid- and far-west regions.

The monsoon, although generally regular, occasionally fails to deliver precipitation in scattered pockets. At times the monsoon fails successively for 2 or 3 years over widespread areas. Between a high and a low rainfall year, there can be a two to three times difference in quantity (WECS 1982, vol. 2, appendix E).

The effect of the monsoon is very much influenced by Nepal's physiography: ridges and valleys run east to west parallel to each other. Since the direction of the monsoon is generally from the south, the southern flanks receive more rainfall than the northern ones. However, the northern flanks, which receive less solar insolation, are better able to retain moisture. The heaviest rainfall occurs along the Siwalik foothills with a drier rainshadow to the lee of these regions. There are alternate zones of comparatively moist and dry conditions parallel to the mountain ranges.

In December, January, and February, northwestern Nepal receives some nonmonsoon winter rains, which are due to cyclones of west Mediterranean origin (WECS 1982:2-3, vol. 1). They are influenced by a depression over the western Tibetan plateau about which little is known scientifically. This depression weakens progressively as it heads east, and its noticeable impact is mainly in northwestern Nepal. Although for the country as a whole the volume of precipitation is only 13 percent of the annual total, it is higher for the western regions. For some northern areas like Jomsom, it amounts to as much as half the total annual rainfall.

This winter rain, not as impressive in volume or intensity as the monsoon, is vitally important for several reasons. Most of it falls as snow, which melts in the dry season between February and April to provide moisture and river runoff at a critical time. Because of the lower temperatures in the winter, there is less evaporation loss; and a lesser intensity of rainfall means lower runoff and higher rate of percolation into the soil. This moisture could have a critical buffering effect in the root zone of the soil during the following dry

season of March, April, and May. Lack of or inadequate precipitation in the winter, followed by a delayed monsoon after the dry heat of May, could turn out to be an extreme climatic stress on the ecology.

The representative climatological data for the various physiographic regions of Nepal are shown in Appendix Table A-1. There are 232 meteorological stations in Nepal averaging 600 km^2/station (WECS 1982:2-3, vol. 1). Their spatial distribution is highly uneven with the majority located in the upper Bagmati and middle Kosi basin. Very few are located above 3000 m, which includes about one-third of Nepali territory. Seventy-eight of them were established after 1970; most of the others were established in the 1960s. Very few stations were established before the 1951 revolution.

Both the quantity and quality of published meteorological data are not adequate for making conclusive statements about the weather conditions. More than 1400 meteorological stations would be necessary to assess accurately the monthly, seasonal, and annual rainfall in Nepal (LRMP 1984:11). Stations are located next to accessible habitations, which generally are in the river valleys. Unfortunately, because of orographic and convection effects, there can be a substantial difference in precipitation between the high ridges and the valleys.

The vast majority of the weather stations are equipped only with rainfall gauges. Most of them are not equipped to measure temperature, sunshine duration, and evaporation. As a result, little can be said of evaporation loss of the precipitation. Some stations record only rainfall while others record a combination of temperature, humidity, and sunshine. Measurements are sporadic and irregular in many locations primarily due to unsatisfactory training, lack of dedication by employees, unattractive incentives, and poor administration by management. In many stations listed in the publications of the Department of Irrigation, Hydrology, and Meteorology, data are either nonexistent or large gaps exist in the data series. The result is that the recording of extreme events (like once-in-many-years frost in the Tarai) can easily be missed.[2]

The essential point to be borne in mind is that the climatic knowledge base upon which hopes can be built regarding water resources development is sparse, as is accurate knowledge regarding the country's soils and land uses. Policy measures emanating from such a weak foundation should be sensitive to the inherent uncertainties in describing Nepal as a country rich in water resources.

NOTES

1. Little is known about the exact mechanics of the monsoon, although it provides the life-blood of South Asia. It is now suspected that a low pressure zone in Tibet north of the Himalayas also plays a role in drawing the southwest monsoons. (See Bahadur 1985; WECS 1982; LRMP 1984:186; and Yoshino 1971.) It may also be worth ruminating over whether or not irrigating the Rajasthan desert would weaken the monsoon turning most of South Asia into a dry savannah, all for the marginal benefit of a narrow strip of green near the Thar sand-dunes.

2. For example, during the monsoon of 1987 some parts of the eastern Tarai received 500 mm of rain in less than 48 hours. During such heavy downpour or unusually cold frost, it needs professional dedication to record the event. Regarding reliability of data, see MRD (1987:340): "and stories of small village boys urinating in erosion study plot rain gauges are too numerous to be amusing any more."

5. DRAINAGE AND HYDROLOGY

Although an evaluation of the scope and potential of hydroresources should begin with what the clouds bring in, the image of Nepal's major rivers is evoked when one talks of Nepal's water wealth. These rivers originate in the snowmelt of the Himalayas, flow down to the Gangetic plains, and ultimately into the Bay of Bengal. Traditionally the rivers have been the mainstay of an entire civilization's culture. As shown in Figure 1, Nepali rivers are mostly the headwaters of the Ganga basin, which includes western Bangladesh and the Indian states of Uttar Pradesh, Bihar, and West Bengal. The development and progress of the Indic civilization of South Asia have mostly followed the drainage corridors between the mountains and the plains.

Figure 4 shows the drainage basins of Nepal. The four major river basins of Nepal that originate from the snow-capped Himalayas are the Mahakali, the Karnali, the Gandaki, and the Kosi. Six smaller southern basins--the Babai, the West Rapti, the Bagmati, the Kamala, the Kankai, and the Mechi--originate in the middle hills and flow into India to meet the four main rivers of Nepal in India before they join the Ganga, or the Ganga itself. Similar to these southern basins in character are many others like Surnagad and Rangun on the Mahakali; Thuli Gad, Lahore, and Gad on the Karnali; Bari Gad, Andhi Khola, Ridi, and Tadi on the Gandaki; and Mauling, Rosi, and Pikhuwa on the Kosi. The East Rapti and Arung in the Gandaki Basin, as well as the Trijuga on the Kosi, are also of this category. They originate in the middle hills but meet the main stems of the four major rivers within the territory of Nepal and are traditionally classified as part of the four megabasins.

The Tarai belt has many small streams originating from the Siwalik foothills. They are in spate during the monsoon season and have very little flow during the rest of the year. Since they pass through some of the richest agricultural lands of Nepal, their waters are harnessed to varying degrees of efficiency by government and

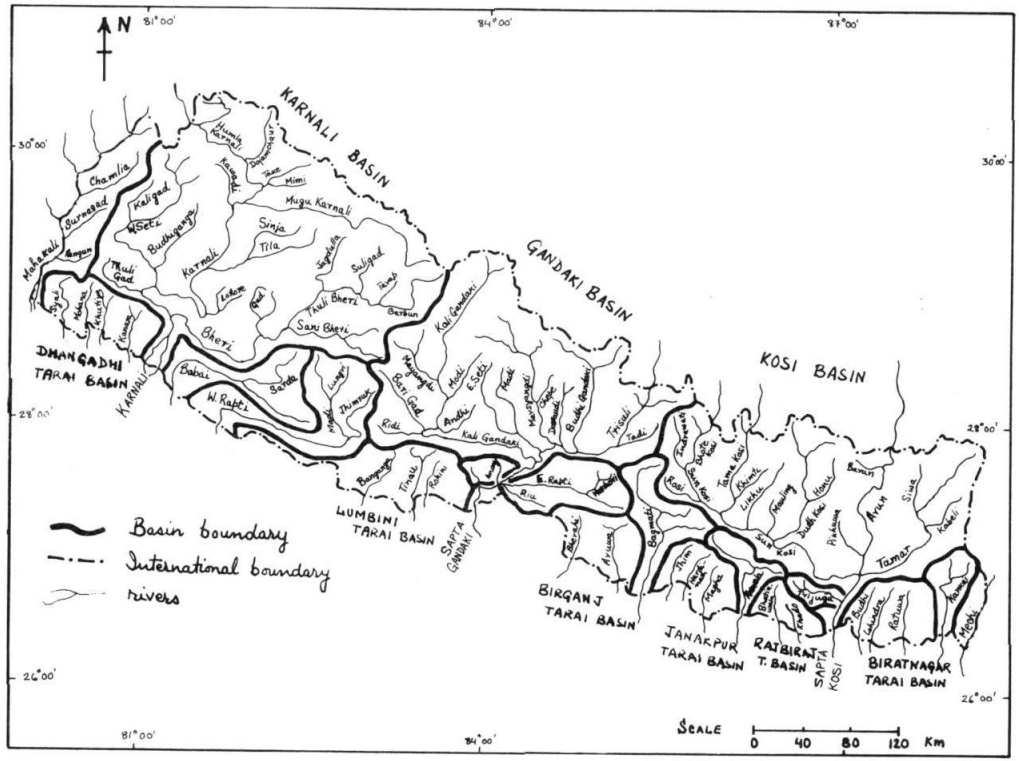

Figure 4. River basins of Nepal.

Source: Based on HMG Survey Department Publications.

nongovernment irrigation schemes. These Tarai rivers are grouped into six independent "basins": Dhangadhi, Lumbini, Birganj, Janakpur, Rajbiraj, and Biratnagar Tarai. They range from nameless nullahs to more respectable streams like the Mohana and Khutiya in the Dhangadhi block, the Banganga and Tinau in the Lumbini block, and the Bakra and Ratuwa in the Biratnagar block.

Appendix Table A.2 depicts the observed hydrological data for the different rivers of Nepal at the lowest gauging stations. In most cases these are at the points where the river debouches onto the Tarai plains and not at the exit point into India farther downstream. A serious effort to look at Nepal's water began only in the 1960s with help from the U.S. Geological Survey in the form of a project to set up hydrometrological stations (Kattlemann 1986; Shanker 1976). In certain areas like Barahakshetra at the confluence of the Arun, Tamar, and Sun Kosi, as well as Banbassa on the Mahakali, full-fledged hydrometrical stations or partial gauging stations have been maintained and monitored by India since the 1940s.

Even through partial gauging stations, only 156 of the 6000 rivers of Nepal have any data at all (C.K. Sharma 1977). There are a total of 38 hydrological gauging stations--1 on the Surnagad (Mahakali), 5 on the Karnali, 1 on the Babai, 2 on the Rapti, 12 on the Gandaki, 4 on the Bagmati, 12 on the Kosi, 1 on the Kankai, and none on Kamala, Mechi, or the 6 independent Tarai basins. On the great rivers, the stations are confined to the main channels at lower altitudes below 1000 m (WECS 1982, vol. 1, plates 1, 2, and 3). Only the stations at Kulekhani (Bagmati), Dudh Kosi, and Balephi (Kosi) are above 1000 m but below 1500 m. The consequence of this is that, although they are of some help in planning large hydroelectric or multipurpose projects, they are not very useful in planning medium- and small-scale water projects meeting local needs and interests. Hydrological data from larger rivers hide tremendous variations in flood peaks and drought conditions in upstream tributaries because of great differences in local geology, terrain, precipitation, and other microclimatic factors. Carson (1985:18) describes how one tributary

could be clear but another nearby much discolored with sediments. Also no data are available on the surface outflow from the independent Tarai basins. As shown in Appendix Table A-2, the estimates of their runoff vary between 0.1 and 10 percent of the total runoff.

Keeping in mind all these uncertainties, the total annual outflow of Nepali rivers can be estimated at about 150 billion m^3, 70 percent of which occurs from June to September. About 90 percent of the surface outflow from Nepal flows down the four great basins of the Mahakali (which is a border river shared with India), the Karnali, the Gandaki, and the Kosi. The remaining outflow is from the Babai, the West Rapti, the Bagmati, the Kamala, the Kankai, and the Mechi basins, the last of which is also a border river shared with India. Both the great and the southern rivers carry between 70 and 80 percent of the total annual runoff in the four monsoon months from June to September.

In comparing the cultivable area, population, and availability of surface flows, one can see a natural spatial skewness, which, together with the temporal mal-distribution, would justify calling Nepal a water-poor area: where there are cultivable land and people, there is very little water and vice versa (see Figure 5). The larger settlement valleys of Nepal like Surkhet, Dang, east Chitwan, Kathmandu, Sindhuli, and Udayapur are water-poor; but they have the largest potential for urban and industrial development. Providing water to these basins would involve expensive transbasin water transfer schemes through uncertain Himalayan geology. There is a major ongoing study to supply drinking water to Kathmandu Valley (which is actually a plateau rimmed with hills in comparison with the surrounding basins) by pumping water 400 to 600 m from the Trisuli or the Sun Kosi basins.

The great rivers not only carry the largest volume of discharge but also show the least variations in flow because of the seasonal buffering provided by the snow and glacial storage. The ratio of their recorded daily maximum discharge to daily minimum discharge is between 25 and 50, whereas for the southern rivers it ranges from 250 to 1000 (WECS 1982, vol. 1, Table 2-2). Figures 6a and 6b show the

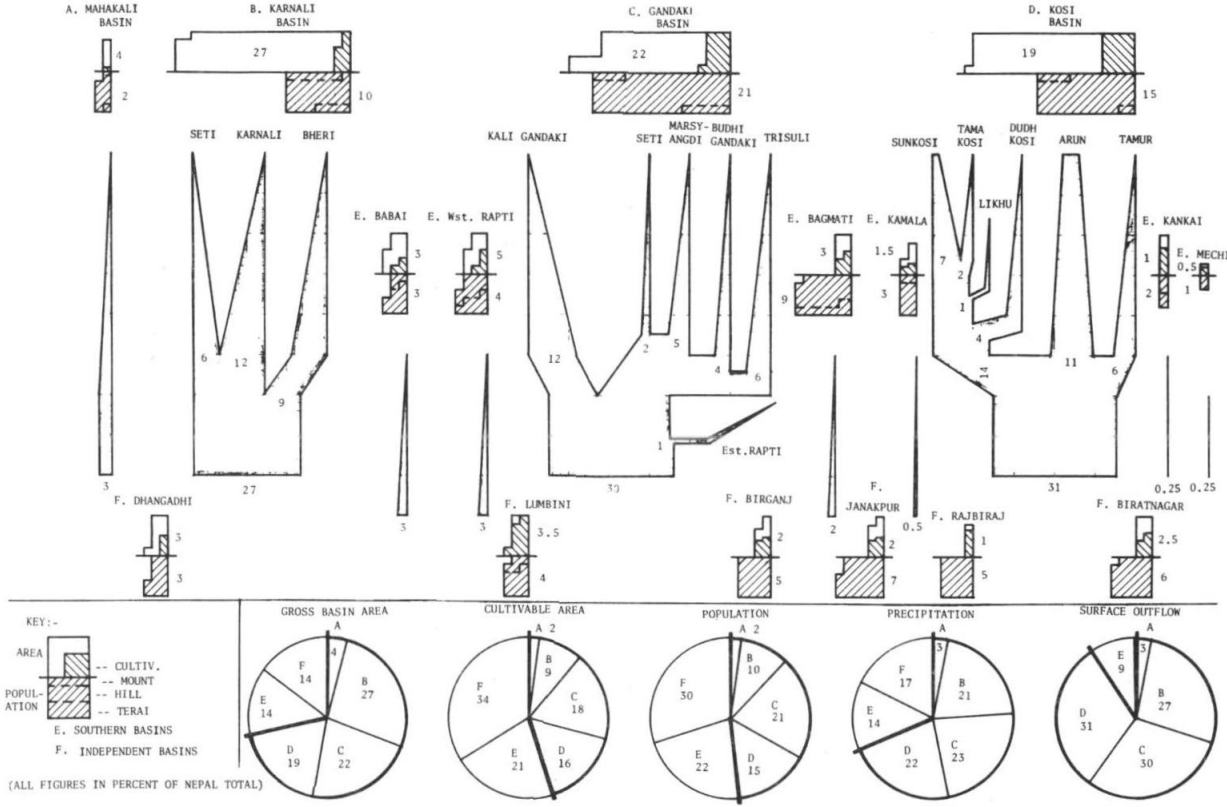

Figure 5. Nepal's river basins and their characteristics.

Source: Author's calculations based on data from ADB and HMGN (1982), P.L. Joshi (1986), LRMP (1984, 1986), and WECS (1982).

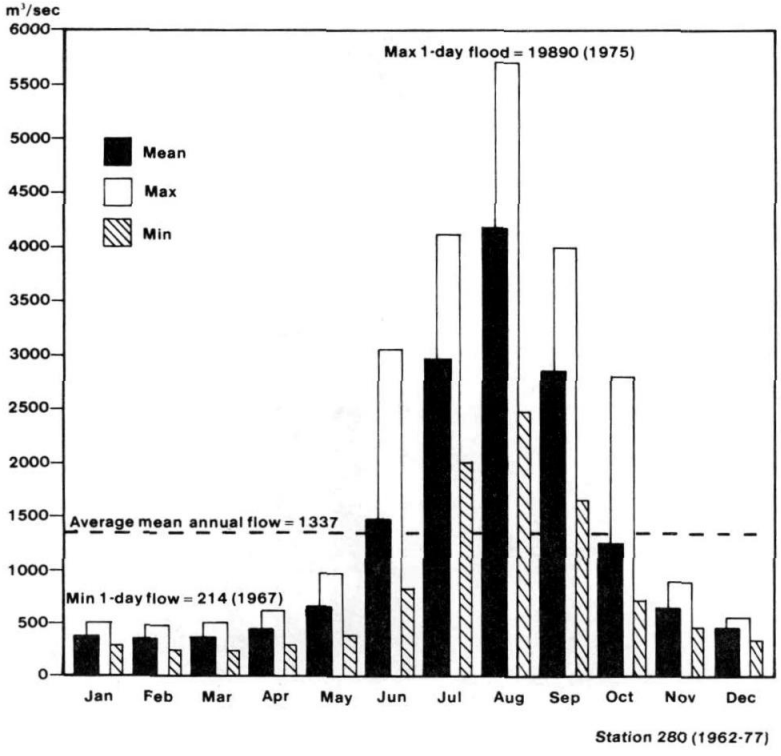

Figure 6a. Karnali at Chisapani: Monthly hydrograph.

Source: WECS (1982).

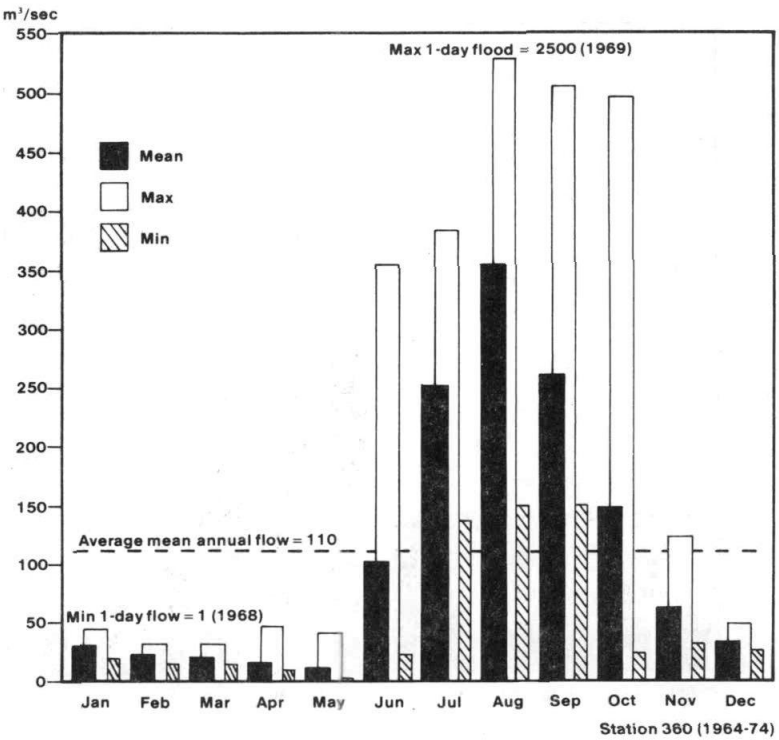

Figure 6b. West Rapti at Jalkundi: Monthly hydrograph.

Source: WECS (1982).

hydrographs of average monthly flows of Karnali (as a typical example of a great river) and West Rapti (as a typical example of a southern river), respectively.

There is also some import of surface water flows. The largest transboundary river flowing from Tibet into Nepal is the Arun with a catchment area in Tibet of 29,700 km^2 (90 percent of the Arun Basin and 50 percent of the Kosi Basin). Since the Tibetan catchments are in the rain shadow of the Himalayas, imports account for about less than 10 percent of the flows in these rivers, although there are no direct hydrological or meteorological measurements to verify these estimates. An example of the unpredictability of rivers from Tibet to Nepal is the Bhote Kosi flood of 1982, which wiped out the "Friendship Bridge" between Nepal and China at Kodari (which the Indian press had complained as being built too strongly for the needs of civilian traffic) and severely damaged the Sun Kosi powerhouse barrage many kilometers downstream. A similar "flash-food" on the Sun Kosi during the monsoon of 1987 again destroyed portions of the highway to China. (For a description of this type of hydrologic event, see Ives 1986.)

One of the important elements of the hydrologic cycle is snow, which has a much longer retention period than rainwater. It is conventional wisdom that snowmelt is a critical element for streamflows during the premonsoon dry season, and it has been estimated at 10 percent of the annual streamflow in Nepal (C.K. Sharma 1977:191). However, there are no measurements to back the estimates. The critical unknowns in the snow hydrology of the Himalayas are snow accumulation and melt at high elevation during the monsoon, proportion of annual flow contributed by snowmelt in each basin, magnitude of evaporative losses from snowpacks, snowpack energy balance at high altitude, ephemeral snow cover at lower elevations, glacial fluctuation, and applicability of snow-covered, area-based run-off models (see Kattlemann 1987:281).

Groundwater is another important hydrologic pathway with a large retention time, which is, in effect, a storage that is an environmental service. Placing numbers on the quantity of groundwater

is also a very difficult task. Of the total annual precipitation, it is again estimated that between 10 and 20 percent is retained as deep and shallow groundwater. C.K. Sharma (1974:58) states that 10 percent of the total annual precipitation percolates to the goundwater, whereas in a later publication (1977:191) he puts the figure at 18 percent. However, given the high intensity of monsoon precipitation for a few months when the ground is saturated and absorptivity is low, this figure could be optimistic. The northern portion of the country with more impervious, granitic rocks retains less water, but a unique geological formation (known as the "Bhabar Zone") at the foothills of the Siwaliks allows a high recharge that feeds the aquifers of the Tarai. Deep seepage losses in the Siwaliks are about 3 percent of the total precipitation (LRMP 1984:105). Certain experimental boreholes in the Tarai region have shown high yields of 100 to 300 m^3/hr at modest drawdown depths of 10 to 15 m (Shahajan 1983:151).

For all its valleys and mountains, the Nepal Himalaya has a remarkable paucity of lakes. Certain inhabited valleys like Kathmandu were lakes in the geologic past; but plate tectonics resulted in unstable land mass, which probably destroyed natural dams faster than they were created. Lake Phewa in the Seti, Tiliccho in the Marsyangdi, Lake Phoksundo in the Bheri, and Rara Lake in the Karnali subbasins are some of the better-known lakes. They are fairly small (<500 ha) and not very deep (about 25 m) (Zutshi 1985:334); and so their storage potential relative to the precipitation is negligible. In fact, as shown in Table 2, the storage potential in the Nepal Himalaya--although as large as a hundred billion cubic meters in gross terms--is small relative to the flow. If all these reservoirs were built, the average retention time would be only 4 months.

The drainage corridors of the Nepal Himalaya transport not just water but also matter. When we use the word "rivers," what comes to mind is water that flows in them. In the context of glaciated temperate zones in Europe and America, this may be mostly true, with silt being an almost negligible nuisance. In the Himalayan context,

Table 2. Storage potential in the river basins of Nepal

River basin	Area (km^2)	Storage sites (no.)	Gross storage (M m^3)	Net storage (M m^3)	Average flow (m^3/sec)	Residence time[1] (months)
Mahakali	15,260	2	10,550	6,390	660	3.7
Karnali	42,890	7	30,580	18,510	1,337	5.3
Gandaki	31,100	7	27,230	15,140	1,568	3.7
Kosi	81,150	5	25,550	16,550	1,638	3.8
Southern + Tarai	36,387	9	6,481	4,836	918	2.0
Total	206,787	30	100,391	61,426	6,121	3.8

Source: Pradhan and Shrestha (1986).

Note: Basin area includes areas in Tibet (Arun) and India (Mahakali).

M = Million

[1] Residence time is arrived at by dividing total stock (net storage) by the flow. Tarai flows are from Shanker (1985).

however, soil material is a coequal passenger of the drainage corridors. The Himalayas are geologically young and still active, which means that the Indian tectonic plate is still subducting under the Asian one thrusting the mountains even higher at a rate of little over 1 mm a year (Valdiya 1985:12; Bhandari and Gupta 1985:39; see also Figure 2). It is also eroding 1 mm a year (Carson 1985:24) on the average, and the only outlet for the eroded mass is the one available for water--the river channels. This usually ignored fact has immense consequences when one talks of water storage projects, for when one dams a river one dams the water and the solid material flow as well.

The mass that moves down the drainage corridors is of two types: suspended load (silt) and bed load. Data on either are very hard to come by. Their importance has only recently been realized when it was found that the actual inflow of silt in reservoirs of the Indian Himalaya averaged four times the design inflow, which correspondingly reduced the life of the reservoir by a factor of 4 (Tejwani 1986). Dams in the Indian Himalaya have been designed for a silt load of 4.3 ha-m/100 km^2/yr. It has been observed that the actual siltation rate is about 4 times higher at 6 to 17 ha-m/100 km^2/yr. One hears similar stories for the Kulekhani reservoir, although nothing has been formally published. (See Tejwani 1987 and Narayan 1987.) Even less is known about bed-load movements. A recent study by Carson (1985:28) has shown that these rivers could be transporting about six times more matter as bed load than the suspended silt load (see also Ramsay 1985). The result is that Nepali rivers debouch into the Gangetic plains in the form of alluvial fans, creating inland deltas with channels that shift as the river bed rises. The most dramatic is the case of Kosi as it emerges from the Chatra gorge near Barakshetra. The river has moved 100 km eastward in 250 years, earning it the sobriquet "Bihar's River of Sorrow." Similar movements, although not as dramatic, have been traced for the Gandaki and the Karnali (Singh 1973; Zollinger 1979).

In intervening into the natural regime of water and matter flowing down the Himalayan gorges through the erection of barriers in the form of high dams, more questions should therefore be asked at the policy level of the long-term effect--upstream and downstream--of such actions.

PART II

WATER AND THE SOCIAL SYSTEM

To understand properly the role of water in Nepal's development efforts, it is necessary to probe into the nature of the Nepali social system and to understand how it views the natural asset. A feature, such as the cascading waters of the Himalayan rivers, can remain as such for centuries without being manipulated by human society if the views and visions are not there to exploit it for economic uses. A lot of falling water is not necessarily a natural resource. What makes an aspect of nature something of immense value to society is a right synthesis of physical features with social views and values. One cannot have an economic resource if the physical phenomenon is there but the requisite social climate is absent, or if a society has the longing but not the physical phenomenon. Only an appropriate conjunction of the two can convert a physical phenomenon into a "natural resource."

Nepali society and its social philosophy remained isolated from the mainstream of world events well into the twentieth century. The inundating tidal waves of Western culture and values were kept at bay almost to the end of World War II by a policy of retreat and isolation, and the few contacts made with the Western World were by a handful of elite households. The results of interaction with Western civilization did not penetrate to the broad masses till after the revolution of 1951, which overthrew a powerful dynasty of hereditary prime ministers.

Within such a milieu, the concept of harnessing the river waters to provide for the enhanced economic well-being of the common man could not be nurtured to the extent envisaged by present-day development planners. Even today, the prevalent philosophy of living in Nepali society continues to mold the thinking of men and institutions in the country in ways not in concord with the philosophy of development.

The previous sections looked at the existing uncertainties and

large gaps in our understanding of the physical aspects of the Himalayan waters. The following sections examine the different facets of Nepali society that have a bearing on water resources, their use as well as management in Nepal. The question asked is whether various traits of the Nepali sociosystem are inimical to the software necessary to exploit a natural endowment like abundant falling water.

6. SOCIAL PHILOSOPHY

It is a truism worth reiterating that the world-view of a society (Weltanschauung) is what molds its attitude toward, and its actions upon, its surroundings. A society's relationship to nature determines to what extent the environment is modified or manipulated to achieve perceived benefits. The harnessing of Nepali river waters for economic development needs, as a precondition, a social mind-set with such a vision or hope that can be translated into reality after some collective, concrete efforts. It is therefore necessary to examine the dominant social philosophy in the country in order to understand how water was used in the past and how it is being proposed to be used in the future.

Large-scale anthropogenic remolding of the environment from its natural state (as in any long-term engineering effort such as harnessing a river or building the Pyramids) is more of a social than an engineering problem. Water has been running down Himalayan slopes and has been used for irrigation and motive power for grinding wheat probably since the dawn of the Asiatic mode of production. What has changed in recent times is the suggested scale of engineering to achieve results that were previously inconceivable. The technology involved in this endeavor entails a type of social management that differs from that employed previously to get power from water mills (the traditional ghattas) and to achieve local irrigation. A social system can manipulate its surrounding environment to a high degree. The environmental goods and services so procured can be harvested or mined, depending on the degree of local use of the resource. For example, the American Indians (or the western Nepal Rajis and Rautes) had a high degree of local use of resources with practically no manipulation of nature. The "Gold Rush" miners of California in 1849 (or the Nepal government forestry department that contracted out forests for wholesale export in 1979) had a low degree of local use of resources but conducted extensive modification of the environment (D. Gyawali 1986).

Such a change in the scale of social involvement requires commensurate changes in the prevailing social philosophy, which should be translated into the actions of everyday life through some form of sociopolitical consensus. External institutions in a society are a reflection of internal ideas, and technology comes from a favorable set of social attitudes and conditions. The fashionable concept of "technology transfer" mostly ignores the requirement for a right sociophilosophical climate necessary to nurture technology.

Long-term engineering--especially a construction effort that spans a decade or more from inception to operation--has a long gestation period wherein the bulk of the benefits will probably accrue to another generation or group of beneficiaries. If society consisted of atomistic individuals maximizing solely their personal welfare as the neoclassical economic philosophy assumes they do, then such tasks would probably never be undertaken (see Norgaard 1985). However, such feats do get done by individuals acting in concert with little save altruism to motivate them. Only a socially shared world-view that values the effort can sustain such endeavors during the harsh years of labor. How long a social fabric can withstand the strain of labor without tangible rewards depends to a large extent on the prevalent social philosophy and the value it places on the future as well as future generations.[1]

The traditional Nepali world-view can be classified "Oriental" as opposed to the aggressive world-view it is encountering in recent times, which can be termed "Occidental." In a distinction, which will be elaborated in the following paragraphs, the upholders of the former may be termed homo mysticus and those of the latter homo faber (see Beer 1975 who uses the terms homo faber and homo gubernator). The basic difference between the two concerns the concept of human happiness and the relationship to nature. Both would agree that human misery can result only when the individual interacts with the external world, and the end result is not favorable to the individual or a collective group. However, they look in different directions for a solution to the problem of human misery.

The homo faber thinks that the external world--the physical environment--causes all the misery by reacting upon him in a way he does not like. He therefore sets about remolding it to his tastes, training it as a master would his pet. If, for example, floods or drought bring hardship on him, he modifies the rhythm of the rivers by building dams (see Yukawa 1967).

The homo mysticus, on the other hand, believes that the external world fluctuates about him in an eternal dance of cycles totally oblivious that it is causing the poor mortal much agony. He does not think that the environment is to be blamed at all, for it is only behaving in a manner intrinsic to its nature--as it would behave even if he never existed. To use his poetic simile, he compares the external world to a dog's curly tail: reformer after reformer have tried to straighten it out by immobilizing it in plaster, but the moment the cast is removed it curls back to its old shape (Vivekananda 1973). Hence the homo mysticus leaves the external world to its own rhythms and sets out to master the internal world of the self which experiences sorrow as well as happiness.

This difference in world-views results in two strikingly divergent attitudes toward nature. The homo faber regards himself as the master of the external world and considers manipulating it to his tastes an act of holy crusade. His objective would be to leave the world in a state better (according to his perception of what is good) than he found it. On the other hand, the homo mysticus thinks of himself as a mere temporary custodian of the physical assets whose quantity and quality are governed by the intrinsic laws of their nature, and he would regard challenging that order an act of hubris. Some concept of progress (albeit material) is implied by the former: the latter would be based on the idea of the steady-state, since progress to the homo mysticus is in the nonmaterial realm.

The homo mysticus philosophy dominates the Nepali sociosystem. It has traditionally drawn "the best and the brightest" to its crusades to master the internal world. The homo faber has not been absent in this society, but he has been relegated to a subservient

role. The ascetics and the renouncers (and the lay priests of Hinduism who bask in reflected authority of these holy saints) have managed to impose the conventional laws and mores of Hindu behavior on the homo faber and themselves have managed to live above and beyond them (Thapar 1978). The homo faber, who is burdened with running the economy, is not the master of the household in that he does not determine its policies of production or expansion.

This state of affairs is conducive to a feudal mode of management of production discussed anon. From the viewpoint of social values, however, the two consequences of the homo mysticus's dominance on the overall development of Nepali society are the prevalence of an ossified, steady-state culture and a lack of work ethics.

If "culture" is not to be confused with "heritage" (which is the culture of one's ancestors), it may be defined as the way in which Truth is conceived and expressed, Beauty is perceived and appreciated, and Existence is dealt with (D. Gyawali 1983c, 1979). It is a dynamic present and not a defunct past. As such, some of the units of its expression would have to be based on the current workings of the material basis of production. How vivacious a society's culture is depends on how much of a master of his own house is the homo faber. If he is not free to experiment with his concepts to make his work more meaningful, culture ossifies under the drudgery of exploitative travail. There will be no incentive to strive for and seek to develop excellence.

Generations upon generations of Nepalis have continued to manage land and water as their revered ancestors had done--a steady-state of affairs with all answers predefined and no new questions asked. Such a culture can be expected to last until an unprepared-for clash with an alien civilization. The ossified and complacent Nepali culture of the past is now in the midst of redefining its values vis-a-vis Western technical values. Two centuries of failure to conduct such an internal debate led to a steady and placid state of affairs wherein social institutions and habits, which should have been either rejuvenated or replaced by more virile ones, continued to exist as before, bereft of the capacity to meet new challenges.

Moral domination by the homo mysticus has resulted in another feature of Nepali social values, which is a major hurdle if one envisages developing the country's water resources. It is the value of physical labor. If mastering the internal world requires much rumination and psychological stress but little physical work, remolding external nature requires a lot of muscular activity. This task is easier in a society where dignity of labor prevails than in one where work is the bane of menials.

In Nepali society, karma yoga notwithstanding, the general populace does not consider labor as an ennobling act. One can pass a judgment to this effect by examining the idioms and expressions in the language. For example, when housewives chat they are likely to mention with envy so-and-so's daughter who is so fortunate: "She does not even have to break a twig!" The fortunate life is equated with the lack of necessity for physical activity coupled with conspicuous consumption.

In raw terms, economic development means more accumulation than consumption, and more investment in increasing production. This means catering to the needs of the homo faber more than that of the homo mysticus. The economic take-off of the western Eurasian peninsula in the fourteenth and fifteenth centuries took place due to a set of self-feeding cycles. Pluralistic institutions in the society allowed for the growth of commerce, which generated profits that were not consumed but accumulated. Because of the Protestant work ethic, the social philosophy encouraged investments of this accumulated capital into activities designed to improve work. Technology flowered precociously. This led to cheaper products and therefore better commerce, and therefore more profits (Stavrianos 1981:35). The sheer momentum generated by this process subjugated more advanced civilizations like the Sinic and the Indic. The effects are apparent even today.

An important factor in western European economic development was the change in social philosophy regarding labor and acquisition of wealth. Asceticism made labor an act of worship; puritan morality

eliminated conspicuous consumption; and capital thus accumulated was used to improve labor conditions (technology improvements). One could labor to be rich "for the glory of God." Once the mechanical foundations of capitalism had been laid, however, it no longer needed the support of religious asceticism (see Stavrianos 1981:47; Weber 1958:158).

Nepali society has not seen any upheaval in its social philosophy that would be akin to Calvinism or Quakerism. Non-Western societies, which have met the challenge of the intruding civilization, have had to do so with some form of proto-Calvinism that extolled hard work. The Russian social philosophy had to go through the traumatic surgery of Bolshevik puritanism, the Chinese literati with Maoist peasant revolution, and Brahminical India with ascetic Gandhi's social redefinitions before these countries could strive for the status of coequals with the Western World. Nepali societal philosophy saw a brief flicker of renaissance in the early fifties with literary giants like Devkota challenging established mores, but the flame never grew into the necessary conflagration (L.P. Devkota 1959).

Social hierarchies and social philosophy have coevolved together, leading to an elite class with severely restricted vision regarding the role of the weaker sections of society in development. This has led to their viewing the progress of life as a zero-sum game between the "haves" and the "have nots" rather than a partnership where all can benefit mutually. Homo mysticus has essentially "opted out" and left the homo faber prey to the rapacious.

Development efforts have largely failed in Nepal because they have concentrated too heavily on the hardware and ignored or downplayed the changes needed in the social software if artifacts such as hydropower plants and lift-irrigation systems are to function and be self-sustaining. Water will not be harnessed if the pump mechanic or the electric linesman or the field surveyor will continue to be relegated effectively to bottom rungs of the society's caste hierarchy. Modern water resources development has to be looked at within this context.

NOTE

1. See Haldane (1930) who uses biological analogies to ask what is the right size of a social organism, just as it is asked here: what is the right time of gestation of social efforts.

7. HISTORY AND WATER RESOURCES

Water resources development in Nepal is a function of its history. Historical factors and relationships have determined the rate of economic growth and the level of technology and its use.

Although Nepalis have intervened throughout their history in the natural ecosystem to enlarge the niche of certain plants and animals deemed useful to them (e.g., slash-and-burn of the hill-slope forests to increase livestock pastures or terracing for rice cultivation), the level or intensity of intervention has been different. This is true with harnessing water too. They have been diverted into traditional kulos to irrigate fields or to run water mills for ages in the past. In Kathmandu Valley, some of the bygone centuries saw the construction of technically sophisticated sunken baths having stone spouts with continuously flowing water, while other epochs have been rather fallow in this regard.

Issues in water resources development should also be looked at from an historical perspective to see how the problems arose and how they are interlinked. Although water management is a burning issue of contemporary public policy, one sees little interaction between water resources planners and historians.[1] An historical analysis would provide insights into the background of various decisions over time, into the evolving nature of present problems, as well as the relevance of the past to its solutions. This section will attempt to outline the basic historical forces that prompt the Nepali sociosystem to intervene in the natural regime of the physical system.

Nepal's history can be divided for analytical purposes into three phases: the precolonial phase, the phase of responding to the colonial challenge, and the modern era. Although historical processes have a temporal spread over a fuzzy penumbra, certain dates stand out like watersheds. The year 1769, when the House of Gorkha rose to supremacy (70 years after East India Company acquired zamindari rights around Calcutta and 12 years after Clive laid the foundation of British rule at the Battle of Plassey), divides the precolonial phase from the

phase of response. The year 1951 (3 years after the departure of the British from India) saw the dawning of the modern era.

Nation-building effort in the Nepali hills proceeded in step with the collapse of the Moghul empire, with the subsequent "times of trouble" (signified by Maratha maraudings), and with the parallel expansion of Western influences in northern India (see English 1985; Stavrianos 1981).[2] Modern times followed the collapse of the main support of the Rana satrapy.[3]

The initial encounter of the Nepali nation-state with Western civilization was characterized by aggressiveness highlighted by the Gorkhali military expansions along the Himalayas and into the Ganga plains, which culminated in the Anglo-Nepal wars and a humiliating Treaty of Sugauli in 1816. It was followed by a strategy of retreat and isolation for a century when the supremacy of the military technology of a mercantile society became painfully obvious. The modern phase may be considered as a final admission by the nation that although the monetized and commercialized social values of the Western World may not be to its general liking, its power and efficiency cannot be denied and must be emulated. Nepali society still has not reached a final social consensus on this issue as signified by an increasingly more clamorous Hindu fundamentalism.[4]

A key element in modernization and social change is the history of introduction of Western technology (see Mumford 1963, 1967, 1970). It was brought into Nepal by the wrong people for a wrong reason in sharp contrast to the phenomenon in the land of its birth. In Europe the social carriers of technology were the rising mercantile class who used it to enhance production. In Nepal, however, if instruments of war like guns and gunpowder are discounted, it was her autocratic shoguns--the feudal Ranas--who first introduced technology into the country as an item of luxury (which is the outward trappings of power).

Electricity was first generated in 1911 at the 500 kW Pharping Power Station in southern Kathmandu Valley hardly two decades after Tesla's invention of the alternating current motor. It was used to

light Rana palaces and the houses of loyal retainers. There were no charges; and it is within living memory of old engineers at the Nepal Electricity Authority that some residents in Kathmandu balked at having their electricity metered in the late 1960s because Rana Prime Minister Chandra Shumshere (1901-29) had decreed that they be provided free electrical lights.

The internal combustion engine in the form of a motor car made its appearance around the same time. The vehicle had to be dismantled at the Churia foothills and carried by porters, together with the fuel, through the Chitlang pass to Kathmandu where it was reassembled. It then carried the Ranas about in the few kilometers of valley roads--more a symbol of luxury and the flaunting of power, which conspicuous consumption symbolizes, than a means of increasing productivity.

A narrow-gauge railway was built in 1927 from the Indian railhead at Raxaul to Amlekhganj 43 km to the north toward the Siwalik foothills. A few years earlier, a 38 km ropeway was built from Bhimphedi to Kathmandu. Together with the railway, it was the chief means of freight transport to the valley. All this would seem like a productive use of technology only if one ignored the end use, which was to ferry housing and construction materials for the burgeoning industry of the day--the construction of opulent stucco palaces for Rana offsprings.

In 1924 slavery was abolished in Nepal. On the face of it, an almost causal assertion can be made that the introduction of labor-saving devices previously mentioned allowed for a progressive measure to be taken; however, this was not the case. The guiding social motive behind such imports of modern Western technology was the desire of a feudal aristocracy to impress a growing stream of European visitors (see D.R. Regmi 1950).[5] Without an entrepreneurial middle class, there was not, and could not be, any manifestation of a social will to enhance production through technology. The banishing of Nepal's first modern mechanical inventor, Gehendra Shumshere, by his cousin, the Rana prime minister, showed that technology was an

appendage to power, feared by the powerful and certainly not meant to empower the powerless.

Luxury, and not production, has historically determined the use of Western technology in Nepal. Her sociosystem groans with discomfiture as complex changes from the physical to the metaphysical are demanded by the use of seductive artifacts from the West. Technology is not a value-free black box. Transferring technology means importing the features of some of the social imperatives that went into its creation. Technology brings its own software of sociocultural values and imposes new demands on the behavior of the sociosystem.

In recent times, technology has also come as the beachhead of a penetrating market system, but this motif is not as strong as that of mimesis and luxury. This has been true of highways that allow market access. An interesting example is the small railway line along the left bank of the Kosi, which transports stones needed for Indian construction works from Chatara into Bihar.

The introduction of technology, which has brought about some changes in life-styles to certain dominant segments of Nepali society (and in a sense has entailed a change of dharma), has meant some disharmony in social philosophy, social behavior, and the environment (see Stutley and Stutley 1977 for a definition of dharma as not just a religion but a "way of life").

At the philosophical level, the dichotomy between Eastern and Western world-views is thrown into sharper contrast and has been discussed previously. Acceptance of Western technology willy-nilly implies an acceptance of the Western world-view that mastery of nature and not of one's self is the paramount goal of human life. The eminent historian Toynbee (1971) writes:

> From the beginning of this human chapter of history, Man has been bent on mastering Nature, and he has now succeeded in mastering the whole of terrestrial Nature except himself. This is an ironical achievement and an ironical failure. Self-mastery is,

> for Man, the key to happiness, to welfare, and to survival. Yet human nature is still recalcitrant to Man's command, and this unregenerate human nature is a threat to Man's existence, now that man has armed himself with inanimate Nature's titanic forces.
>
> Man has now fallen into conflict with human and non-human nature alike. This is why, today, his enhanced power and wealth are causing him increasing anxiety and unhappiness. But this present-day disharmony dates only from the invention of mechanized industry. Pre-industrial man, the hunter and cultivator, managed to make Nature minister to his needs without going to war with her.

In the social arena, the introduction of technology has fueled the revolution of rising expectations on a mass scale, because technology does have a seductive charm for the hewers of wood and drawers of water. This has put traditional institutions under tremendous stress. They were designed to allocate scarce privileges under well-behaved caste and ethnic hierarchies, and now find it difficult to handle mass-scale aspirations.[6] Social institutions, like representative democracy and market economy that are designed to handle such demands, are still at a formative stage in Nepal.

In the environmental sector, the disharmony between what nature can provide on a sustained basis and our burgeoning wants has become a visible problem. Where relations with nature were based on harvesting of its flow of bounties, the advent of technology has changed it to a one-time mining of stock. The growth in the power of exosomatic organs like saw-mills and trucks allow for a manipulation of nature unprecedented in the history of the Nepali society.[7] The newly imported social philosophy of neoclassical economics (which was fostered in a mercantile world of colonial expansion) allows for discounting any future beyond a decade as valueless and thus helps justify mining. Although traditional societies have placed a great

value on the sacredness of place, the philosophy of market economy places absolute importance on time, considering place as substitutable (D. Gyawali 1988; Deloria 1973). These new imports have yet to find their harmony with the rhythms and capabilities of the Himalayan environment.

Nepal is undergoing a change from the metaphysical to the social and environmental--changes quite unlike what she had seen in the past. Whereas previous historical changes have implied a change of managers with the societal productive processes intact, today's changes strike at the very root of age-old tradition and culture, which have guided resource management of yesteryears. In any change, it is essential to assess whether or not the elements are in harmony. In Nepal, if her history is any guide, they do not seem to be so. Technological intervention into the regime of nature through large-scale water resources development implies an equally large-scale sociosystem involvement that can take place only after massive social restructuring. Such developments must therefore be planned with a proper historical perspective in mind.

NOTES

1. This is a widespread problem. See Jackson and Patterson (1977). By historians, one means the analytical dissectors of social causes and not chronological scribes. The former seek to apply objective laws to the historical process to explain or predict different events. The latter believe that personalities shape events and are content to record the activities of kings and princes. Among Nepali scholars, a representative of the former is Mishra (1986) and of the latter, Yogi Naraharinath. See also Braudel (1980).

2. Stiller (1974) rejects any such linkage.

3. Internally, the Rana regime was a shogunate. Externally, it functioned as a neocolonial satrapy for the British Empire. See Kiernan Hypothesis of the political stagnation of those regions that served as reservoirs of mercenary recruitment (English 1985; also D.R. Regmi 1950 and Mishra 1986).

4. The mimesis effect of power is discussed by Toynbee (1948, 1957). The deciding role of power in shaping social evolution is best discussed by Schmookler (1984) and Becker (1936). Hindu fundamentalism asserts itself in jingoism and a harking back to mythical bygone traditions. It is a bleating of desperation and not a cry of strength. (See Khanal 1987b and D. Gyawali 1983a.)

5. Also, in the opening lines of his speech in liberating the slaves (B.S. 1981 Marga), Rana Prime Minister Chandra Shumshere said "but in front of the civilized world that (glorious) name (of Nepal), those glorious deeds are tarnished by a terrible shame. This stain is upon us because the repugnant practice of slavery is still in our midst." Rana Chandra Shumshere, 1924, "Shri Teen Maharaj Bata Kariya Haru Lai Amlekh Garaune Bare Ma Baksieko speech (speech given by H.H. Shri 3 Maharaj about liberating the slaves)"; published by Subba Ram Mani Acharya Dixit, Shantiniketan, Kathmandu; 1981 B.S. Marga, p. 2.

6. The Economist (March 9, 1985, London) reported that in 1984 alone companies worldwide spent $150 billion on advertising "the good life." Its impact can be seen in remote tea shops in the Nepali hills several days from the nearest roadheads, where walls are plastered with advertisement posters from the world of market economy. This shows the titanic powers of cultural mimesis and the market.

7. Exosomatic organs (like cars) are ones we are not born with as opposed to endosomatic organs (like legs). This is a term used

by Lotka and expounded by Georgescu-Roegen to show that economic development should be seen as an adjunct to biological evolution. (See Georgescu-Roegen 1971:11.)

8. WATER RESOURCES DEVELOPMENT AND NATURE OF THE STATE

In studying the role of water in a society, it is conventional to start with the different types of uses (i.e., power production, irrigation, domestic uses). In this analysis we take a step further back and look at the source of the demand--the various actors, their proclivities, and the genesis of their desire that the physical system behave differently to deliver to them goods and services of their liking. One of the most important actors involved in engineering a hydraulic civilization in Nepal is the nation-state. This chapter will review its characteristics and compare them with those ideally needed in a state that wishes to harness the titanic forces of the Himalayan rivers.

The method of analysis, which is illustrated in Figure 7, splits the society or country as a whole into the two dichotomies of the expanding nation-state and the autonomous villages.[1] On the Y-axis are the two levels of societal organization: the expanding nation-state and the autonomous villages. On the X-axis are the four levels of intervention into the physical system from the farm through the cooperative to the basin and megabasins (Khan and Romm 1978:3). Water projects fall within this plane as a function of the actors and the level of intervention sought.

Even today Nepal is a conglomeration of villages where 96 percent of the population lives in settlements of about 500 people (which are the hamlets or actual villages of Nepal as opposed to the official villages that are called village panchayats) (Blaikie et al. 1979; CBS 1986a).[2] Barely two centuries ago they were held together in regional groupings of some fifty principalities until unification in 1769 under the chieftainship of Gorkha. The traditional trading corridors of Nepal are aligned north to south, almost along the river basins and drainage corridors. Effecting a viable east-west economic link is a formidable task before the nation-state.

Many of these hamlets are monoethnic with one tribe or caste, although another ethnic group may be its immediate neighbor. Their

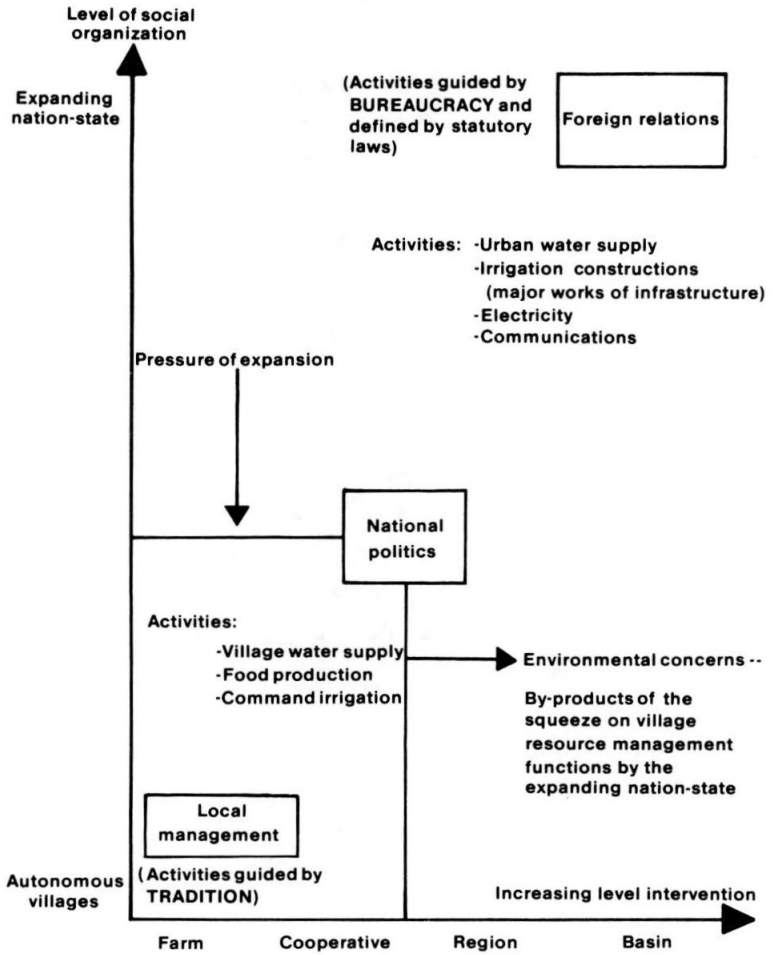

Figure 7. Politics of resource management.

Sources: Author's original creation based on footnote 1 and Khan and Romm (1978).

ethnicity covers a spectrum from Tibeto-Burman to Indo-Aryan with a medley of intermixtures in between. They speak more than twenty different languages and many more dialects. These actual villages are adherents of Hindu (90 percent), Buddhist (5 percent), Islam (2 percent), as well as other religions from advanced ones like Jainism and Christianity to different forms of animism (3 percent) (CBS 1986b). The social practices of these nationalities and subnationalities differ; their life-styles are quite often determined by caste-dictated occupations. The melding of this heterogeneous population into a modern nation began toward the end of the eighteenth century, but the process was arrested in 1846 with the rise of the Rana shogunate.

The basic instrument of the nation-state--the bureaucracy--was created after unification but was subverted by the century-long Rana rule. In the initial stages of nation-building, the nation-state's bureaucracy meant the army. The important management function of this instrument of state was empire-building and security of frontiers. The management of forests and agricultural lands lay in the domain of the autonomous villages, which recognized the overall sovereignty of the state, paid taxes, and helped maintain the army and its activities.

After the British effectively checked Gorkhali expansionist ambitions and imposed the Treaty of Sugauli upon it in December 1815, the nation-state was unable to define new social goals in order to cope with this radical change in its objectives. There followed an uneasy interregnum during which the unbearable burden of maintaining a purposeless army bureaucracy fell upon the country (Stiller 1981). Under this strain, compounded with subjective factors like weak rulers and capricious consorts, the evolving nation-state collapsed in 1846 into the feudal stagnation of Rana rule wherein the bureaucracy became an instrument of rent extortion for the Rana household management.

In the aftermath of the 1951 revolution, which overthrew the Ranas, the overt objectives of the state changed from that of maintaining a feudal status quo for the benefit of the shoguns and

their retainers to that of modern development for the masses. The outward trappings of today's Nepali bureaucracy (e.g., the judicial system, the Public Service Commission, the service ministries and their departments) are a legacy of this revolution.

The expansion of the nation-state has meant the expansion of its instrument--the bureaucracy--in sheer physical terms. In some sparsely populated northern townships of the country like Jumla or Manang, the number of central government personnel almost outnumber the local inhabitants, making civil service the largest industry. In functional terms, the expansion of the bureaucracy implies the taking over of resource management functions of the autonomous villages by the nation-state. Nationalization of forests, for example, implies the Department of Forest taking over forests managed by the villages according to their traditional practices. It must be remembered that a forest, like a river, is a physical phenomenon with many useful properties like timber, fodder, fuel, food, fiber, and habitat. When a nation-state nationalizes it, what is basically being nationalized are only one or two properties and not the others. When forests are nationalized, it is the standing stock of timber that is valued, and the other goods and services provided by them such as food and wildlife habitat are ignored.

The nature of control and management differs substantially at the two extremes of the nation-state and the autonomous villages. At the local level, it is mostly unwritten tradition that is well understood and accepted, which guides local efforts at harnessing properties of the physical system. The interests of the state, which are expressed and realized through the bureaucracy, are maintained through statutory laws. When the nation-state is expanding, the bureaucracy strives to expand its sphere of influence into the zone at the southwest corner of our diagram (Figure 7), which has traditionally been the sphere of local management. Irrigation is a good example. If it is defined as providing large dams and major canals, then the sphere of activities of the Department of Irrigation is everywhere. If irrigation is defined as a factor (and perhaps not even the most critical one) in

food production, then a successful example of that bureaucracy's contribution is rather difficult to find.

The bureaucracy is generally the servant of the political master of the day; the servant only strives to please the master by catering to his needs. The Nepali state since its inception has maintained a feudal character and the bureaucracy has been functioning within this context.[3] Of interest to this particular essay is the implication of this character to economics. In essence, a feudal society differs from a capitalist one in that the creation of scarcity and rent-seeking is the goal rather than increased production and profit-making. In that sense, the system of licenses for starting industries, although paraded as a means of planned development, is a means of creating a barrier to entry and thus retaining monopoly privileges.[4]

Traditional land management practices have shown the worst character of feudalism in that rent extortion practices overwhelm any incentive for increasing production (M.C. Regmi 1978).[5] The control of land and related water resources is in the hands of a feudal elite in control of the state and its bureaucracy. The influx of new and more powerful technologies is enhancing the power of this group, which is enlarging its fiefdom at the expense of the autonomous villages (Borgstrom 1980; Blaikie et al. 1980). Even corporations in the modern, nonagricultural sector are not free of the malaise. A quotation from an Indian sociologist studying the Nepali scene illustrates the point:

> As a result of 25 years of Nepal government policies, a new class has emerged that is determined to get concessions from the government in the name of development. Two types of classes are visible to Nepalese society today. First, those landlords who have not sold their lands would try to evict tenants and turn them into wage labourers. Second, many landlords who are conscious of the profit opportunities of farming are turning to agricultural capitalism on privileges of state-supported

development institutions. Consequently those who had economic and political power in the traditional feudal system would still remain powerful and maintain or increase their level of exploitation in alliance with the small emerging industrial class in Nepal. The accumulation of wealth created by this alliance may not be re-invested in developing Nepalese society. Rather it may be siphoned to other countries. "Autocratic feudalism" has been transformed into "neo-feudalism." It is eager to accept new technology if it does not change the existing pattern of exploitation" (Yadav 1984).

In the evolution of the state and its bureaucratic machinery, the revolution of 1951 was a watershed. Although the forces that attempted those changes are termed "popular" as against those ruling Nepal today termed "traditional" by Borgstrom (1980), in reality the revolutionary forces were a progressive India-educated and Gandhi-influenced elite somewhat similar to the Decembrists of 1825 Russia. Despite being motivated by lofty ideals, their assessment of the power of the entrenched feudal order, as well as the cultural and psychological shackles around the collective national memory, was weak. The pace of attempted social changes, especially in land management, was faster than what the social fabric could bear. For example, the attempt to marketize clarified butter (ghee) ignored the barter producers of local ghee in the autonomous villages. The ensuing protests led by obscurantists and feudal elements, together with the absence of an objective underlying historical factor for rule by the masses (democracy), made the task of reassertion of the feudal order in 1960 much easier.[6]

For analytical purposes, the royal takeover in 1960 and the promulgated panchayat system can be compared with the Tudor reaction to market penetration in English history: it did not stop marketization; it only slowed down the process to make it socially bearable (Polanyi 1957:38). Similarly, the net result of the panchayat system has been to slow down development (i.e.,

marketization of Nepali society and social values). It may be argued that this brake on too rapid a change has allowed the Nepali social fabric to catch up with the processes that took three centuries to evolve to the south in India. In this context, the Nepali bureaucracy, faithful as ever to the political climate, is geared to promulgating feudal practices and not to achieving development goals--which would basically democratize society, decentralize economic (and consequently political) power, and uplift the productive elements of society (as opposed to the consumptive ones).

At present the nation-state's bureaucracy consists basically of four parts split between two wings. One consists of the army, most of the armed police, and other security organs. The second is the apparatus, which encompasses the foreign ministry, for maintaining external relations. The third agglomeration consists of the formal government and engulfs a patch-quilt of service ministries, departments, and government-owned corporations. The fourth is a rather recent phenomenon consisting of quasi-official organizations basically in health and culture. These used to be under the third part as a unit of some ministry or the other, but now they have been able to wriggle out from under the discipline of related ministries.

The two wings are the regular civil service under the de jure cabinet of ministers and the palace secretariat with its de facto policymakers. This anomaly of dual rule has been highlighted by no less a person than the longest serving prime minister under the panchayat system (Baral 1977:108). Of the four parts of the bureaucracy, the function of the armed forces and the appointment of its senior officers have never come under the de jure cabinet. Foreign policy and appointment of ambassadors are also beyond the purview of the elected representatives.[7] The quasi-official organizations are also beyond the effective control of the de jure cabinet (and the formal government), as indicated by the raising of unofficial taxes with impunity by the Sports Council (Saptahik Janjyoti, 1986/87).

The different ministries function with varying degrees of

autonomy from the palace secretariat. The organizational chart of the government and it ministries (the de jure structure) is something superimposed upon the real institutions of feudal Nepal, which are designed for the privilege of rent-farming (which is profit-making not by increasing production but by creating and maintaining scarcity). Real institutions are modes of decision-making powers, which in turn overlay a feudal mode of governance structure dispensing privilege. In that sense, what are seen as de jure government bodies are but the shadows of the de facto instruments of governance, more adequately expressed by a Zen haiku (Stevens 1977:39):

> Who says my poems are poems?
> My poems are not poems.
> After you know my poems are not poems,
> Then we can begin to discuss poetry!

The role of the de jure cabinet in formulating the country's water resources and other development policies has been further curtailed by the third amendment of the country's constitution in 1981. Whereas the preamendment constitution gave the right of economic and other policymaking so necessary for ruling the country to the cabinet of ministers, the third amendment restricts the cabinet to "day-to-day administration" (S.P. Gyawali 1981, 1987; Panday 1987a). As a result, the process of policymaking and the responsibility for its success or failure, which has to be transparent and well defined in order to achieve popular participation in the country's development process, is undefined and therefore ineffective. Economic stagnation is merely a by-product of this state of affairs.

As Figure 7 shows, large-scale water resources developments require a wise intervention by the nation-state through its bureaucracy. Only an effective bureaucracy commanding the confidence of the entire populace can cope with the task of developing water resources on a basin-wide basis. This is especially true when, looking outward, it has to come to grips with other nation-states,

namely, Bangladesh and India. The task of developing large projects (like West Rapti, Bagmati, or Kankai) and megaprojects (like Chisapani on the Karnali or the Sapta Kosi high dam) involves the exercise of foreign and economic policies by a civil service at least as capable, as efficient, and enjoying similar de facto authority as one's neighbor's. Similarly, only a strong government with its people fully participating in and supporting its decisions can make decisions with long-term consequences such as building large hydrotechnical structures. The development of the country's water resources must be analyzed with the existing bureaucracy in mind, since it is this instrument that has been entrusted with the responsibility of harnessing Nepal's water.

NOTES

1. "Expanding nation-state and the autonomous villages." I owe this expression to Prof. Jeff Romm of the University of California, Berkeley, who says it comes from the eminent Indian Historian Romila Thapar. Indeed, some of Thapar's writings (1966:241-265; 1978) express the concept eloquently, but I have been unable to find her actually using the phrase. Of course, no village is completely autonomous since inter-village trade has always existed. The word "autonomous" would refer more to local control over resources and its management as opposed to central control and dependency.

2. Village panchayat boundaries actually include several of such actual villages or hamlets in sometimes geographically senseless conglomerations, thanks to widespread gerrymandering at every election. This makes planning for rural electrification a frustrating task. For example, before the referendum in 1979, Nepal had about 3000 village panchayats: during and after the referendum the figure went up to 4000, although the number of

actual villages had not changed. This would imply that, as per our propounded thesis, the village panchayats are more of an element of control by the nation-state than a unit of rural self-help. In such a context the principle of decentralization would be theoretically unimplementable (Merrill Goodall, pers. com.). (See also Goodall 1985; ADB and HMGN 1982.)

3. Perhaps the finest work on land resources management in Nepal is by M.C. Regmi (1978) where the feudal birta system of land management is described. The culture behind this practice has crept into the management of public utilities run by the government, where the distinction between what is public property and what is private is elastic.

4. For a study of this situation in the Indian context, which is also applicable to Nepal, see Jha (1984) and Bardhan (1984). In the Nepali context, licensing acquires added meaning as a protective measure against the tremendous pent-up demand in India that, together with the long open border, has a powerful distorting effect on the Nepali economy.

5. It must be remembered that feudal elites have no incentive to increase production because they already enjoy many privileges vis-a-vis the share-cropper that they do not need any more. It is only when they compare themselves to people outside the Nepali society (Western tourists, Indian businessmen) that they would feel any sense of deprivation.

6. In reading Tuladhar (1982), one gets the impression that social reality was far behind the modernizing views and behavior of the Nepali Congress leadership. See also G.B. Devkota (1980:225-233) for a description of the Dalda ghee crisis faced by the Nepali Congress cabinet, and Baral (1977) for the role of obscurantists.

7. Nepal's most eminent diplomat, Prof. Yadu Nath Khanal, reminisces in a recent publication: "In policy-making, because of royal assertiveness, the necessary national debate regarding the various aspects of policy remains muted." (See Khanal 1987b.)

9. NEPAL'S ECONOMIC DEVELOPMENT

Professional economists came to Nepal in the early fifties piggy-backing on foreign aid. They were mostly Western expatriate experts whose one major success is to have managed to spawn a fair-sized tribe of Nepali practitioners. The geopolitical climate that favored such a transplantation was the raging Cold War, which made it necessary to provide to the newly decolonized "Third World" a theology of worldly salvation different from that of the second world.[1]

The standard economic mensurations of the country do not present a rosy picture. Nepal is classified as one of the least developed among developing countries. It has a GNP per capita of only $160 (in 1984 US$) and, between 1965 and 1984, a GNP average annual growth rate of 0.2 percent with a population growth rate of 2.6 percent. Half of its total population is of working age, of which 93 percent is employed in the agricultural sector, 6 percent in services, and 1 percent in industry. Its agriculture contributes about one-half the GDP, its industry and manufacturing about one-seventh, and services (mostly government) about one-third. It has a negative balance of payments (mostly in its trade with India). It is a food importer with declining agricultural productivity (the average index of food production per capita declining 9 percent since 1974). Foreign aid accounts for practically all the development activities.[2]

Since Nepal has a large informal or nonmarket economy, the preceding numbers actually measure the items that are formally traded and taxed and are thus an index of the degree of marketization of the country. The GNP and GDP numbers are not a true reflection of its wealth or industrious productivity. They are a measure of the strength and dynamism of the nation-state, and neoclassical economics is an excellent tool both for this assessment and for tinkering with the nation-state's economy within a market framework. It is applicable only after appropriate social restructuring has eradicated feudal monopolies and created the basic rudiments of a market culture.

The following statement by Paul A. Samuelson is quoted by Lachmann (1984): "The Invisible Hand will only maximize total social utility provided the state intervenes so as to make the initial distribution of dollar votes ethically proper."

For such an intervention, the state and its bureaucracy must have the right political philosophy and motivation. If the elite in command of the state benefits from this initial maldistribution, the motive to restructure will be missing, and the publicly announced tools of redistribution, such as taxing luxury, will be subverted. The failure of neoclassical practitioners of development in the context of feudal poverty is due to their not asking the first basic question before prescribing solutions: What created this poverty in the first place, and what should be done so that benefits from efforts to remove this affliction will not be hijacked by the same forces that created the poverty? Ceteris paribus, one cannot have development since planning then gets confused with elite-led activities.

In the practice of development, statecraft and the exercise of its main policy are the relevant factors. The Nepali word for politics is raj niti, which translates as "main policy." It is futile to decry policy failures in individual sectors such as agriculture, education, and finance without relating them to failures in the main policy. Development economics in the feudal context of scarcity creation could be expected to be quite different from the development economics of expanded production. Nepal today is the result of its statecraft and the exercise of its state powers in meeting the challenges of external developments and internal evolution rather than some uncontrollable external circumstances.

There are a few salient conclusions one can draw from the host of available literature and numbers on Nepali economy (see MOF 1987; WB 1986; Panday 1987b; IDS 1983; NPC 1984, 1987; Amatya 1986). Most important is that the raising of internal revenue from taxation is very insufficient and inefficient. In FY 1985/86, taxes accounted for only one-third of the total expenditures.[3] Although agriculture provides employment to 93 percent of the working population, as well

as half the GNP, land revenues amounted to only 2 percent of the total taxes. Loan repayment and interest already account for 25 percent of the regular government expenditures, a fact conducive to fueling massive inflation. The security apparatus consumes about 30 percent of the regular budget with a growth rate in the last 5 years of nearly 20 percent per annum. The share of external capital in development activities is overwhelming.

External inflow of capital into Nepal is of two types: diffuse Indian and Western foreign aid (including formal Indian). Little formal studies have been done about diffuse Indian capital, but it is generally recognized that Indian businessmen have begun to play a crucial part in Nepal's economy. This should not be surprising because of the 800-km-long open border, historical trading patterns between the hills and the plains, cross-boundary family ties, and the fact that India has been marketizing and commercializing its society for the past several centuries and is in a better position to expand profit-making potentials for its capital.

The experience of western Europe has shown that once the "satanic mill" of the market has been created, nothing can stop the juggernaut from expanding except another equally dynamic market society.[4] True to Ashby's law that only a like can control a like, once the power of the market has been unleashed on a neighbor, the course of evolution is for the neighbor either to be subjugated and colonized or for him to acquire market power to an equally efficient degree. British market power forced India to marketize its society so that it came to its own and was able to displace the colonizer. It also broke down the traditional Brahmin-Chhetriya economic domination and allowed the baniya (or merchant) class to rise. Indians have struggled long and hard (with as much as 22 percent savings) to become a major capitalist power on their own. After all, 10 percent of India (which is already 80 million people) has a living standard comparable with western Europe. As a result there is a high degree of peripheralization (or internal colonization) in India.[5] India's neighbors have the choice of making the necessary painful internal structural changes to

marketize society and its values while the freedom-fighting Gandhian generation still holds the market forces at bay, or suffers some degree of ruthless market penetration once less orthodox leaderships begin to emerge.[6]

Although the inflow of diffuse Indian capital has been to the "autonomous villages" (in the broader sense as per our scheme outlined before) purely guided by the profit motive, the inflow of Western capital has been to the state mechanism and has the cover of altruism.[7] This foreign aid has upset value commitments in Nepal. It has made money cheap in social terms since it is easily available without much effort on the part of the recipient. It has lead to a quixotic situation where the donor is more anxious than the recipient. It has dictated national priorities[8] and has poorly understood the internal dynamics it has fueled.

Figure 8 shows the dynamics of foreign-aid fueled dependency cycle for Nepal.[9] The perturbation is provided not by oil rent (as is the classic case in Nigeria) but by a massive inflow of foreign aid that accrues to the state. This acts as does an inflow of nutrients to an algal pond: the net result is a massive growth of the central bureaucracy and the choking of villages. The cycle has a positive feedback because the intermediate imperative of the process creates justification for more aid and repetition of the cycle.

The internal dynamics of this process begins with public investments that lead to an urban-industrial boom for the urban elites controlling the state, an import boom, rent-seeking licenses, and an overvalued exchange rate that leads to inflation. The need to keep the disproportionately powerful urban population happy requires the setting up of trading and marketing organizations that result in a profit squeeze in agriculture giving rise to urban to rural migration and declining food production. This fact feeds on the need to import food through licenses. Investments in education (necessary to fill the need for skilled cadres to operate the urban and import booms) lead to an uncontrollable rise in the level of popular expectations that cannot be fulfilled. Social rumblings increase, requiring growth

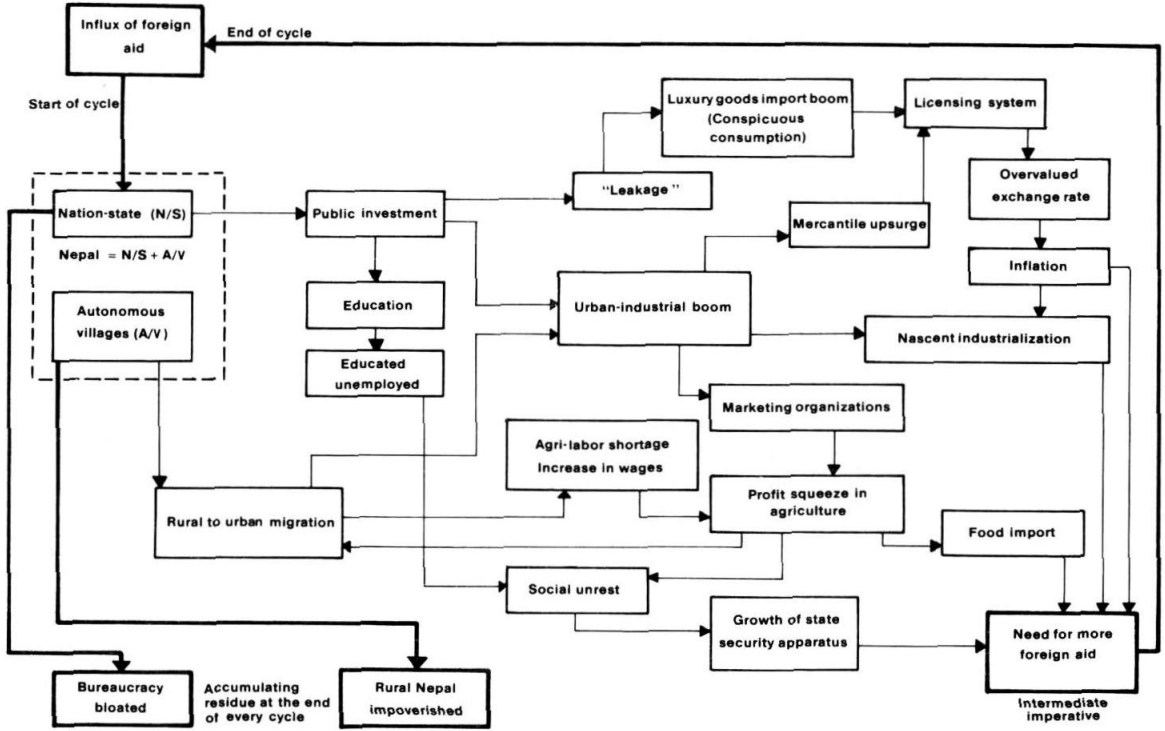

Figure 8. Dynamics of foreign-aid fueled dependency cycle for Nepal.

Source: Author's original creation that heavily adapts to Nepali conditions some basic ideas of Watts as per footnote 9.

in the state's security apparatus. Akin to the magnetic hysteresis left after every cycle of magnetization and demagnetization, at the end of the foreign aid cycle what is left are a more cumbersome bureaucracy and rural impoverishment. Skimming the cream are the very forces that kept rural Nepal poor in the first place (see Banskota 1983). Such a process would question the applicability of the neoclassical belief that, since lack of capital is the root of all evil, importing it in massive doses would solve the problem.

Modern water resources projects are very capital-intensive and demand specialized equipment, as well as skills neither easily available in Nepal nor easily purchaseable with the currently available stock of accumulated Nepali capital. Furthermore, the structure of state apparatus and the health of the economy are not conducive to bringing about the necessary accumulation of capital before the nation can venture forward with major water resources development programs. Whether Nepal can implement such projects based wholly on foreign aid--as is the case now--must be seriously questioned in light of the past history of rent-skimming by the elites. Planned intervention into the development process must be able to transcend technological fixations and look at complementarities such as hydropower--fertilizer production--irrigation, which the planning process has, till now, not done. This, however, would require an economic structure and political processes much broader than the present.

NOTES

1. It is interesting to note that Rostow, the neoclassical guru of the "take-off" theory of economic development, subtitled his work "a non-communist manifesto." For an excellent study of the history and impact of Western economists on eastern statecraft, see Rosen (1985). For an insightful survey of the geopolitical

context of modern development economics, see Griffin and Gurley (1985). For relevance of neoclassical approach to development, or lack thereof, see Jacobs (1985).

2. For the standard economic numbers, see WB (1986) and MOF (1987). In official statistics, foreign aid accounts for about 60 percent of the "development expenditures" with the rest supplied by HMG as its contribution mainly for administrative expenses. In reality, however, many nonproductive expenses (e.g., vehicles for personal uses, furniture, building upkeep, perks to balance low salaries) are subsidized by foreign aid. Many important sectors such as electricity and women's development are entirely foreign-aid funded. The last hydroelectric project designed by the Nepali nation-state was Devighat (ultimately built by India), and the last one actually constructed with national resources was the Surkhet microhydro project almost a decade ago. If scarcity of capital was the cause of underdevelopment, it would be difficult to explain the Nepali anomaly where only 30 percent of the committed aid money is utilized leading to donor competition.

3. Much of the rest was made up by foreign aid, which is mostly justified on the grounds that "Nepal is a poor country with no capital resources." Recent evidence of overbooking in share prices of public companies indicates that a counter thesis might be more correct: "Nepal is a country with a lot of blocked capital." Amatya (1986:50) blames the free-wheeling fifties for the reason there is so little trust among the public in investing in government-sponsored ventures.

4. The term is from Polanyi (1957). See Schmookler (1984) for the market as a power system capable of directing the internal evolution of society.

5. India could be considered as a "France embedded in a Sahel." Ten percent of India (larger than the size of France), consisting mostly of the urban elites, enjoys an effective per capita income comparable to western Europe. This 10 percent ends up in effect colonizing the remaining 90 percent. (See also Bardhan 1984.)

6. Examples of a feudal order with a strong sense of nationalism and national independence creating a national bourgeois class is Tsarist Russia encouraging the growth of its merchant-capitalists after its defeat in the Crimean War of 1855 and in making necessary structural changes by abolishing serfdom. (See Stavrianos 1981:335.)

7. There is a lot of noncommercial Indian aid and, in fact, some major infrastructures have been developed with its help. However, because of the stacking of the terms of trade in India's favor, more aid goes out than comes in. See Lama (1985:176) and Dharmadasini (1984:55). Western aid is generally justified to the average Joe Taxpayer on the grounds of Christian charity, and many highly qualified development professionals working abroad, unmissionary privileges notwithstanding, genuinely believe that it is so. However, there are scholarly writings that discuss the hidden "neocolonial" agenda of foreign aid. (See Payer 1982, 1974.)

8. See P. Pradhan (1983:260): "By and large, foreign aid helps to maintain the status quo in the administrative system and at the same time it helps to develop negative bureaucratic behaviour"; Gurung (1983:324): "Foreign aid, especially when it comes as grants, is in itself a symbol of trying to support and sustain a political system. Foreign aid cannot thus be expected to lead a country towards socio-political transformation"; and Mishra and Sharma (1983): "This collusion, or appeasement, of foreign aid in supporting the upper class in their interests can . . . seriously

distort the national scheme of priorities . . . can sharpen the contradiction between the upper class and the under class . . . and can create an imperative for a larger dosage of foreign aid--if only to postpone a resolution of the contradictions."

9. The figure is based on a similar exercise done for Nigeria by Prof. Michael Watts at the University of California, Berkeley, Energy and Resources Group "Growth Seminar" of Spring 1986. The excess of oil revenues to a state unprepared structurally to handle large capital inflows leads to what has been called the "Dutch Disease" and a breakdown of the state apparatus. For Nepal this is a qualitative exercise for conceptual consumption. There are not many studies that would allow placing numbers on the boxes or the flows between them.

10. NATURE OF DEMAND FOR WATER

Demand is a social phenomenon. In order to understand its nature, it is necessary to understand the society that gives birth to the demand. All too often, it is treated as an adjunct to the technical paraphernalia under investigation. For example, the demand for electricity or irrigation is studied not for the subject itself but as a part of a project to build a hydroelectric dam or an irrigation canal, and by those entrusted to build these things. Objectivity in such cases can be swamped by zeal and enthusiasm. Electricity demand in places of Nepal that never had it is probably best studied by anthropologists since such demand stems from life-style changes. Political economists are perhaps most capable of studying the demand for irrigation water. Of course, a role for engineers in explaining how existing technology works and how proposed new technologies work more efficiently will only enhance the quality of investigations.

In the previous pages, we examined some of the features of today's Nepali society. In this section, the essence of the nature of demand placed by this sociosystem on the nation's physical water system will be discussed.

Several types of demands on water are made by the sociosystem at both the village and the state levels. The demands of traditional village societies have been mostly local or cooperative between a number of adjoining villages. They involve a relatively lower level of manipulation of the physical system. The demands placed by the nation-state, however, are extensive in that they range over regions, basins, and countries in the neighborhood. They are intensive as well in that the proposed level of manipulation of the natural regime is very high.

Because of the source and availability of research funds, such state schemes are the ones most studied and discussed. A great deal of data (with varying degrees of quality) has also been generated for state projects, and this makes possible scientific discussions about

them. In comparison, very little is known about sociosystem demands at the autonomous village level, and attempts to know more requires extensive, expensive footwork for which there are few state-funded grants. The villages do not generally pay for such investigations not so much because of paucity of funds but because of their view that traditional ways of resource management or exploitation are acceptable as they are and that there does not exist any inbuilt reason or benefit for the village to want to change them. This is especially valid in a rent-seeking situation where any profit generated by the producers of the autonomous villages would be skimmed off by the structure of the state. The following is a look at the various demands for Nepali water.

Hydroelectricity

Since 1911 when electricity was first generated in Nepal, hydroelectricity development has always been a prerogative of the state. From 1911 to 1951, only two stations with capacities totaling less than 1 MW were commissioned because the sociosystem demand was limited exclusively to the palaces of the Rana shoguns. After the advent of democracy, demand for electrical energy has come from a much broader section of the populace, although only 4 percent of Nepal's population at present has access to electricity.[1] This population is today paying about six cents per kWh of electricity, which is what an average North American (with a per capita annual income a hundred times more than the average Nepali) pays. Although the country is described as being rich in water resources, the cost of developing medium-sized hydroelectric projects has been $2000/kW for the 60-MW Kulekhani and $3500/kW for the 69-MW Marsyangdi. The small hydro units are more costly at almost $5000/kW. The corresponding figures for hydrodevelopment in the Indian Himalaya are less than $1000/kW. This discrepancy can be explained by the existence of a more efficient productive market system in India than in Nepal where the structure of

the state apparatus has a feudal rent-seeking character.

One hopeful phenomenon in this regard is the prevalence of small traditional hydroturbines called ghattas that dot the Nepali hills. They are used principally for grinding corn. Ways have been found to improve these turbines and penstocks so that the hydroenergy can be more flexibly used for motive power as well as electricity. The capital cost of these 10 to 100 kW plants has been as low as $500/kW. Although the quality of their electricity supply is not high, it seems to be enough for rural needs. Its main attraction is for the supply of an efficient and flexible mechanical power that allows not only the grinding of corn but also rice hulling and oil expulsion--functions that the old ghattas did not do. The Agriculture Development Bank in Kathmandu has found that some of their most profitable loans are for these turbine projects (see ADB/N 1987).

The biggest difficulty in further developing these small hydro units relates to water rights at the site and conflicting use with existing irrigation. This is because of the nonexistence of statutory laws regarding water rights in Nepal, which are merely adjuncts to the land laws.[2] Although farmers have enjoyed traditional rights of these small kulos built and maintained mostly with their efforts, organs of the nation-state have not acknowledged this prior right. Many micro-hydro plants have been built by the Department of Electricity using the coercive powers of the state to forcibly capture water rights. This, however, is the norm not only for water power but also for urban water supply.

The potential power available in the river basins of Nepal and the projected demands are shown in Table 3. What is important to note is the small size of the demand compared with the magnitude of the physical asset. Also, where the development has taken place and where the demand comes from shed some light on the politics of the demand. The drawing power of the urban boom at the central seat of the nation-state along the Kathmandu-Hetauda-Birganj corridor is clearly seen although these areas are water-poor. As discussed previously, electricity demand still has not been sufficiently articulated by the

Table 3. Hydroelectric potential in the river basins of Nepal

River basin	Theoretical potential (MW)	Identified sites (no.)	Established potential capacity (MW)	Potential energy output (GWh)	Present developed capacity (MW)	Power demand	
						1984 (MW)	2000 (MW)
Mahakali	13,000	2	2,250	10,000	0.1	0.8	6
Karnali	23,170	11	8,840	40,000	0.8	0.2	2
Gandaki	20,650	13	6,200	30,000	125.0	20.5	90
Kosi	22,350	53	11,840	62,000	27.0	0.5	2
Southern	4,100	9	630	3,000	94.1	60.0	255
Tarai	10	1	1	50	1.0	23.0	145
Total	83,280	89	29,761	145,050	248.0	105.0	500

Sources: Various master plans, feasibility studies; Pradhan and Shrestha (1986); H.M. Shrestha (1966).

Note: Potential power is calculated at between 45 and 60 percent load factor. In what we classify as the "Tarai," some of the larger streams like the Tinau have some hydel potential. At Butwal, a 1 MW plant is in disrepair on the Tinau.

Present developed capacity includes built-capacities on the Kosi and the Gandaki, which have never run anywhere near full capacity, as well as some of the construction under way.

productive sectors of the economy. Electricity still carries with it the birthmark of being an element of luxury, namely, domestic lighting. This is more blatant in the rural areas where several steel tubular poles and kilometers of conductors are used to supply household light to as little as one house at state expense.

The Nepali sociosystem, however, is only a small fraction of the overall sociosystem that places demands on Nepali water. The social urge to harness the Himalayan rivers largely stems from beyond Nepal's political frontiers. In assessing the potential of Nepali rivers, power has always been the top priority for the state because of the possibility of revenue from export to the supposedly large market in north India. One of the difficulties has been the lack of funds to develop the capital-intensive megastructures that such a venture requires and the need to rely on two major actors: the market governments of India and Bangladesh, and the larger circle of governments that would back the financing consortium. This would mean that the Nepali nation-state would have to deal skillfully with the larger geopolitical issues.[3]

The other has been the disadvantageous political economy. The hope behind attempts to export electricity is of reversing Nepal's unfavorable balance of payments with India. The success of this effort is questionable because there exists an effective monopsony situation with the Government of India as the only customer. Unlike oil and timber, which can be mined and packaged for easy export, water resources--either as hydropower or irrigation waters--cannot be mined but should be harvested seasonally and therefore is not amenable to easy export as a raw material from a colony. It demands some sociosystem restructuring and long-term sociosystem involvement.

Electric power is, in the final analysis, not an end in itself but only one of the factors of production--a raw material. India would not buy it from Nepal, which is a captive market for India, as an element of charity--certainly not at the scale envisaged. As a monopsony, India's bargaining stance with Nepal would basically consist in trying to reduce the price of electricity sold to as close

as the cost price--which would leave Nepal no benefit at all. Furthermore, Nepali power would have to be cheaper than the Indian alternative, which would mean that products from factories across the border using that power would be more competitive and hence more would be exported to Nepal. No country has really "developed" by the export of raw materials alone, and one has to examine the comparative advantages for import substitution of final products rather than export of raw materials. Serious macroeconomic impact studies must be conducted before building hopes along these lines.

Irrigation

Although irrigation has been practiced since time immemorial in Nepal, it is difficult to say how much of it is there and in what form. If irrigation is taken to be a factor of food production, then the responsibility for it has always belonged to the autonomous villages. If it is taken to mean "infrastructure development" (meaning basically large dams and canals capable of year-long supply), then irrigation falls in the realm of the nation-state, because the feat of creating an hydraulic civilization is possible only when society is organized on a larger scale. Nepali agriculture, to a large extent, is rainfed and not hydraulic. The scope of hydraulic plumbings in diversions and canals where they exist is still small enough to be managed by the autonomous villages (see Martin and Yoder 1986).

The focus of most of the attention of academics and planners has been large-scale government-developed irrigation, but even here reliable or meaningful numbers are difficult to find. Figure 9 shows type of land and irrigation in Nepal. Since most irrigated lands do not get water during the dry season but only some supplemental water in the wet season, the impact on food production cannot be thought of as high. This is even more painfully true when one realizes that the connection between food production and the irrigation bureaucracy is

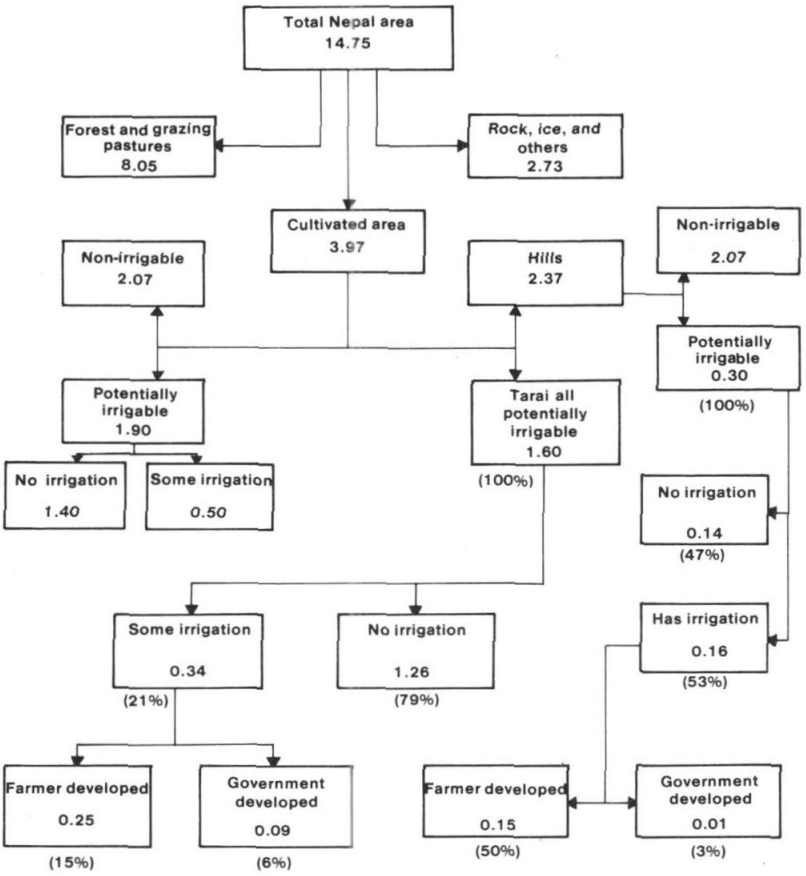

Figure 9. Land and irrigation in Nepal (all figures in million hectares).

Sources: WECS (1981) and LRMP (1986).

extremely tenuous as indicated by the fact that water charges (when levied at all) do not even meet a fraction of the operation and maintenance costs (Shrestha, Shakya, and Shrestha 1984).

Since the ultimate objective of irrigation is enhanced food production, it is difficult to assess these numbers in the absence of any relation to the additional food produced. State statistics are silent on the matter, in all probability because nothing of the sort has been collected due to the poor system of land production taxes. When coupled with the large informal rural economy and the feudal nature of landholdings discussed earlier, the problem becomes one of game theory. Large-scale irrigation works in Nepal can be seen as a game between landholders and the state. Once the state intervenes (or is made to intervene) without any prior commitment from the farmers to help meet some of the costs (in the form of agreed tariffs or agreements with water users' groups), then the state is basically trapped as it cannot just walk away with its structures. The result is a situation where most projects are not even able to raise the revenue required for operation and maintenance, to say nothing of capital repayment, allowing the rich feudal farmers to become free riders in the economy.

The basic problem with irrigation in Nepal arises because it is treated as the sine qua non of agricultural productivity. As with electricity, water (and that, too, water above and beyond what is provided by nature and improved by village communities) is only a factor of production and perhaps not even the most critical one. In light of the discussions on the nature of the state, one would suspect that problems of rural credit, landholdings, and market access are more critical than supplemental water at exorbitant costs. If part of the megaresources thrown into civil engineering were used instead for improving these previously mentioned factors, a better rate of return would probably ensue, leading to some capital formation in rural Nepal (see Vohra 1985; Repetto 1986).

Water Supply

From the perspective of the autonomous villages in the hills, water for domestic uses is regarded as the most pressing of their needs. In major urban communities like Kathmandu Valley, besides the problem of scarcity, issues of pollution of supplies have become critical. In synthesis, the central issue of domestic water supply is one of changes in cultural habits and the success or failure of the nation-state in meeting the changed expectations of its urban and rural denizens.

At the state level, three organizations deal with water supply in Nepal with conflicting jurisdiction: the Water Supply and Sewerage Corporation (WSSC), which deals with urban water supply in twelve towns (out of the official thirty-three); the Department of Water Supply and Sewerage (DWSS) in the remaining towns, as well as in settlements with populations exceeding 1500; and the Ministry of Local Development, which looked after the needs of villages with populations of less than 1500 till recently when this activity was transferred to the DWSS. The WSSC deals only with twelve towns because it was created to execute the World Bank loans, which extended only that far. The towns (designated Nagar Panchayats) are sometimes as much as 75 percent rural areas administratively lumped into a municipality. Furthermore, the bulk of Nepal's population lives in settlements of less than 500. The resulting breakdown of responsibilities is rather arbitrary. The centralized administration of localized products, such as water and sewerage, is a reflection of the need of the nation-state's bureaucracy to expand and usurp the resource management functions of the autonomous villages.

The official figures of the Water Supply Decade Plan, which was launched in 1981, envisage providing (through these organizations) water to 66 percent of Nepal's population by 1990 (MWR 1981). The present capability is stated to be 11 percent for all Nepal and 6 percent for the rural areas. The 1981 population census showed that the population of Nepal was 15 million with an annual growth rate of

2.7 percent. Eight years have gone by, and no assessment of what has actually been achieved has come to light.

The problems with domestic water supply in Nepal stem from ignoring the autonomous villages and acting on the belief that only the nation-state is ordained to perform. This has resulted in an excessive reliance on new and large-scale civil engineering as the panacea instead of good housekeeping and a careful husbanding of resources. A glaring example in the heart of Kathmandu is the state of ancient public spouts where continuous water flows to this day and is used by a large section of the core urban population. It has never figured in WSSC's scheme of things, and even its statutory legal entitlement is uncertain.

The problem of nonirrigation water supply is twofold: first, the water received by villagers is not adequate (during the drought period), not easily accessible (requires up to 3 hours per day of trekking per family), and not safe (medically); second, the growing and increasingly Westernizing or industrializing urban areas demand nontraditional piped water supply at a very fast rate from an inadequate physical base. For example, Kathmandu Valley is growing rapidly into a metropolis, but the Bagmati Basin within which it lies is water-poor. Many of the attempted solutions for water supply, whether municipal or rural, have floundered because a patronizing attitude has been adopted, which ignores the capacity of the autonomous villages to solve their problems.

Fisheries

Nepali rivers contain fish of some commercial importance but of value chiefly as a diet supplement to the rural population in a subsistence economy. It remains unassessed by the nation-state.

Fisheries bring to the fore some of the most glaring environmental problems. Keeping aside the very important issues of the intrinsic rights of species to exist, the need to maintain the

richness of the genetic pool, or the preservation of the aesthetics of the surroundings, environmental problems can be defined as the destruction of a resource base of importance to the autonomous villages by the actions of a nation-state and its bureaucracy that devalue or undervalue some of the properties of the natural system. For example, the construction of the Dhangadhi-Dandeldhura highway and the consequent avalanche of silt and debris decimated the fish in the Doti Khola in the Mahakali Basin. At the level of the Department of Roads, this fact was, however, not even a concern: there were poor people at the lower strata of a subsistence society in Dandeldhura for whom fish was one of the few easily accessible protein sources.[4] To preserve this kind of a resource base that provides goods and services, the environment makes its own demand on the natural waters of Nepal.

Navigation

Traditionally rivers of Nepal have been as formidable barriers to transport as the high mountains. Turbulent streams have cut off villages from each other even though they may be within shouting distances. The method of crossing the streams was either by pulling oneself across a "twing," which is a cable strung tautly between two banks, or by means of a dug-out wooden canoe in the relatively quieter stretches of the river. In the hill areas of Nepal, transportation is basically across a river rather than along it. With the introduction of stronger steel cables for more reliable suspension bridges, river-ferrying is fast losing appeal.

In contrast, the southern stretches of the rivers after they debouch into the plains are suitable for use as arteries for goods transport. Traditionally country crafts have plied their lengths ferrying goods within Nepal and to India. They have suffered after the construction by India of barrages from purely irrigation considerations (Thapa 1984:100).

However, the real value of river navigation to land-locked Nepal is the "access to the sea" it would provide.[5] This demand stems from the nation-state and not from the autonomous villages. Such an access would enhance the prestige of the nation and its sense of economic and political security. Technically this is possible since the Indian Government has declared the Ganga a national waterway, and its three main tributaries from Nepal--the Gandaki, the Kosi, and the Karnali--are navigable from the territory of Nepal to the confluence with the Ganga for barges and crafts having a draft of more than a meter with practically no additional river training required (see Thapa 1984:86-113).

The practical difficulties in achieving it are manifold. First of all, this demand suffers from an inherent weakness: it comes not from a dynamic commercial sector within the country but from the nationalistic intelligentsia. The result is that the cool-headed economic thinking against which the heavy costs must be evaluated is missing in the public debates.[6] The second problem is that this proposition will never materialize unless India agrees. Nepal has very few trump cards to bargain with India.[7] The only plausible one is that Nepal owns the hydro sites where reservoirs could be built, mostly to India's benefit. Bangladesh has already indicated its willingness to allow Nepal access to the sea, possibly because of its wish to see reservoirs in the Himalayas as an alternative to the Brambaputra canal in its dispute with India over the Farakka barrage (Abbas 1982:106). Without a similar vested interest of India involved, Nepal will continue to be land-locked.

Other Demands

Rivers are an important element in religious and cultural life of the Hindu. Many of them are considered sacred. Some of the holiest shrines are located on the banks of rivers or at the confluence of two tributaries; and rivers, especially from the Himalayas, have a special

mystical grip over the Hindu psyche. Many of the Vedic sages are described by tradition as having meditated on their banks.[8]

Among the many important religious river sites in Nepal is Dev Ghat at the confluence of the Kali Gandaki with the Trisuli-East Seti where Lord Rama of the Ramayana is said to have conducted his Ashwamedh Yajna (a sacrificial ritual for territorial gain involving horses). It is an important pilgrimage site for most of west Nepal, as well as north India. Another is the Barakshetra where a small Koka Khola meets the Sapta Kosi before this mighty river debouches into the Tarai plains. It is regarded as one of the mukti kshetras (the holy ground of liberation) with the very important temple of Varaha, the boar incarnation of Vishnu. River Bagmati in Kathmandu Valley has many significant temples along its banks. It originates from the flanks of the Shivapuri hills at Vag Dwar (Gates of Saraswati), flows past the temple of Gokarneshwar Mahadev (where Ravana of the Ramayana fame is said to have meditated), past Pashupati and Guheshwari temples, past Sahnkhamool tantric sites, and finally out of the valley at Chobhar Gorge past the temple of Chobhar Ganesh. Thousands of pilgrims bathe at these sites during festivals.

From the perspective of hydrotechnical construction, most of these places with narrow gorges and upstream storage potential happen to be ideal hydro sites. If the level of manipulation of the regime of rivers were to rise (e.g., with large diversion schemes or flooding of temple sites due to storage reservoirs), conflicts and contention could rise, which would not be amenable to easy solution.[9]

What has been described here can be regarded as an unorthodox version of "recreational and aesthetic" aspects of conventional water resources planning. Another unconventional use of Nepali rivers is growing, which demands that the river be left in as pristine a natural state as possible. It is whitewater-rafting, and the upper reaches of Nepali rivers are becoming commercially important as an exciting place for those with a passion for such adventures. This tourist potential is growing rapidly every year. Demands such as these are in complete conflict with conventional water engineering. In planning a higher

level of intervention into natural river regimes, these contradictory needs must not be ignored.

NOTES

1. The official government figure is 10 percent, but that is derived by totaling the population of districts where electricity is available, although only the district headquarters may have erratic electricity supplied by a diesel generator for a few hours every night. The 4 percent figure comes from totaling the number of electrical meters in the kingdom, assuming half of them are in households, and multiplying by 6 as the average number of people per household. This 4 percent in Nepal pays the same price for electricity as an average Californian (i.e., about 6 cents per kWh).

2. Based on interview with bank staff. Nepal's Mulki Ain (Mahal 8/No.1), as well as Supreme Court Decision No. 1528 of 2039.1.26.1, establishes the doctrine of riparian rights with the right of prior capture as the law of the land. However, the state with stronger organization than the villages can and does ride roughshod over prior rights. As the nation-state or even villages seek to introduce new technologies, this law is bound to come into conflict with the forces of the market and development. (See also Polinsky 1983; Meyers and Tarlock 1979.)

3. Comment by Sir Robert Jackson, special assistant to the U.N. Secretary General, on the prospects and pitfalls for large-scale hydrodevelopment in Nepal at the Mohonk Conference, New York, April 1986.

4. Interview by the author in Dandeldhura, April 1982. Such ignoring of local needs and concerns are well documented in Blackwelder

(1983), Blaikie (1985), Goldsmith and Hildyard (1984a, 1984b, 1984c), Vohra (1985), Williams (1983), Alexis (1984) and Bjoness (1984). See also Redclift (1984) for the first serious Marxist look at the environmental crises and its political interpretation.

5. A quotation from His Majesty the King in MWR (1981): "River systems can be so developed as to help land-locked countries in their search for a passage to the sea. If countries such as Austria and Switzerland can solve their problems of access to the sea, there is no reason why a similar solution cannot be worked out in our part of the world. Given genuine friendship and mutual cooperation, I declare in the name of my people and my government that Nepal is willing to cooperate in such a joint venture."

6. For Nepal, besides navigation, there are other forms of transportation such as electric ropeways, which are at first glance more economic than trucks running along expensive mountain highways on imported petroleum. However, this first-crack economics ignores political economy: the truck owners in Nepal have effectively sabotaged the only functioning ropeway and could possibly do the same to any other alternative transport envisaged, including navigation. (See Wuest and Herzog 1983.)

7. In the past three decades, Nepal has not managed to wrest major trade transit concessions from India. Nepal continues to take a confrontational position, and India continues to view such demands in the light of "deflection of trade" (i.e., smuggling). (See D. Gyawali 1983b; Malwan et al. 1981.)

8. The Ganga is regarded as descended from Lord Shiva's matted locks. See Nobel Laureate Herman Hesse's Siddhartha (1987) for the mystical reverence enjoyed by rivers in the Indic civilization.

9. Standard economics fails at this point because, in it, space is considered interchangeable. For example, a piece of land flooded by a reservoir could be converted into liquid cash and exchanged for another "similar" plot. A temple from a dead tradition like Abu Simbel could be removed at a cost to another equivalent site. In living Hinduism, however, space is sacred and cannot be exchanged. A mukti kshetra (a consecrated ground generally with important temples) cannot be moved to another spot because that corresponding "holiness" will not be there. Many traditions in the nonmarket civilizations have similar problems with the market's blase attitude regarding the sacredness of space. See Deloria (1973) for the American Indians' difficulties with the market system's desecration of their ancestral grounds.

PART III

EVOLUTIONARY PATHWAYS

In converting a natural phenomenon like flowing water into a socially useful resource, the thesis propounded in this monograph is that both nature and human society are called upon to deviate from the usual. In the preceding chapters, we have seen that the physical characteristics and behavior of Nepali water are wild, erratic, and not easily predictable, while her social climate is not hospitable to efforts at remolding nature. In this final chapter, having gained some insights into what we have and what we are, it is necessary to ask ourselves what can be done with the situation as it exists and how. This is the very ambitious task of synthesis set at the very beginning.

Let us first recapitulate the salient conclusions of the previous chapters. As a physical phenomenon, Nepali water is of a wild temperament. It is dependent upon a climatic pattern of extremes quite unlike the milder precipitations of temperate western Eurasia and North America. It flows through geologically unstable physiography of extreme contrasts. The hydrology of this water, like the country's precipitation, fluctuates tremendously from season to season and year to year in alternating cycles of floods and droughts. The rivers also carry some of the highest silt loads among rivers in the world. This is compounded by a scantily studied bed-load movement along these drainage corridors as high in magnitude as the Himalayas they come from. These physical characteristics of Nepali water militate against an easy economic exploitation and are plagued by a high degree of scientific uncertainty in their knowledge, making it difficult to say with technical confidence how such a wildness can be tamed.

As a social phenomenon, water and society have intertwined into a complex pattern of mutual influence. Social mores coevolved with the physical behavior of water: over time, social institutions developed that had features of both stability and resilience within the limits

of prevalent uncertainties. The level of intervention into the natural regime of water was commensurate with these uncertainties and the collective hopes and beliefs they fostered. A social philosophy evolved, which considered battling against nature a meaningless enterprise; and this in turn facilitated the formation of a zero-sum feudal state that oversaw the control and allocation of flow resources in autonomous villages in a climate of a fixed rather than expanding economic pie.[1]

Modernization, the Nepali sociosystem's belated response to intrusion by Western civilization, introduced new cultural values into the sociosystem. The result has been a change in society's perception of what nature can provide and what can be demanded of it--a change that has wrought disharmony within society and between society and nature. Development problems, which occupy much of the time and efforts of governments and experts, are but the coming to terms with these values and the cultural artifacts they bring with them. Although an effective native-born social philosophy is yet to be seen, the imported social philosophy of neoclassical development economics has not had much success in molding the behavior of people and institutions since its acceptance is far from universal in the current Nepali society. Similarly, a back-to-nature and idyllic past attitude is also doomed to failure: it has not saved the village artisan of the past in the face of the onslaught by the market. However, in the feudal context, the nascent market can be used as an alternative by the downtrodden to squirm out from under the feudal yoke.[2]

It is difficult to engineer wholesale changes in some elements of an interrelated complexity without effecting changes in other elements. Most development efforts have been focused on changing the physical regime of water using new artifacts of technology, while ignoring the changes needed in the sociosystem from the metaphysical to the cultural and political. Properly operating space-age machines with twelfth century social software should have been seen as inconceivable from the very outset. The result of development efforts that have concentrated on hardware and ignored the sociopolitical

dimensions has been expensive projects poorly operated and practically not maintained.

Since the process of modernization began in the 1950s, the vision of the modernizing segment of society has been to even out the maldistribution of water resources in time and space through the feat of hydrotechnical superstructures. These modernizers have not closely examined the basis for their belief that such a technical redistribution would be followed by increased wealth in terms of food and revenue from the export of hydropower.

In examining the assumptions closer, one sees that the simple equation of "if water then wealth" does not follow automatically. If Nepali society is to be considered poor under a certain type of calculus, it must be remembered that it did not, in the course of its history, choose to be poor: rather it was impoverished by a set of historical forces and deep-set structures. Attempting to eradicate poverty willy-nilly implies modifying the social software and the structural architecture of the state it has calved. Who are the set of actors--the owners, the renters, the buyers, and the sellers? What are the "terms of trade" between them, what should they be, and how is the change to be effected? What is the role of the state in this enterprise, the role of the individual, or the role of fairly autonomous social conglomerations like ethnic villages or socioreligious groupings like guthis? How could the role of the state be made more efficient than what prevails now? Until such questions are asked and the needed modifications attempted--a process that may be termed "social engineering"--falling water will not become a source of wealth.[3]

With all these constraints as given, what policy prescriptions can be made? What actions must be taken so that water and the Nepali society can evolve harmoniously to the benefit of both the sociosystem and the aquatic environment? In what follows, the underlying assumption is that there exists a shared acceptance that the status quo of stagnation is not acceptable, and that whatever is done should be done for the greatest good of the greatest number.

The first and most important requirement is an intensified level of inquiry and debate in the realm of Nepali social philosophy. Neither development nor the wisdom for it can be a gift from the national and international elites to the have-nots. They must be churned from the rich brew of a dynamic culture through the process of social consensus-building. The advantage of this type of interaction would be to reduce the risk of failure (because more aspects would have been considered with a debate than without one); to cushion the negative social impacts of wrong decisions (because everyone would have been involved in their making in one way or the other); and to force society to first ask the relevant questions and then to look for sensible answers (because asking the right question is already giving half the answer). Such a culture, in Tagore's (1912, verse 35) words, is one

> Where the mind is without fear and the head is held high;
> Where knowledge is free; . . . Where tireless striving
> stretches its arms towards perfection; . . . Where the clear
> stream of reason has not lost its way in the dreary desert
> sand of dead habits; . . .

The next important thing is to increase the primary scientific database. Basic information is lacking in the earth and life sciences, and what is available is not very reliable. Traditional water management practices had been compatible with the forces of nature and developed risk perception and resilience, which could manage with lesser scientific certainties. In constructing and maintaining traditional water mills (ghattas) and irrigation canals (kulos), the sociosystem did not need to know about once-in-a-hundred-year floods. In case of damage, the recolonizing resources were within the sociosystem's risk portfolio. The scale of envisaged interventions in modern times, however, entails much larger risks, and therefore requires a far higher level of scientific certainty. Many of these data can be generated at the nation-state level or with its

active encouragement. Its revenue resources, however, are limited for such mundane tasks that involve no fanfare. It can partly be overcome by encouraging national but nongovernment research through various incentives within a broad strategy of primary data collection. An enlightened nation-state could encourage a rational and open scientific society, and this would greatly facilitate such a task.

In approaching the problems of water, it would be advisable to adopt a basin approach. The administrative structure of the Ministry of Water Resources and its departments should reflect a basin-wise breakdown so that planning can take this approach. Scientific studies should begin by determining water balances for the basins, highlighting the unknowns, and conducting activities to fill the gap. This should be started with the Bagmati Basin because of its easy accessibility and better data, and the lessons learned should be used to ask questions about the other less readily accessible basins. This would help in other aspects of development planning because the hill economy and its people have mostly followed the water to the Tarai.

The role of the state and the level of its involvement in the management of resources like water, land, and forests should be the subject of an informed public debate. This role today is fraught with contradictions and economic inefficiencies. For an efficient functioning of the state apparatus, the existing schizophrenic de jure and de facto split between authority over, and responsibility for, policymaking should be done away with. From theoretical perspectives, either the palace secretariat or the formal government secretariat (not simultaneously) could function as the repository of both power and responsibility for water resources development. However, among the two, only the latter is open to all segments of Nepali society, and this fact could be expected to generate better consensus across the entire spectrum of the country's ethnic mosaic. The present pathway of evolution of the state, however, would imply more inefficient bureaucratic expansion, using the civil service as a human resources "sink" that would consume more resources rather than create them.

The task before enlightened Nepali statecraft is to move away from the exploitative mode of "nation-state versus autonomous villages" to the partnership mode of "nation-state with the autonomous villages." The former pathway has been followed till now with the resulting stagnation; the latter has not been tried and therefore cannot be said to be wanting. It at least holds the hope of a light at the end of the tunnel. However, it would require less political elitism and hubris and would allow the nation to march forward decisively rather than simply muddle along buffeted by external circumstances.

Good governing would mean designing such homeostasis mechanisms as will allow the state to go on autopilot. One of the tested homeostasis mechanisms is the capital market, provided it could be made socially responsible both nationally and internationally. For example, most of the problems in power production, irrigation, and water supply can be solved by the state relinquishing its monopolistic management role, confining itself to the larger problems of good governing, and allowing for economic pluralism that would include the people and the autonomous villages as equal partners.

Recently, with the realization of the disaster of nationalizing Nepal's forests in the 1950s and the recognition that the autonomous villages have to be partners in its judicious exploitation, a beginning has probably been made with community forestry (see Chapagain 1985; Wallace 1985). This should be extended to water resources by giving local demand more leeway to determine its supply in lieu of the situation now where a controlled and monopolized state supply determines demand. The state's role then as an enlightened adjudicator of water rights needs to become paramount. Simple privatization without political and economic justice, however, would not be meaningful since, in a feudal socioeconomic milieu with hazy distinctions between what is public and what is private property, such an act would lead to privatization of public wealth and commonization of costs.

An example of uneconomic control that fosters scarcity is the

microlevel control over power generation. A law still exists that deems all electrical generation in the kingdom is the prerogative of the state. A high-level bureaucratic post of "chief electrical inspector" existed for more than a decade in the Ministry of Water Resources to control private electrical generation (similar to the officials who handed out licenses to own radios in Rana days). The post has been allowed to lapse because it was made irrelevant by the portable generators. The government has now allowed private hydroelectric generations of up to 100 kW;[4] but there is no good technical or economic reason this limit should not be scaled in megawatts, and why Nepali financial institutions and individuals should not be provided the right incentives to set up private generation and supply companies. After all, it is the power of the eighteenth century English joint stock companies that was able to usher in development as understood today (Stavrianos 1981).

In fact, such an approach may allow Nepal to break out of the quandary she is in right now. The traditional approach to power export has been the creation of a monopsony customer by Nepal. This needs some explanation. Nepal deals with the Government of India for water resources projects with export potential; but water and electricity are state subjects in India, zealously guarded but beginning to crumble under the subverting impact of the central government's grants and handouts. If Nepal had chosen a less high-profile water resources propaganda and opted to deal with individual factories in northern India and the three neighboring state electricity boards, she would have had more customers to bargain with. There are precedents regarding Nepal's other major resources--her forests, forest products like herbs, or even agricultural products--where exports have not been to a monopsony customer.[5]

Smaller scale projects (50 to 200 MW run-of-river types instead of 5000 MW storage behemoths) can be peddled with lesser risk. If the offer were turned down, Nepal could always absorb this smaller magnitude of power into her own system. Furthermore, if energy is cheap (and if this "colossal water wealth" propagandized with much

fanfare is a reality, it follows that it should be cheap), there would be no reason for Delhi to object to Lucknow or Patna buying power from Nepal. Medium-scale projects handled within the market discipline and under corporate cultural practices would assure both the Indian government and the Indian customer that the security of their supplies would not be jeopardized. In parallel, it would liberate the Nepali water bureaucracy from the very natural paralyzing fear of dealing with a monopsonistic superpower.

The formation of the South Asian Association for Regional Cooperation (SAARC) involving participation of several countries (Nepal, India, Bangladesh, and Bhutan) sharing the Ganga-Bramhaputra Basin will have a critical impact on Nepal's water resources development, perhaps not directly because bilateral water issues are still too sensitive to be regionalized but certainly indirectly in the molding of public thinking and debates. In the Nepali context, this external obligation's impact will be felt mainly in the country's internal functioning, which will have to be changed for better efficiency and compatibility with internationally accepted norms (see Khanal 1987a).

As a precondition, development requires commitment by the state, its elites, and its intelligentsia.[6] Relying on external forces to bring about development implies a lack of commitment. Foreign aid could be a useful tool for economic development in the hands of committed statecraft under a rigorous set of conditions; but if it is allowed to function as a master, it imposes its preconvictions without an adequate feel for the pulse of the country. Nepal must seriously examine what sort of water resources development will ensue from efforts only through foreign aid, as is the state of affairs now.

The current evolutionary path envisages large-scale water resources development based on foreign capital, mostly as grants and other cheap handouts. This is also a path, but its pitfalls need to be properly assessed by the sociosystem. The issues, which should be kept in mind, are (1) capital at the scale required is not available as grants but has high financial and political costs (e.g., the

Karnali project would require a capital input several times higher than the country's GNP, requiring one to ask whether one is putting the project in Nepal, or Nepal in the project, and to ask who is going to be in charge and how much); (2) with U.S. debts in the trillions, there is a squeeze in the external capital market, making it unlikely that Nepal at this late stage can fuel her development with cheap foreign investments as was done by Thailand; and (3) the sociosystem should be prepared to make the necessary internal changes to attract capital and make itself credit worthy, a process that can be expected to be uncomfortable as it means overriding the rent-seeking structure of the state apparatus and replacing it with a civil service facilitating such enterprises.

The alternative pathway would consist of encouraging the people of Nepal in her autonomous villages to participate in development through economic decentralization and sociopolitical pluralism. Without indigenous national effort, albeit modest, the necessary confidence building never occurs. This approach would also imply changing the role of the nation-state's bureaucracy from that of master creating scarcity for control to that of public servant encouraging industriousness for prosperity. In water resources development, the formidable task before such a state committed to development as a means to achieving the well-being and prosperity of its people would consist of promulgating economically and environmentally rational policies, encouraging primary scientific research, and allocating water rights according to well-designed and debated master plans so that modest demands from the bottom can encourage sensible means of supply. The enterprising and hard-working people of Nepal can easily do the rest.

NOTES

1. The idea of a zero-sum society is defined by Thurow (1980) in the context of allocation of losses. Feudalism creates scarcity and

allocates losses, albeit mostly to the serfs. For an explanation of zero-sum behavior in the feudalism of the modern Nepali bureaucracy, see Commentator Bhadra (1983).

2. In a recent project by the Integrated Development Systems/Nepal (called "sustainable development of the poor by the poor"), it has been shown that providing market access to the very poor has enabled them to indulge in craftswork and be free of the compulsion to work for nothing for the local landlords.

3. Even aid agencies with Keynesian beliefs that the lack of capital is the root of all evil have begun to realize the need for structural changes if inflow of capital is to be effective. The World Bank has now begun a program of "structural adjustment loans"--a macroeconomic project designed to change the economic structure of the country with again a monetarist tool in the form of a loan carrot. Although the results have yet to come in for a proper assessment, it may be speculated that by ignoring political economy the project would probably play into the hands of the same elites responsible for the economic debacle so far and adept at nibbling away the carrot while avoiding the stick. (See Panday 1987b.) That development is a political process has been stated once too often and also ignored by aid agencies as often. (See Major 1977; Stavrianos 1981; Daly 1973; and Uphoff and Ilchman 1972.)

4. The sole exception is the 5 MW Andhi Khola project near Butwal being built by a missionary group in a not very clearly understood partnership with the erstwhile Nepal Electricity Corporation and the Rashtra Bank. This group is a reincarnation of the private Butwal Power Company whose facilities were extremely efficiently run until nationalized by the government. (See ITECO 1987.)

5. Several experts have questioned the heavy investments in, and hope-building around, water resources when, from a game-theoretic perspective, such a move only enhances the Government of India's bargaining stance. (See Rogers 1984.) Regarding exports of forest products, reckless deforestation may be raised as an example, and questions asked whether this state of affairs will not repeat itself in water resources. The point here is one of getting the best economic rent (or price) for a product, not how fast it should be exploited or to whom the rent (or profits) should accrue. This is a problem of political economy of which enough has already been said.

6. See D. Gyawali quoted in Ives et al. (1987:338) regarding the standards against which commitment of both the local and the foreign experts must be measured--the units of the milli-Gandhi and the milli-Teresa--if development is to occur.

APPENDICES

Table A-1. Representative climatological data of various physiographic regions of Nepal (temperature in centigrade, precipitation, and evapotranspiration in mm, humidity in %)

	Tarai region (60 m to 500 m)											
Station 705	Altitude 110 m					Latitude 27-31			Longitude 83-26			
Bhairawa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean min temp	7.5	9.6	13.6	19.8	23.4	24.0	25.0	25.1	23.8	20.7	13.3	8.1
Mean max temp	22.2	24.7	31.2	36.2	36.6	34.6	32.4	32.5	31.6	31.0	28.2	23.4
Daily mean temp	14.8	16.4	22.4	27.8	29.8	29.4	28.7	28.7	27.6	25.9	21.0	15.9
Av precipitation	12	4	61	17	31	184	581	398	357	16	8	4
Evapotranspiration	55	76	167	250	241	154	150	147	123	100	96	53
Humidity AM	90	81	64	54	57	73	83	82	85	84	81	91
Humidity PM	66	49	32	26	43	62	74	76	78	69	57	71
Max temp 42.4					Max 24-hr rain 193					Total annual precipitation 1,673		
Min temp 2.0					Min annual precipitation 701					Total annual evapotranspiration 1,612		

	Inner Tarai (dun) region (200 m to 1,000 m)											
Station 406	Altitude 720 m							Latitude 28-36		Longitude 81-37		
Surkhet	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean min temp	3.6	6.7	10.1	15.8	20.0	22.6	22.7	22.6	20.9	15.6	8.6	4.0
Mean max temp	19.5	22.0	27.4	33.3	34.9	32.7	30.2	30.6	29.6	29.3	24.7	20.5
Daily mean temp	11.5	14.1	18.8	24.5	27.4	27.7	26.5	26.6	25.2	21.9	16.6	12.3
Av precipitation	47	37	32	33	50	287	589	577	320	75	3	14
Evapotranspiration	16	26	62	120	174	177	159	153	122	86	39	19
Humidity AM	95	89	68	46	47	71	88	90	89	86	89	95
Humidity PM	70	56	39	27	32	56	77	80	79	74	72	76
Max temp 40.1					Max 24-hr rain 187					Total annual precipitation 2,064		
Min temp -0.6					Min annual precipitation 900?					Total annual evapotranspiration 1,153		

? = Estimated value

Hill (valley) region (500 m to 2,500 m)

Station 803	Altitude 918 m				Latitude 28-14		Longitude 84-00					
Pokhara	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean min temp	7.8	9.1	13.6	17.4	19.3	21.2	22.0	21.8	20.7	16.6	11.8	8.5
Mean max temp	19.1	21.1	25.9	29.4	29.9	29.4	29.1	29.0	28.0	26.4	23.2	20.1
Daily mean temp	13.4	15.1	19.7	23.4	24.3	25.3	28.9	25.4	24.4	21.5	17.5	14.3
Av precipitation	29	28	58	89	251	646	870	831	563	187	16	9
Evapotranspiration	20	30	68	107	128	131	189	132	112	79	36	29
Humidity AM	75	67	57	54	64	82	87	87	84	73	71	73
Humidity PM	60	49	43	48	59	75	79	78	80	76	70	65

Max temp 35.3* Max 24-hr rain 205 Total annual precipitation 3,577
Min temp 2.6 Min annual precipitation 3,208 Total annual evapotranspiration 1,061

*The values of maximum and minimum temperatures and the maximum 24-hour rainfall are for station 804 at the nearby Pokhara airport.

Hill (slope) region (500 m to 2,500 m)

Station 809	Altitude 1,097 m				Latitude 28-00		Longitude 84-37					
Gorkha	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean min temp	7.6	9.3	13.8	17.6	19.0	20.0	20.1	19.8	18.9	15.9	11.6	8.5
Mean max temp	17.7	20.5	25.2	28.9	29.5	28.8	27.3	27.2	26.8	25.4	22.2	8.7
Daily mean temp	12.6	14.9	19.5	23.3	24.2	24.4	23.7	23.5	22.8	20.6	16.8	13.6
Av precipitation	86	14	34	68	130	316	429	379	210	65	14	5
Evapotranspiration	24	33	66	107	128	127	131	125	106	80	45	28
Humidity AM	74	65	55	54	69	87	93	94	92	84	75	75
Humidity PM	66	55	45	44	57	75	82	83	83	76	62	69

Max temp 36.0 Max 24-hr rain 116 Total annual precipitation 1,750
Min temp 0.9 Min annual precipitation 9007 Total annual evapotranspiration 1,000

? = Estimated value

Table A-1 (continued)

	Mountain region (2,500 m to 8,848 m)											
Station 601	Altitude 2,744 m					Latitude 28-47			Longitude 83-43			
Jomsom	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean min temp	-2.6	-1.2	1.5	4.3	7.2	12.5	13.8	13.4	11.1	4.7	1.1	-2.1
Mean max temp	11.5	12.7	16.0	19.7	23.0	24.7	25.0	24.4	23.1	19.0	15.5	15.0
Daily mean temp	4.5	5.8	8.8	12.0	15.1	18.6	19.4	18.9	17.1	11.9	8.2	5.5
Av precipitation	19	17	21	15	7	16	42	48	32	35	2	2
Evapotranspiration	12	16	33	51	75	99	109	102	89	49	25	16
Humidity AM	78	62	52	49	52	67	76	80	78	66	66	72
Humidity PM	58	59	57	57	55	66	70	70	67	70	65	58

Max temp 30.5 — Max. 24-hr rain 30? — Total annual precipitation 256
Min temp -10.0 — Min annual precipitation 50? — Total annual evapotranspiration 676

? = Estimated values

East to west change in precipitation

East ⟶ West

Tarai towns	Anarmani	Birat/N	Nijgadh	Bhairawa	Nepalganj	Dhangadhi
Longitude	87-59	87-17	85-10	83-26	81-34	80-36
Precipitation	2,242	1,896	2,075	1,673	1,238	1,612

Monthly precipitation and evapotranspiration as percent of annual total

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bhairawa	P	0.7	0.2	3.6	1.0	1.9	11.0	34.7	23.8	21.3	1.0	0.5	0.2
	T	3.4	4.7	10.4	15.5	15.0	9.5	9.3	9.1	7.6	6.2	5.9	3.3
Surkhet	P	2.3	1.8	1.6	1.6	2.4	13.9	28.5	28.0	15.5	3.6	0.1	0.7
	T	1.4	2.3	5.4	10.4	15.1	15.4	13.8	13.3	10.6	7.5	3.4	1.6
Pokhara	P	0.8	0.8	1.6	2.5	7.0	18.1	24.3	23.2	15.7	5.2	0.4	0.3
	T	1.9	2.8	6.4	10.1	12.1	12.3	17.8	12.4	10.6	7.4	3.4	2.7
Gorkha	P	4.9	0.8	1.9	3.9	7.4	18.1	24.5	21.7	12.0	3.7	0.8	0.3
	T	2.4	3.3	6.6	10.7	12.8	12.7	13.1	12.5	10.6	8.0	4.5	2.8
Jomsom	P	7.4	6.6	8.2	5.9	2.7	6.3	16.4	18.8	12.5	13.7	0.8	0.8
	T	1.8	2.4	4.9	7.5	11.1	14.6	16.1	15.1	13.2	7.2	3.7	2.4

P = Precipitation; T = evapotranspiration

Seasonal precipitation and evapotranspiration as percent of annual total

		Bhairawa	Surkhet	Pokhara	Gorkha	Jomsom
Precipitation	R	90.9	85.9	81.4	76.2	53.9
Evapotranspiration	R	35.6	53.0	53.2	48.9	59.0
Precipitation	W	2.6	8.5	7.5	10.5	29.3
Evapotranspiration	W	23.6	16.1	18.3	21.0	17.5
Precipitation	D	6.5	5.6	11.1	13.3	16.8
Evapotranspiration	D	40.9	30.9	28.6	30.1	23.5

Sources: Climatological data are from DIHM publications (various years); evapotranspiration figures are as computed in LRMP (1984).

R = rainy season (Jun-Sept) W = winter (Oct-Feb) D = dry season (Mar-May)

Table A-2. Observed hydrological data of the rivers of Nepal at the lowest downstream gauging stations (in m^3/sec)

Station 280, Karnali at Chisapani — Drainage area 42,890 km^2

(No. of upstream stations: 4) — Years of record: 1962-77

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	355	345	351	443	653	1,873	2,965	4,176	2,853	1,233	686	459
Monthly maximum	495	471	498	612	967	3,053	4,118	5,706	3,993	2,802	899	559
Monthly minimum	280	241	233	286	387	820	2,003	2,481	1,653	718	466	346

Maximum instantaneous peak discharge = 19,890 (1975)
Maximum one-day flood volume = 15,700 (1971)
Minimum one-day low flow = 214 (1967)
Mean average annual discharge = 1,337

Average annual discharge of upstream tributaries:
Bheri (Stn. 270) - 450 Seti (Stn. 260) - 312 Karnali (Stn. 250) - 608

Station 290, Babai at Bargadaha — Drainage area 3,000 km^2

(No. of upstream stations: 0) — Years of record: 1967-74

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	19	15	12	11	15	62	179	222	201	88	33	21
Monthly maximum	33	25	18	37	64	167	392	413	461	192	58	30
Monthly minimum	10	10	7	5	5	13	89	92	124	40	22	12

Maximum instantaneous peak discharge = 3,875 (1969)
Maximum one-day flood volume = 3,100 (1970)
Minimum one-day low flow = 4 (1967)
Mean average annual discharge = 74

Average annual discharge of upstream tributaries: ?

Station 360, West Rapti at Jalkundi — Drainage area 5,150 km²

(No. of upstream stations: 1) — Years of record: 1964-74

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	30	23	20	16	12	102	252	356	261	147	62	33
Monthly maximum	44	32	32	47	41	354	384	529	505	496	123	47
Monthly minimum	20	15	14	9	3	23	137	150	148	21	30	24

Maximum instantaneous peak discharge = 4,228 (1974)
Maximum one-day flood volume = 2,500 (1969)
Minimum one-day low flow = 1 (1968)
Mean average annual discharge = 110

Average annual discharge of upstream tributaries: Mari Khola (Stn. 330) - 64 Jhimruk - ?

Station 450, Sapt Gandaki at Narainghat — Drainage area 31,100 km²

(No. of upstream stations: 8) — Years of record: 1963-70

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	412	321	285	368	565	1,596	3,813	4,638	3,412	1,822	896	565
Monthly maximum	501	396	372	470	699	2,396	5,055	5,602	4,983	3,453	1,073	820
Monthly minimum	257	199	189	226	334	1,107	3,055	4,059	2,744	1,264	631	357

Maximum instantaneous peak discharge = 10,160 (1968)
Maximum one-day flood volume = 8,820 (1968)
Minimum one-day low flow = 190 (1966)
Mean average annual discharge = 1,568

Average annual discharge of upstream tributaries:

Andhi Khola (Stn. 415)	- 33	Kali Gandaki (Stn. 420)	- 494	East Seti (Stn. 430)	- 52
Marsyangdi (Stn. 439.9)	- 207	Budhi Gandaki (Stn. 445)	- 156	Trisuli (Stn. 447)	- 175
Madi	- ?	Daraundi	- ?		

(The East Rapti river meets the Sapt Gandaki (Narayani) below Narainghat. It has 4 hydrometric stations, the average annual discharge at Stn. 460 being 31. It also receives the regulated flows of Kulekhani Khola diverted from the Bagmati basin.)

Table A-2 (continued)

Station 550, Bagmati at Chobhar — Drainage area 585 km^2

(No. of upstream stations: 4) — Years of record: 1963-77

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	2	2	2	2	2	15	44	53	37	16	7	4
Monthly maximum	4	3	4	6	6	73	95	80	92	39	10	5
Monthly minimum	1	1	1	0.3	1	1	16	34	18	8	4	2

Maximum instantaneous peak discharge = 876 (1972)
Maximum one-day flood volume = 398 (1975)
Minimum one-day low flow = 0.02 (1964)
Mean average annual discharge = 16

Average annual discharge of upstream tributaries: Nakhu Khola (Stn. 540) - 1.1
Average annual discharge of downstream tributaries: Kulekhani (Stn. 570) - 4 Thado Khola (Stn. 560) - 0.8

Station 695, Sapt Kosi at Barakshetra — Drainage area 81,152 km^2 (of this 60% in Tibet)

(No. of upstream stations: 11) — Years of record: 1947-78

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	400	364	362	418	716	1,976	4,056	4,729	3,389	1,740	856	530
Monthly maximum	483	618	759	586	1,146	3,994	6,770	6,982	4,807	3,290	1,683	656
Monthly minimum	337	266	274	310	536	932	2,412	2,744	2,458	889	613	486

Maximum instantaneous peak discharge = 25,853 (1968)
Maximum one-day flood volume = ?
Minimum one-day low flow = ?
Mean average annual discharge = 1,638

Average annual discharge of upstream tributaries:
Sun Kosi (Stn. 680) - 710 Tamur (Stn. 690) - 332 Arun - ?

Besides these readings from functioning hydrometrical stations in Nepal, there are various estimates of annual runoff of other important rivers:

Mahakali - 662 (WECS 1982), 665 (C.K. Sharma 1983), 557 (Shanker 1985)
Kamala - 75 (Shanker 1985), 60 (C.K. Sharma 1983) Kankai - 73 (Shanker 1985), 79 (C.K. Sharma 1983)
Other (Tarai) rivers - 5.9 (C.K. Sharma 1983), 578 (Shanker 1985)

Similarly, Sharma estimates that the total runoff is 6,048, whereas Shanker estimates 6,396 (4,877 from basins in Nepal only).

Sources: WECS (1982); LRMP (1984).

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