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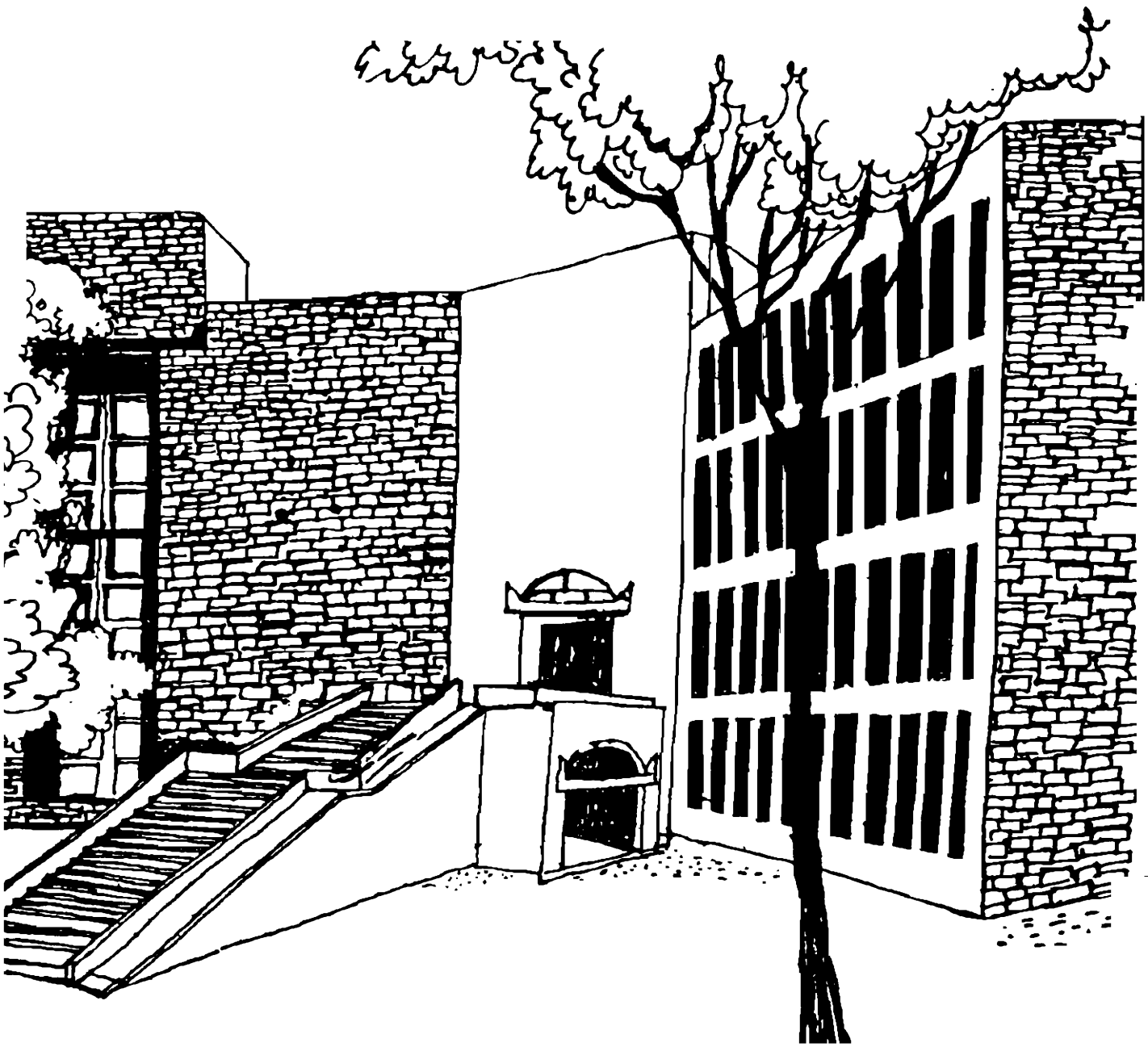

BLENDING CULTURAL VALUES, INDIGENOUS TECHNOLOGY AND ENVIRONMENT: THE EXPERIENCE OF BHUTAN

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Abstract

How did an extremely less developed, isolated mountain country succeed in keeping its 64 per cent of the area under forest? How did it succeed in avoiding any case of widespread deprivation and keep ecological balance in a fairly sustainable manner? What problems are it facing in its anxiety to keep its cultural core intact and at the same time improve the level of living of its people. This paper deals with the experience of Bhutan, a tiny land locked Himalayan country which has evolved common property and other collective institutions for resource management.

Buddhist ethics plays an important role in blending culture with technology. The paper is divided into seven parts.

Part I deals with the culture of conservation and Buddhist ethics. Part II includes a discussion on the framework of institutional emergence in mountain societies. Rules and principles have to be distinguished while dealing with boundaries of [illegible] and ethical responsibilities towards environment. Examples of specific institutions for managing water, grazing land, forest and labour contribution for public and common goods are provided in Part III. The institutional innovations are related to technological innovations. Culture of this innovative ethic is reviewed in Part IV. Specific examples based on water stream driven prayer wheel, architecture and education, alignment of irrigation channel, movement of livestock, prevention of diffusion of animal diseases, generation of cropping system and management of shifting cultivation are covered in this part. Part V includes issues that are emerging in the process of technological transfer given the above context.

What are the major risks and how are they perceived by the people is discussed in Part VI. the role played by collective institutions, moral responsibilities and non-monetised reciprocities is particularly highlighted. The policy implication for sustainable development of mountains are listed in Part VII.

We believe that bureaucratic or market institutions have failed to conserve natural resources anywhere in the world. The Western concept on of resource conservation through complete closure are neither scientifically or socio-ecologically sustainable. The principles of maintaining socio-ecological diversity and complexity through innovative institutions are available in the, framework of Buddhist ethics. The rules which can guide the behaviour of individuals and groups have to be developed in the changing technological and politico-economic environment. Bhutan's experience can be helpful even for the developed countries.

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Blending Cultural Values, Indigenous Technology and Environment : The Experience of Bhutan

Anil K Gupta and Karma Ura *1

A drop of water :

A Zen master known as Gisan asked a young student to bring a pale of water to cool his bath.

The student brought the water and, after cooling the bath, threw on the ground the little that was left over.

"you dunce!" the master scolded him. "Why didn't you give the rest of water to the plants ? What right have you to waste even a drop of water in this temple ?"

The young student attained zen in that instant. He changed his name to Tekeisui, which means a drop of water.

('Zen Flesh, Zen Bones')[1]

Context

Why do formal development models tend to 'destroy the only cultures that have proved able to thrive in these (isolated and harsh) environments'.[2] The question raised in the recent report of World Commission on Environment and Development has been asked in Bhutan ever since the programmed efforts to reduce isolation started few decades ago. Blending indigenous technology evolved in the crucible of culture and local environment with alien concepts, techniques and tools requires adapting institutions as well. The relationship between natural re-

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sources and the people have been forged within moral, cultural, politico-economic and ecological boundaries. Respect for these boundaries by different communities and social groups was ensured historically through a set of formal and informal rules and norms. It is obvious that not the same rules will help regulate human 'needs' and 'wants' in characteristically different economic and institutional environment, Experience of Bhutan offers lessons for late 'starters and early 'stoppers' in the game of sustainable development. The creative conflicts in the policy choices are sought to be resolved in the light of Buddhist ethics and values.

The new institutional arrangements sometime mirror these values but occasionally fail to do so. The choice of technology and definition of sustainability are [illegible] then in a typical way of a Zen story - a simple and subtle beginning and an enigmatic ending, leaving enough scope and opportunity for multiple interpretations. Basic belief is that there is no need to rush through the so called transformative (and modernising) modes of development. The regenerative, inter-dependent and eco-adaptive alternatives must have precedence. But these alternatives do not always have precedence and the problems coming in the way are resolved experimentally, intuitively and at time through debates in the national assembly and local levels.

Part -one
Culture of Conservation - Buddhist Ethics

There is, in general, a great disdain in Bhutan towards taking animal life to gratify one's tastes. Buddhist culture requires its followers to recognize that the animals have capacity to suffer and that one could not differentiate between human and non-human species as far as suffering goes. It is a philosophically refined culture, which in principle, rejects speciesism, i.e. putting the status of human beings above that of other animals. Any erosion of this principle leads directly to exploitation of the animals in our interest. Given that taking life for food is considered morally repugnant, the society has a tendency to hold those producers who directly raise beef and pork in less esteem. In modern Bhutan, meat industry is by and large, spiritually inhibited by this principle of not taking life. Though there are signs that such spiritualism is yielding to commercial considerations.

Eating meat, vital for survival amidst harsh climate, poor soil and very limited scope of agriculture produced guilt. Giving back to nature in some form what has been taken away was thus institutionalized as a compensatory or purifying ethic. The concept of accumulating virtues (be it by going in for retreat - withdrawal from material world to monasteries for a few years or by contributing land, labour or wealth for common good) perhaps, provided a ethic counteracting or counterbalancing the compulsions to kill some animals.

There are various other strands in the national culture that allow some degree of culling. The semi-nomadic yak herders (the brockpas) do not frown upon culling a few male yaks in a year.For yak's meat and dairy goods are the only basis of exchange with the cultivators .And piggery is accepted part of subsistence animal husbandry. There is also often a gulf between the ideals of the religion and the pragmatism of daily life. In what is perhaps a device to have the cake and eat it, too, non-vegetarianism is not a taboo but slaughtering animals is. But it can be argued that the interaction of the demand and supply of meat unites the butcher and the consumer into one single moral persona. Their economic and moral existences appear interwoven.

The farmers in Paro valley used to enter into contracts with pastoralists of Ha- a hilly district -to exchange paddy with cheese, butter, ropes etc. The ecological context provided basis for economic exchanges across space and time. The interdependence thus between not only butcher and consumer but also between cultivators and pastoralists , monks and ordinary people etc., constituted several layers of consciousness or boundary of multiple roles underlying conservation ethic. The retreat into monasteries could regenerate individual consciousness. Leaving lands fallow under swidden cultivation systems allowed regeneration of natural system. Both the system required social sanctions and faith in natural and spiritual order.

The principle of respecting life in all forms extends to wildlife. Protecting the natural environment, in which wildlife occurs, is the reverse side of the same coin. The Bhutanese have seldom been keen on trapping, hunting and shooting animals and gamebirds. Wildlife has never been regarded as a sport. No trophies of prize catches adore walls of private or public mansions. These conservationist attitudes were, in an Asokan move, legally formalized and reinforced by restrictions on hunting and killing wild animals. One may kill a wild animal if it poses threat to life and property and if the fact that it is threat to life and property can be proved. Even this narrow latitude in the rules is not often fully utilized with the prevailing aversion to killing. Farmers have sleepless nights guarding their crops by making noises against such pests as wild boars, deer and bears, but they would rarely do something to terminate them.

But when farmers do attack wild animals causing repeated damage to crops they are in trouble .If animal don't die on the field but run away into forest, the concerned farmer faces penalty. International advisors have suggested that people inform the forest departments in advance of shooting when that became

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necessary . The faith that administrative policing would provide more enduring safety for wild life than a voluntary conservation ethic is perhaps misplaced. The issue of protecting habitats of wildlife to total exclusion of human beings has been debated. IUCN shares the belief that 'even the ecosystem which

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at some point in the past. Exclusion of "human influence from 'natural' ecosystem, as in the strictly protected national parks, can lead to situation that has not occurred for thousands of years" and it is feared, might, "have unknown ecological implication; the devastating fires that hit yellow stone National Park in 1988 are dramatic example of what can happen when nature is allowed to take her own course without human intervention" (McNeely 1989). Buddhist ethics of cohabitation and peaceful coexistence might thus need reinterpretations and reassertion in the light of international advice for wildlife protection parks exclusive of any human interface. Retribution for greed and reward for restraint are inherent in a genuinely conservation ethic. IUCN studies show that this ethic may even be superior on scientific grounds.

The Bhutanese have been conscious their green heritage and its distinctiveness compared to, say ,Tibet for a very long time.

Epithets such as 'the southern land of medicinal herbs' and 'the land of cuppresses' characterised this distinction. Both Buddhist and pre-Buddhist (bon and animism) beliefs promoted a cautious attitude to environment. They believed that there were spirits inhabiting "three parts of the world - the sky, atmosphere and

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the earth "(Vigoda ,1988) . The mountains, rivers, lakes, streams, forest, rocks and soil were believed to be the domains of the different spirits. Pollution and disturbance to these sites were believed to be the cause of deaths and diseases.

It might be surmised that nature conservation was part of the traditional Bhutanese culture. Religious basis of traditional life bred in the people a respect for life in all its forms and their ecological niches. The constant interaction of the people with natural environment would have naturally sharpened their intuitive insight into eco-adaptive resource use strategies.

Part-two

Rules ,Principles and Culture
Framework for institutional emergence in mountain regions

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Jodha (1989) while outlining the mountain perspective has highlighted two important interlinkages among mountain specificities, (a) commonality of causative factor and (b) shared consequence of disturbance to each other. In the first case, it is suggested that the "degrees of diversity, fragility, marginality, human adaptation and in accessibility are, in different measures, directly linked to factor like elevation, slope angle, slope orientation and exposures" besides the climatic factors. The second interlinkage is the 'externality' imposed by disturbance in one subsystem over rate and extent of regeneration of other sub systems.

The relationship between objective ecological conditions and subjective human perception and response is mediated by the cultural and institutional memory of society .Which consequences of disturbances are considered externality is in fact the outcome of cultural consciousness. The boundary of responsibility towards the shared consequences we could argue, is one of the important outcomes of historical institutional development. Once the state and its authority supersedes the authority of religion, village or community institutions, the conflicts between historically desired perception of this boundary and the legally, administratively or politically legislated limits of these boundaries, are bound to arise.

How these conflicts are resolved can be studied only after the relationship between culture, institutions, technology and ecology is properly appreciated.

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Socio-ecological perspective makes two assumptions, (a) ecological conditions define the range of economic enterprises managed by different classes of households and (b) the scale and mix (or portfolio) is determined by the access to factor and product markets , non-monetised kinship and other exchange networks; public, private or communal risk adjustment strategies ;the perception of and response to various environmental and social risks .The stakes different classes have in environmental preservation thus are modified by the surplus , subsistence or deficit condition of the household budget on one hand and by the institutional context on the other.

Once beliefs about what is considered 'natural' or even 'spiritual' are shared widely, the cultural codes get institutionalised .Thus certain conflicts about choice of technology or scale or mix of resource use do not arise because duality between cause and effect is resolved through oneness with the phenomenon.Thus if the share of birds in the crops is considered as justified as men's own , historical selection of varieties with loose set grains easy for birds to pick can be understood.

In other cases technological and institutional innovations help

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generate rules and principles cemented through social sanctions, individual repentance and some time accidental (but believed to be mythical or godly) dispensation of justice or retributions.

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Rules do not have to be devised always . They could arise in atleast in certain cases, through perhaps the logic of circumstances. Khalil cites the cases of traffic rules. If there were no rules, the result might not be a chaos. Any one who has seen huge congregation around religious centres or festive occasions would have noticed how crowd could arrive at an order after some time spent in adjustment. It is suggested, "(the) pedestrians or cars interact for no purpose (when they move on a rule less road); rules arise because they are in each others'

way"[11].

The principles are supposed to specify purpose. The destination of pedestrians is determined by the purpose .The possibility of reaching a given destination may of course depend upon the evolution and observance of rules. The grammar, syntax, vocabulary and style facilitate communication. It is the idea, will and a need for relationship between sender and receiver that constitutes communication. Buddhist Ethics, is "an ideology with a set of principles dressed up as rules". The ideology could spell out the limits or boundaries of communal or individual rights irrespective, as Khalil says, of the substantive principle at hand. A scheme of rationalization is considered necessary for achieving this. The scientific theories may serve such a purpose in modern times. It is argued that religious mythology served these needs in pre-modern time. We however, believe that even in current context, proper bridges between so called scientific theories (generalizable,consistent and verifiable) and a set of historical beliefs or cultural codes (be of religions or mythological origin) are necessary.

The restraint on individual wants and acceptance of social and ecological limits in deference to the claims of next generation may become difficult to institutionalize through only so called rational rules.

A snake house in a cultivator's field was almost a common sight in many villages in Bhutan. The owner of land would offer milk on certain days in these houses. The rats could be kept in check by snakes and in the process a sustainable exchange could be strengthened .Many of the e houses have started breaking down though the problem of rats remains.

The long time frame in which returns should be appraised and the multiplicity of vectors on which utility is assessed become acceptable, perhaps through what Jodha calls, the limits or potential of shared consequences or externality.

The public choice theorists often equate principles with rules and emphasize a narrow definition of justice i.e. procedural fairness[12]. Their contention is that "as long as the rules of the game are fair, one should not manipulate the outcomes. Distribution of income, for instance is one of those outcomes which the state should not temper with (Khalil 1989: 51)[13]. The substantive principles like primacy of equality over an unequal system or of collective rights over the need for an individual autonomy can't be resolved mathematically. Under what circumstances state should circumscribe individual rights and autonomy would thus be resolved politically and not 'scientifically'.

The legitimacy of such restrictions o individual needs/wants, our contention is, may spring from respect for ecological principles and the cultural basis of generating an socio-ecological ethic .It justifies primacy of these principles over certain other rules dealing with individual preference of life styles.

other rules dealing with individual preference of life styles.

Thus an affluent person could not justify violation of certain rules regarding clearance of area near roads for establishing apple orchards or killing animals or cutting trees as long as he/she could pay the necessary taxes or penalties. Such a procedurally just system we submit, may violate the subsbstantive principles that sustainable development in a high risk mountainous requires priority to (a) rights of community or individual, (b) non-consumptive over consumptive use (c) consistent consumption below maximum sustainable yield MSY (also
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called as 'inte nal bioethics over upto MSY and (d) slow steady growth rate with homeostatic advantage over high, volatile and unstable growth rate of resource use.

The mountain societies have evolved unique ways of moutaining social amity amidst conflicting resource demands and experiences. In Mera Sakte (located at about 11000' height) there is a particular specie called as 'Embarrassment Tree'. Everybody comes and hangs their embarrassment over tree. People play jokes even those which in normal course are not acceptable - and curse each other or makes from - go back in the evening. Catharsis at the community level has been known as age old institution for settling emotive books of accounts in the short run so that moral book of accounts could be settled in long terms.

Cultural norms can help in counteracting some of the 'rational' (in short term), but non sustainable resource use strategies. A pastoral group can evolve norm of spending most time on patch-
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es with highest rate of return ; or can evolve norms of mobility even if resource supply did not warrant it. . It could be guided by the need to avoid intermixing of yak herd with cattle herd (as we shall see later) to avoid disease transfer. In some cases, hunting tribes have used a randomization rule to overcome the tendency to hunt where the maximum game is likely to be
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found . Assume that there is a water point where animals come at a particular time in the day. 'Rational' strategy might imply hunting the animals when they come there. Some tribes use different ways of deciding the direction in which to go for hunting by circulating a stone tied to sling of rope and ,then throwing it. In which ever direction the stone went became the direction for that day's expedition.

Such norms require that group should consider no catch or game some day with lots of catch on other days with equanimity.It is also expected that norms of sharing will emerge to take care of the bad days.

Centralized exchange network sometimes could compensate for
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geographic diversity . In a study of Torbel, a small mountain village in Switzerland, the adaptions of the community to diversity of resources and uncertainties of environment has been explained through expansive, intensive and regulation process
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. Building irrigation channels though inter-village coordination was the expansionary strategy .Fertilization of meadows,

repair or modification of irrigation channels and recovery of washed away soils were described as the intensification process. Regulation referred to the exclusion of outsiders from the citizenship of the village, limiting number of grazing stock, limiting of wood cutting and democratic means to centralization of power.[19]

Mixing fluctuating scarcities with geographic diversities and resource concentration could lead to complex social structures among three groups of people in Zagros mountains of Pakistan viz. Pathan farmers, Kohistani farmers and Gujar Herders. The farmers using rich soil and water resources exchanged goods with the herders who exploited dispersed grasslands. Two of the groups shared a resource. Gujar herders utilized Kohistani pastures in the winters when the latter fed their cattle from resources[20]. Mutual dependence among cultivation and herders in some cases could be mediated by state control as in the middle east[21]. The segmented, polycentric, integrated network on the other hand concede the autonomy of different sub groups, diversity of their goals and multiplicity of leadership or potential for leadership[22]. Gerlach and Palmer (1981 : 350) suggest several possible ways in which strategies of environmental adaptation could be classified[23] :

(a) Diversity as compared to uniformity of resources could dealt with through alternating structures, specialization segments and exchange through networks;

(b) Concentration of resources generated consolidation of consuming or defending segment, cooperation in network and expansion of resource use.

(c) Scarcity of resource could be responded through competitive expansion of resource use and elimination of outsiders; of structures, diversification of resource itself, increasing efficiency of resource use, specialization of segments and regulation of resource use.

(d) Fluctuation required alternating structures, maintenance of the same, establishment of redundant resources, networking and surveillance of resources, randomization of risks, storage of resource and decentralization.

Bhutanese experience not only illustrates use of several of these strategies but also expands the framework of adaptation through interdependence. Just like Japanese villagers, Bhutanese may not rely entirely on socialization as a means of ensuring behaviour that avoids the tragedy of the common[24]. They do not rely just on material incentives or disincentives. There is no assumption made about isomrphism between 'religious reformulation and practical experimentation' (Brightman, 1987:137); and long standing contradiction between 'sign' and 'interest' values provide impetus for continued experimentation about relevant rules and principles for changing resource endowment.

The 'sign' values are semiotically determined through social sharing and reciprocity of meaning. The 'interest', value signifies the position of valuated object in relation to purposive activity'[25]. The red rice may be grown because these required less water and also served symbolic purpose for certain religious offerings. Once foreign demand for this rice converts it into a highly prized commodity, the interest value might supersede momentarily the sign value. After advent of Buddhism, animal sacrifices were substituted by symbolic rituals requiring animal forms made of flour or other eatables .

Maintenance of law and order in olden times was achieved through reflection on a total of 26 deeds - 10 fruitful good deeds and 16 livelihood deeds. Every family considered it a privilege to have a lama from one's family. Bands between religious (the others worldly life) and day-to-day life were forged through unresolved contradictions between ideals and programmatic imperatives of survival. The doctrine of omission or passive indifference thus permitted acquiescence in killing of animals through others and eating of meat. But other features of Buddhist logic required compensatory measures to appease nature gods so that one set of compromises were perhaps offsetted (now or in next life) by another set of good deeds. Calculus of survival imposed need for conservation as intensely as perhaps it provided practical way out of the contradictions.

Conservation ethic has been often defined inadequately leading to inappropriate design of reinforcement mechanisms. Brightman (1987: 135) refers to reemergence of conservation ethic after various religious symbols, signs and restraints fail to check resource depletion. It is observed that the game shortage was dealt with not by controlling invaders, nor by 'developing' conservation ethic but by moving out.

The error here seems to be that 'moving out' is not considered a part of conservation ethic.

Cyclical nature of natural forces and their interaction is an important basis of eastern philosophy. The search for existence; absence; dormancy or activation of different rules will suffer if this dimension of resource management institutions was missed. Not all rules can be invoked at all times for all types of resources.

There are 'episodic' institution as different from 'concurrent institution. The episodic institution may come an surface only under certain critical circumstances. Certain principles may be transformed into rules, if the purpose has been served. Such rules may not be easily recalled by people unless the relevant idiom and critical context is recalled (see Maitreyi 1990). In any case, these rules may also mutate as the changes in the supply of resources or availability of technology take place.

formulation of rules and associated social organization has taken place in Bhutan differently in various resource situations. The spatial, seasonal, sectoral and social variabilities in different resource regimes illustrate how the pressures of contemporary social values are fusion with or contradicting the traditional norms and institutions.

Part -three

Institutional context for Resource Management :Water, land, labour, livestock, forest

Notwithstanding the efforts of some scientists to divide mountainous regions into different agro-ecological zones, we feel that ecological variability within a valley or slope is so high that any broad centralisation on this basis will be meaningless. Micro-ecological niches have to be considered an inalienable feature of any mountainous region. The correspondence between these niche characteristics and the norms of institutional governance of resource use is complex. It would be difficult to predict or suggest with the available knowledge of those institutions, how rules would vary in different niches.

But available evidence does indicate that study of this relationship could be quite rewarding for designing experiments for sustainable mountain development.

(a) **Water Management:**

Availability of water streams seems to have been one of the main basis for settlements to have come about in past. There are instances where once the stream dried or got diverted due to some landslide or other factor, the people abandoned the settlements. Such ruins could still be seen.

Need for managing water whether at local, dispersed level or at centralised concentrated level has been considered as one of the major prime movers for societal evolution [26].

Emergence of leaders for organizing social groups for cooperative use of a resource was one consequence of water based technological change. Synchronization of farming needs due to a given terrain and climate imperatives was another .

Depending upon scarcity or sufficiency of water, the cooperation in following certain rules for harnessing and maintaining water management structures like channels became critical. There are instances where villagers have brought water from stream located even 25-30 kilometers away from a particular settlement The rules for maintaining water channels and distributing water may vary some time within a valley at short distance due to micro-

environmental variation in nature of resource, availability of labour or just the difference in power structure of respective social groups. Rules have emerged for following operations:

- desilting canals before farming season;
- repair of minor breech or major dislocation due to landslides or disturbance by wield animals;
- distribution of water over space, seasons, crops and for varying durations;
- waste disposal in streams/rivers;
- Transportation of wooden logs in rivers/streams; etc.

Institutional arrangements for different function have varied in different places. Each household may supply equal labour (one or two persons per household) for annual maintenance function .Or the contribution of labour may be in proportion to the land holding in command and distance of the fields from the canal outlet.

Basis of water sharing identified after a study of 21 farmer managed irrigation systems in Nepal were [27] :

- Allocation on the basis of original investment or shares purchased ; water is sold or purchased independent of ownership of land. Transaction have to be registered with the irrigation committee. Obligation to contribute resources towards maintenance of channel determined on the basis of size of the share;

- Number of hours water received is proportional to the investment made;

- Allocation of water on the basis of land area in the command; size of the notch in the proportioning weir servicing each field or set of them , fixed according to the size of command;

Watersharing

- Water sharing on the basis of labour contributed for maintenance by a village or household

- Distribution on the basis of type of land

- Distribution on demand in systems where water is not scarce.

In Bhutan, several more innovative institutional arrangements have been noticed. In a village with very limited water, the need for providing standing water in different paddy fields almost at the same time, was met by an imaginative use of the rule of randomization. The conflicts were anticipated due to synchronicity of demand. The farmers took as many sticks as the claimants. After writing or etching serial number on each stick, they were shuffled and held in hand. Each person was asked to pick one. Lottery system so determined the sequence.

other cases it could be less or more. The cycle is repeated in the same sequence. There are also situations where the sequences are written into contracts so that people know with certainty when their turn was due. Pooling or exchange of labour, bullocks, implements also was facilitated through known sequence.

In another village, the elders met and decided the sequence, duration, labour supply for maintenance and protection. One person was elected to monitor the distribution. Size of the hole in the weir varied depending upon the allocation. The new settlers were generally given the last turn.

Conflicts did arise once in a while. The defaulters could be asked to (a) give some gift to the person/s who suffered; and (b) miss their turn in favour of the aggrieved parties. If the offense was repeated, the village people would go and destroy the contour bunds bunds in the paddy field of the offender by trampling.

In other case, the supervisory duty was assigned to different people all along the canal length. Each person had to complete his turn and put a flag signifying completion of his task . The next person began from where the earlier one left.

Conflicts also arose on terracing of new fields in the command of old channels.

The punishments for laxity in monitoring could be as severe as the offense of stealing the water itself. In general, people reported that the collective institution of water sharing and canal maintenance was respected. Whenever a conflict went to court or to the higher level officials, the attempt was first made to persuade people to arrive at a solution among themselves. Even though they may have already tried once or twice to do so. But the arbitration was avoided till it became inevitable. There were of course areas where these traditional institutions were coming under strain.

There were instances where a local person was attached as an apprentice with the fitter while an irrigation system was being laid out. Idea was that this person should keep the people in repairing the structures whenever need arose.

(b) Grazing land Management

The role of livestock in hill farming system has been recognized as very crucial for sustainable resource management (Harwood 1979 ; Richards ,1985). While cultivation dominates between 7-10000, livestock is the major means of livelihood between 10-14000' and 14-17000'.

In the first zone, Bajoe breed of Tibetan origin is found besides Thabam freed (a cross of Siri and local breeds); Siri breed (long distance migration breed), and Mithuns .Second zone

is the intermediate area between Cattle and Yak regions with primarily buck wheat as soil regenerative crop. In the third high altitude zone, Yaks dominate the livelihood of semi-nomadic pastoralists. Zo- a cross between cow and yak is used as a draft animal in some places.

Property Rights

Several factors influence evolution of property rights which have a bearing on choice of technology and environmental stability (Gupta ,1985,1986). Because of the widespread prevalence of livestock in rural Bhutan, a large number of institutions have evolved around animal management. Trespassing of cultivated lands by animals and the vulnerability of crops to livestock is a negative part in n otherwise complementary interaction between crops and livestock. Animals have to be confined, tethered, or kept a close watch , if the farmers do not fence their land. Fencing of the land is an extremely capital intensive and full time tending the animals is labour intensive. Neither of these options are economically attractive options for small rural farmers of Bhutan.

The problem created by stray animals in the cultivated fields is very serious and a social institution called as 'Nguliawa' has developed in Bumtang to deal with it . Two or three households are elected every year as "crop police" whose function is to monitor the movements of livestock straying into crops. The "crop police" rounds up the animals caught in a field and maintains a register of estimated damage which would be compensated by the owner of the animal to the crop-owner. A part of the fines levied on the owner of the animal accrues to the "crop police" as his service charge and the remainder is paid to the injured party. The revenue from service charge increases according to the number of "catch" and the amount of fine imposed. Household which rounds up the stray animals gets a share of the fine money . Revenue for the service charges increases as the frequency of the catch increases .This feature gives incentive to the "crop police" to maximise his catch. The accounts of claims of one farmer against another and counter claims are are often settled at the end of the year.Effectiveness of this institution depends upon the visibility of the valley .

Gathering of leaves from a common grove for composting with animal manure or for bedding of animal is a regular activity. Here again individuals can not strip the forage in a unilateral race. Forage is collected from common grove only on a publicly declared day so that all community members get their fair shares.

Institutions evolve when the conflicts in resource use are inherent in the nature of demand and supply situation and there are considerable externalities involved . In general we have found some evidence for such institutions to arise more often than not in higher risk environment. The case of 'Auran' land -lands left for gods and goddesses in Rajasthan - is a good example . While aurans did exist in other places but they were

being till maintained in more arid parts of the region [28].

At higher altitudes, there is hardly any problem of carnivorous animals and thus not much need for protection. But at lower altitudes, it was a serious problem.

Case of 'episodic' institution was cited by a administrator. There was an epidemic in 1940s which disabled people during the planting season. The livestock was also adversely affected. To avoid infections, elaborate arrangements were made for transporting food and other provisions. There were kept at pre appointed places from where the outsiders withdrew. The infected people then came and collected the supplies.

Boundaries of grazing territories of different villages and individuals in them were demarcated by cliffs, rivers or stream. A village could lie within the domain of grazing right of another (even non resident) individual. However, the villagers could object if the grazing rights were leased out to outsiders without consulting the villagers.

The herders moving through territories of different villages lying on a migration route needed permission for passages as well as stoppage for varying durations. If the fields are sown with crop, the herders have to send advance intimation to the villagers so that the latter could organize protection. The damages have to be paid for any loss of the crop.

Traditionally, the yak would migrate downwards and cattle upwards on second day of the Bhutanese 4th month. The yak herd must leave about a month before cattle come up. This serves two purposes, (a) the grasses can regenerate and (b) the possibility of certain diseases being transferred from cattle to yak are minimised. Flowering of 'Tseb' flower was also used as a signal for movement of yak back from lower to higher altitude [29].

A survey done in 1984 in Bumtang revealed a very inter woven arrangement for linking pastoral movement with trade relations along with route. Majority of the cattle owners did not own any pastures. Composition of cattle herd was quite different in various regions. Majority of the migratory cattle in Tang were male whereas in Usa were female. Perhaps, because the markets for milk products was more attractive in south than in the North.

Trade and Migration

The barter term of trade were quite different in various regions. For instance in Bumtang, one could get about 11.3 kg. of rice; 34 kg of wheat and about 68 kg. of buck what in lieu of 1 kg. butter.

In Wangudi, one got only 6 kg. of rice in exchange of 1 kg. of butter in 1988. The exchange of meat, rope, barley etc., with rice or butter also varies. In a village near Thimphu, one could

get 17 kg. of barley in exchange of 15 feet rope length made up of yak hair. Six years ago, one could get the same length of rope for half the quantity of barley [30].

Trade and potential and intensity of resource use along migratory routes in different seasons have not been adequately studied. The scope for using market instruments for encouraging sustainable resource use can be identified only if such barter markets are studied together with money exchanges.

There are private grazing rights in the name of individuals. One person say from Bumtang could have such rights in 14 different places towards East and South Bhutan. These rights do not imply any right over trees, rocks, or soil etc.

People living in the villages having the pasture rights of northerners could request the owners for permission to use these resources in exchange of gifts or small fee.

Conflicts around grazing rights have been frequently arising in different places. Some of the most celebrated court cases with the conflict around pasture/grazing rights.

In Pemagatsel, an objection was raised about extended stay of migrants in border areas. The rule was devised by the district council that the migrants could stay for only 11 days. Longer stay than that would invite punishment upto three months of imprisonment.

Fencing by government forest department was also not being accepted easily by the people. In some cases, the level of degradation was intense and livestock was considered the major culprit. The farmers living in the valleys or lower slopes felt that fencing would obstruct water sources and repair of stream channels. Social fencing which worked for so long was getting weaker in several places due to pressures of commercial economy and imbalances in public policies.

There are several reciprocal arrangements arrived by the visiting pastoralists and settled land and livestock owners. The herders would offer to use the grazing land and in return look after the livestock of grazing land owners.

Breeding

Breeding was another common purpose for which institutions had sprung up. In Sambhaka and Yababhog gewogs (blocks) in Gaylephug district, people do not allow to bring bulls of any other breed than Siri. Pure breed of Siri has been maintained here for a long time.

In Ha the local yak bulls are sterilised to avoid in breeding. The breeding bulls are well maintained and changed after a few years.

Disease Control

Disease control is another area for which village institutions have come up. In Bunakha, it was learned that a person was fined for having brought a diseased animal near the village before due time. In the process, some other animals got infected and died. This person was fined for having violated the norm

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of questionnaire and mobility schedules .

Foot and mouth disease has been a very serious source of mortality in cattle. In Komathanga village of Wagudi, a very careful arrangement had been worked out to prevent its diffusion. If the village cattle got infected with this disease, two outposts were set up outside the village in the direct s from where outsiders usually came. People fr n the vil. ook turn to man these posts. No cattle from outside was a lowed to enter the village lest it got also infected. E en the people visiting the village had to spend overnight at these checkposts before

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coming to the village . This was a case where an institution had emerged not to optimise returns to individ a or village. But to generate positive externality. It might be possib e that if everybody reciprocated such a gesture, the diffu n r disease would of course be much lesser.

In some villages rancid pork (2-5 years old) was L d a to cattle as well as used as an ointment. May be ted s a sort of vaccination.

Few of the large herds of cattle kept a male goat which was supposed to prevent a particular epidemic. Smell of goat was assumed to help in keeping the vectors of this disease away.

(c) Forest Institutions

There are several interactions positive and negative between forest, crop and livestock eco-system.

Rights and responsibilities towards forests among cultivators and pastoralists include :cleaning of Sokshing (community forest); collection of firewood (zashi) on a particular day; prevention and control of forest fires; sustainable management of Tsheri lands (shifting cultivation practices); prevention of intrusion of cattle herds into reserve forests; protection of wild life; trees (with prior permission) for domestic use; collection of shingles (flat thin pieces of wood cut for roofing) every few years to replace and repair the roof (the old shingles are piled in the field to be decomposed as manure or burned for preparing field for cultivating buck wheat); collection of leaves and pine needles for preparing bed for animal houses for eventual conversion into manure etc.

We provide only a few instances of institutional evolution or decline to suggest lines of future enquiries.

Forest Fires

It was noted in National Assembly a few years ago that large-

scale outbreaks of fires had become frequent of late. Forest guards appointed for the purpose were found inadequate. Suggestion was made that a person from the village be appointed as fire watcher to work under the village head. The fire watcher would not be obliged to contribute compulsory labour. The person found responsible for the fire was to be imprisoned for three years. If the villagers could not locate the culprit or did not help in extinguishing the fire, they could be penalised.

There is no doubt about the damage fire caused to the forests whether it was done to clear it for growing apple orchard or to grow crops. However, the doubt has been expressed about the potential damage since 1860s whether the firing was not practiced in forests primarily suitable for grazing.

H. Cleghhorn in a Report Upon the Forests of the Punjab and the Western Himalaya in 1862 observed,

> "With regard to the conflagrations which are universally described as being so destructive, according to my observation they are almost in every instance, wailfully caused. The practice is very common in all parts of India, where there are extensive tracts of waste or prairie land used for grazing. At the end of the rains the ripe grass dries up, forming an in nutritious fodder upon which the cattle soon fall off, and the most ready remedy is to apply fire, and burn the withered straw in order that the young grass shoots, which spring up immediately after, may be accessible for browsing. Firing the grass jungle is universally practised in the prairie "khadur" lands along the Terai, where bullocks and buffaloes are grazed and wherever binjarahs take their cattle in the cold weather. The same object leads to it in the hill districts. The paharees will bide their time patiently for wind and weather suited to a favourable spread of the conflagration. In very many instances, the dry withered grass is an evil, for which burning is the only cure. Under these circumstances, it appears to me questionable whether any amount of injunction, or penal enactment will be effective against a practice which is so ingrained with the wants and the immemorial usages of the people. The best plan would be to have the plantations in situations not liable to the risk of fire and the sites best adapted, in other respects for planting would be of that character."

Another British officer writing on the forests of Koollo observed in 1851 that the dry grass was fired to produce new tender shoots of grass and in the process killing myriads of young trees. He suggested that the old sites of certain important forests could be marked and saved from this hazard. He favoured conservation over plantation and added, "we must trust to the law of nature, which constantly provides for the maintenance of any products by

efforts, increased in proportion to the danger of extension....". The suggestion was that villagers should have the charge of the forests and be allowed to collect and ad valorum tax on wood cut there provided they did not fire the grass and prevented any

trees being cut before maturity .

Pastoralists in Bumtang have observed that less fire meant less productivity. Generally the sequence of the activities was that plantation of fur trees were followed by pines. It was set on fire to fertilise the soil and grow buckwheat. After that field were converted into pasture followed by shrubs and then cultivation of wheat. In some cases the cycle was restarted. The practice of growing buckwheat on such soils was actually quite soil regenerative . Even in the cultivated fields the wood was collected and burnt with mounts of sand over twigs in the winter before sowing buckwheat.

The fires do kill young sapling but they also clear the forest of dead wood . In case of pine trees , the needles are long and by the time these have been burned and fire reaches the tip of the shoot ,fire gets exhausted ,exceptions apart . The shoot then sprouts with greater vigour. There are several other ecological links in the chain in humid forests which fire seems to strengthen .

It is true that public policy at present assumes fire in the forest to be an unmitigated disaster. Therefore a series of measures are provided to prevent it. At the same tim historically it was part of the resource management strategies. There may be a case for scientific analysis of the conditions under which firing forests used for pastures might be treated as part of the management practices and at the same time other diverse forests might be protected from it.

The socio-ecological analysis of district-wise data reveals quite clear relationships between terrace cultivation, population and degraded forests. The yaks are found to be much more in the regions having predominant blue pine forest. The cattle was found in the regions having high population density and also terrace cultivation(Ura, 1988)

The rights of people in not merely conserving forest but also enhancing their productivity go hand in hand with their responsibility in the matter. A country with 60 per cent area under forest and with a clear policy of maintaining it at that level has to blend culture, technology and environment in a socially and administratively acceptable manner.

(d)Labour Contribution for Creation of Public and Common Goods

One of the most important features of mountainous societies across Himalayas is age-old practice of voluntary contribution of labour for management of common properties like tanks, irrigation

channels, pastures, mule tracks etc. Bhutanese Government is absolutely clear that the entire development process has to take place with a clear understanding that potential consumers of the facility must pay for it in the form of labour. Five types of labour taxes have evolved in Bhutan:

a) Tax for Local Public Good: Potential consumers of public goods such as domestic water supply, schools etc., are expected to help in generating the same by contributing 20 days per year. The non-attendance attracts a fine;

b) Renovation of Fortress: The seats of administrative and religious authorities are located in the same building in each regional unit. For maintenance of this building every household is expected to contribute at least one man-day per year for which a compensatory wage rate is also paid;

c) The Portage Services are provided for transportation of the goods belonging to public servants or for common use;

d) Renovation of by-ways, drinking water and irrigation channel etc., requires three days per year contribution from every household. This labour is utilised under the guidance of village chief; and

e) Housing tax is charged at the rate of 15 mandays per year per household for creating or maintaining a public good but not necessarily a local public good.

Roughly speaking each household contributes about 41 days per year amounting to approximately 43 million Nugtrums worth of contribution by the people. This practice not only ensures peoples' participation , reduction in wage component but also minimum reliance on immigrant labour. In addition to this labour contribution also reinforces the cultural values which can only be cemented through collective work for a common good. Most developing countries by delinking the creation of public or common good from its maintenance and regulation by the local communities have faced tremendous problems of maintaining these investments. On one hand this maintenance requires large bureaucracies and on the other hand people become more and more dependent upon state for provision of various services. For a country which did not have much to export or generate revenue from internal taxes such an approach inevitably leads to high budget deficit often accompanied by high foreign debt. This in turn not only compromises autonomy of a society but also limits the extent to which state can subsidise essential public services. More and more revenue is spent by such a state on maintaining its own public bureaucracies which inevitably alienates people from the state. Bhutan has very consciously decided to avoid such an eventuality. It has not merely decentralised majority of the functions but also reduced exemptions to different categories of people from paying this labour tax. Given labour scarcity in several parts of the country th choice of slow eco-adapted path of economic development seems the only

sustainable alternative.

Part- four

Culture of Innovation

Sustainability in high risk environments requires innovations both technical and institutional. We looked at only some of the institutional innovations so far. The technical innovations provide a clue as to how a society generated an ethic which was progressive but not necessarily guided by pursuit of accumulation.

(a) Water-streams Driven Prayer Wheel

Use of wind and water energy for keeping the prayer wheels moving led to very innovative mechanical improvements. The energy of streams and small rivers is harnessed through alignment of horizontal and vertical gears. The chants are block printed on Bhutanese Daphne bark-paper and rolled in cylindrical shapes. Reems of chants are incased in a bronze or leather cover and put on water wheels to be turned by the running streams. It difficult to suggest whether this led to the development of water driven flour mills or vice-versa.

(b) Architecture and Education

The construction of Dzongs (fort-monastries) seems no less than a miracle given limited availability of building kits, absence of scaffolding, no pulleys to lift the load, no pins and nails, no formal survey techniques and also no blue-print drawing.

Some of the innovative school teachers have used these buildings to impart basic skills to children about reading, writing, arithmetic and resource literacy. The children are taken to these buildings and asked to measure them. In the process of measuring they are shown use of different types of woods in different parts of the building. The relationship between this wood, the tree of which it is part and the soil and slope at which these trees grow is made obvious to the students. It is not surprising therefore, that such students develop a great pride in their culture which provides rules for respecting religion, environment and common institutions.

A tangible evidence of the enculturation process is almost cent per cent return rate of the students who go abroad for higher education. Except one practically every student has come back to Bhutan - an achievement which perhaps no other country could claim. Lest the fusion between modern ideas and traditional values does not take place, every student who returns is expected to spend about six months in a village assignment to unlearn and realign his/her coordinates of the cultural maps of the country. The new education policy is reemphasizing relationship between

resources and their place in ones life.

(c) Bridges

The settlements across the rivers have always had difficulties of accessi ility and transportation. Since long distance trading for material exchange plays a lesser role in mountain environment, niche specific adaptive strategies had to be developed to fulfill all the cultural needs. The degree of interaction is highly compromised by inter-communal isolation. These problems lead to various technological solutions. One of most remarkable engineering feat promoted by the mountain condition was the construction of iron-chain and wooden bridges across the country as early as 15th century. George Bogle who visited Bhutan in 1774 noted that "the bridges were either entirely of wood or entirely of iron. The wooden bridges are very common and are from 30 to 70 feet long"[34]

The iron chain bridges were attributed to Saint Thangthong Gyalpo (1395-1464). It became as much a technical task as a religious one. Mixing metaphors, bridging building is considered a virtuous act because it alleviates people's obstacles.

(d) Handlooms

Almost all the raw materials for a thriving handloom sector in Bhutan are derived locally. Rural women generate substantial income from this activity. The traditional skills of dyeing and designing were based on local wool, tree cotton and sericulture. The slightly rough but lasting materials were also woven from a specie of Neetle. For final cloths endi-silk is used. The silk worms are reared on the leaves of seem (araliaceae). A wide variety of natural dyes like rubia, lac, zhim (acanthaceae) are used.

(e) Alignment of Irrigation Channels

The science underlying the techniques of aligning channels across different terrains, soil types, slopes remains to be properly understood. While there are cases where channels constructed by the government have failed after few years. The traditional channels have been maintained in some cases for several hundred years. The institutional context of this technology is important basis for sustainability of the channels. The same technology without support of common property institution might fail as easily as the modern irrigation channels. The variety of materials which are used ranging from tree trunks to various kinds of lining also show an extremely innovative effort.

(f) Mobility of Livestock and Feed and Fodder Practices

As mentioned earlier movement across altitudes and of different species is essentially organized by two different occupational groups: the semi-nomadic pastoralist in Laya, Lingshi, Mera, Sakteng and the sedentary agriculturists in other parts of Bhu-

tan. In addition to the institutional arrangements guiding movement of cattle and yak there are several other innovative indigenous practices of veterinary medicine, food and fodder mixtures and livestock shed management. Given the fact that extending human medicine to large number of people in interior mountain regions has been so difficult, the possibility of building up animal husbandry health infrastructure is quite remote in near future.

Reliance on indigenous knowledge systems thus is necessary. Some studies have been done to find out the scientific basis of traditional fodders. For instance, it was found that willow leaves (Salix babylonica) when taken by sheep support the energy and protein requirement for body maintenance as well as growth. Willow leaves, it was recommended could be considered the most suitable fodder for ruminant livestock in and around Thimphu and temperate regions of Bhutan. The leaves were so rich and palatable that they could sustain the animals without any additional supplement. There was no significant difference in me abolizable energy concentration of willow leaves vis-a-vis lucerne, vetch,

fodder maize and fodder oa It is unfortunate that the developmental programmes for mountains often ignore the accumulated wisdom of centuries of experimentation. In this ca out of large number of possible leaves and grasses only a few have been selected by the people in different regions emphasis on cultivated fodders should in fact be lesser than e tree fodders in fragile regions because t ee ecology is much more sustainable than the cultivated crop ecology for higher altitudes as well as steep slopes. In sub-tropical part of Bhutan leaves from fodder trees complement grazing. In sub-alpine and alpine regions wheat is grown as green fodder for cattle and horses. The nimals go through nutritional stress during the long winter in alpine regions. Buckwheat straws and even some crop are used as supplementary diet.

(g) Cropping Systems

Several innovative uses of weeds and other materials have been attempted for fertilizing the crops ,plant rotection or seed storage. The farming systems in Bunthan district in North Central Bhutan are discussed first followe by some other innovative practices. In this district agriculture and animals husbandry are closely intertwined. The pattern of livestock rearing secondary to the cropping systems in the lower settlement valleys of Chumey and Chokhor. Opposite is the case in higher elevation like Pur, Ura and Tang. The potato cultivation is expanding very rapidly and replacing buckwheat which in addition to wheat and barley is the major crop. Wheat and barley are grown in the flatter part of the valley and buckwheat on steep slopes. Potatoes can be grown at any gradient but there is preference for it to be sown in fields near the road and closer to the houses. Turnip, radish, onion, cabbage and chineseleaves are grown as vegetables.

The irrigation plays very limited role in these farming systems. Winter wheat is irrigated only in one of the villages in this district. There is a very limited use of fertilizer in winter wheat, barley and buck wheat. The soils are considered efficient

in phosphorus and of course nitrogen. The soil fertility is made up by a peculiar method: mounds of soil are collected over twigs, branches and dung to be burnt to produce ash.

While the model landholding size is about 20 acres per household but only a fraction of this is cultivated in any given year. A plot is cultivated only once between six to 10 years and there is a regeneration of weeds on such plots in the intervening period. It is in this context that some people have argued for differential norms of landholding in different parts of the country taking into account the productivity and the frequency of cultivation.

Diversity of crop is one aspect of risk adjustment, the diversity of livestock species is another. The agriculture is extremely labour intensive and seeds are replaced every third year or so. The wheat and common buckwheat are alternated in the same field every year. The common buckwheat is a short duration crop and is known to deplete soil nutrient. The buckwheat is rotated with wheat which required less nutrient. The compost is applied for buckwheat plantation but the residual effect is obtained by the wheat planted in the same field next year without adding compost.

The crops in the highland attract large number of pest including bears and wild bors. Buckwheat is exceptionally vulnerable to bears. To achieve defense as a common good all the farmers decide collectively to cultivate buckwheat in one single area. During the saturation period it is not uncommon to hear sounds of shouteks and howls to scare the wild animals away. There are reports of several experiments on the farmers' field taken up in a dispersed manner having been damaged by the wild animals.

Winter wheat is sown in November weeded in April or May and

harvested in September. Bhutan has three species of buckwheat. The common buckwheat or bitter variety is sown in April weeded in July and harvested in August. The common buckwheat has very short maturity period. It is obvious from the overlapping growing period between wheat and buckwheat, that most of the areas in Bumthang has double cropping. This particular cropping pattern besides being consistent with the agro-climatic condition allows the labour, draft animal and management to be spread roughly evenly over time. Planting and weeding of both wheat and buckwheat are staggered so that labour resources are used more efficiently.

Since the early 1970s potato has been cultivated as a cash crop. It is planted in March/April and harvested in August/September. Weeding is done twice the first time in May and the second time in June. In terms of requirements of labour, management, and draft power, potato cultivation competes against buckwheat cultivation and thus the expansion of potato cultivation is taking

place by partially displacing buckwheat.

(i) Preparation of Manure

Igneous and sedimentary to metamorphic and alluvial deposits constitute poorly structured low fertility soils in Bhutan. Exceptions are red clay soil in Samchi, Gayelphug and S Jongkhar. The level of ph is between 5 to 6.5. Most soils lack organic matter and have low cation exchange capacity -both these factors reduce the ability of the soil to retain leave alone accumulate essential plant nutrients. It is in this context that the practices for manuring the soil must be studied.

The dung found in the communal grazing land is collected by the communities and divided among themselves. Dung on private pastures is collected exclusively by the owner. The ash of the burnt dung is applied back in the soil. The cattle or the flock of sheep are penned on the fields to enrich the soil by their droppings. There are customary exchanges among the visiting herds and the owner of the cultivated land in some areas.

The animal sheds are built on the ground floor in a two-three storeyed building for keeping horses, swine, cattle etc. The straw leaves collected from the forest or pasture lands are spread on the bed of the cattle shed mixed with cattle urine and dung. These leaves or straw become highly enriched. Farmers have recognized the difference in the quality of different manures. Oak leaves are considered to make the most potent compost followed by pine needles. The waste from the horse is the most preferred manure. While the waste from swine is considered quite fertile, it creates a problem. The swine often excretes undigested seeds and thus such a manure encourages growth of weeds when applied to the field. A combination of horse waste and oak leaves forms a very superior compost.

The leaves of arthemedes weed (worm weed) are chopped and used for mulching and composting in chilly crop. It is also assumed

that it has some plant protection properties. The boiled extract of green leaves of this weed is given to the animals for controlling flatulence.

(i) Shifting Cultivation

A study on this practice carried out in district Trashigang in Eastern Bhutan has revealed the socio-colonical dimensions resulting in dominance of shiftin cultivation. This is one of the most backward district having predominance of this practice.

Majority of the farmers consume 90 per cent of their grain produce. About 30-40 per cent of the foodgrain is converted into liquor for domestic consumption. Farmers have permanent houses and shifting cultivation is practised either individually or by groups of households. The land may also be owned or leased in. It was estimated that about 32% of the total cultivated land was

under some form of shifting cultivation in Bhutan, though in the case of Pema Gatshel district it goes upto a 79% of cultivated land. The importance of the shifting cultivation can be assessed by looking at the following figures: Only one per cent of the cultivated land is under paddy (irrigated) cultivation. Twenty per cent of cultivated land is under permanent dryland (rain fed) cultivation. Maize and buckwheat are two principal crops grown in dryland. Farmers also grow wheat, barley, pulses, mustard and potatoes as winter crops.

The burning of the vegetation slashed after 3-8 years of fallow is led by one or several fire specialists (Mesungpa). Farmers recognise the correlation between the soil fertility and duration of the fallow period. The land is not ploughed and seeds are either broadcast or dibbled into the soil. The output of this system is considered to be higher than dryland cultivation and labour and other input requirement is lower than any other system. There are reports that productivity of these lands is declining because of factors like heavy grazing of fallow land, deterioration in the composition of vegetation in the fallow land, shortening of the fallow period, erosion and depredations of wild animals etc. Policy makers however, realize that there is no sustainable alternative to shifting cultivation in the near future. The government appreciates that reverting these lands to forestry without generating alternative sources of livelihood would impoverish the farmers a great deal.

(j) Local Technical Innovations in Agriculture

While no systematic inventory exists of the innovative practices that farmers- man and women- have evolved in Bhutan a very limited listing of practices presented here is intended to suggest the potential of this knowledge base.

- In potato before sowing the tuber it is divided into two parts-strong and weak. The one with more buds is considered stronger and one with less buds is considered weak. Depending upon the soil fertility in different parts of a field the placement of seed is done accordingly. Another way to look at the possible difference in productivity is the difference in the shape. The round tuber is put on the hillside and the oval shaped on the other side. While planting, some people follow a practice of seeding four cuts of potato seed in a circle with another cut in the centre. After sowing field is covered with manure and mulch which is burnt to control the pest attack and increase the soil fertility.

- A rope is taken through the paddy field either for dropping the dew on the leaves into the soil or for dropping the eggs of certain insects which may die after falling on the soil

- Chilly seedlings are covered with paddy straw and the mulch so built is burnt. Ash is assumed to help in controlling

the late blight disease.

Local knowledge systems evolve not only about local crops but also exotic varieties / crops .In some cases farmers have discovered that hybrid plants in maize could withstand strong winds better than the local varieties. Several changes are being brought about in the associated components of the farming system in parts of Tashigang district having problem of strong wind [41] .

The technological change influences culture just the way cultural factors influence technology. Further the teething troubles that are being faced by the farmers in the process of technological change indicate that a policy in this regard should be sensitive to the ecological and cultural limits. Several studies pursued by Western scholars in Bhutan have confirmed that most of the ill-designed rushed efforts for technological change have not been very encouraging(Flavin,1989). There are studies which have shown that considerable yield potential exists within the local varieties provided management conditions could be marginally improved.

Part-Five
Technological Transition: Emerging Issues

Bhutan's capability for pursuing research whether on research station or on farmers field are growing only at a slow pace. Part of the problem lies with the framework in which technology development and dissemination has been pushed in the recent past. It was hoped that one or two centres located in the fertile valleys would be able to generate technology to be transferred through training and visit model. It was obviously an erroneous assumption . Recently an Australian company providing assistance for Tashigang/Mongar area development project very emphatically advocated the case of ecological low external chemical input agriculture. It was observed, "there is no great pest/disease problem in East Bhutan, and your ecosystem still seems to be well balanced. Don't fall into the trap of chemical overuse, the only beneficiaries from this are the chemical companies and your balanced ecosystem is likely to become unbalanced very quickly" [42] .

'Furadan recommended for controlling cut worm and stem borer in maize is considered a very toxic pesticide for human beings. Its use needs reappraisal because (a) less toxic pesticides exist and (b) earlier and more thorough land preparation might itself decrease the incidence of pest [43] . Widespread use of pesticides ,it is feared might also eliminate spiders and other helpful predators which keep the crop pest in control .Pest incidence is assessed to be quite low at present in Bhutan but tread mill effect could well be obtained if indiscriminate use of pesticides is encouraged .

As regards diseases , most local varieties are found to be resistant . In rice the blast (P.oryza) is most serious disease in new exotic varieties introduced from outside .

Likewise helminthosporium is a major disease on maize and sorghum though grain yield are not much affected in early stages.It has been feared that since the infected crop residues have to be burnt to control the disease , the shortages of fodder might occur [44] .

Maize and wheat are two of the grains severely attacked by the stored grain pest . Maize is reportedly not eaten by the people until all the rice stock has been exhausted . This means maize has to be stored long enough to be attacked by the pests . Indigenous plant protection practices for stored grain pests exist though are not very popular . The seeds are mixed with wood ash or exposed surface is covered with millet or mustard [45] . In light of the need for evolving or building upon similar practices in different regions dispersed seed processing may be quite necessary .

Such advice may not always be very popular in the light of the fact that modernisation is considered often coterminus with more and more intensive use of external inputs .

The introduction of leguminous crops to enrich the soil is being tried in some of the experiments . Efforts to introduce soybean for this purpose have been critiqued because legumes fix nitrogen during their photosensitive vegetative period . Cowpea fixes more nitrogen according to some studies than soybean which flowers after two months .It grows from May to October .Search for sustainability requires careful trade offs .

Conflicts are emerging between crop and fisheries sub system in southern Bhutan . Fish ponds in Gayelphug and S Jongkhar are drained for harvesting fish and controlling predator fishes before refilling . Clashes take place sometimes between fishermen and the cultivators growing wheat and spring rice because time of draining ponds coincides with the time of irrigating the crops .Some of these conflicts are inevitable and no development is possible without these trade offs. However, if these conflicts are not monitored to learn appropriate lessons ,the process of technological transition may not only become painful but also counterproductive in extreme cases .

Power tillers were introduced because labour was considered scarce. However, many of them have been out of use because they got damaged on steep slopes. It should be possible to involve the concerned companies to engage in research on proper designs supported by international aid agencies. Instead of taking the easy option of transferring whatever designs exist .It is natural that given low level of purchasing power in most mountainous regions the private corporate sector would not have much interest in designing equipments or technologies specifically suited for

the regions. This is an issue in which International Centres for Agricultural Research and other donor agencies should invest. Bhutan's experience shows that despite lack of adequate training and skills quantum jumps in the technological change can indeed be achiev d through imaginative policies. For instance, Royal Government decided that instead of importing computers and remaining dependent on the repair and services on external consultants, they should try to assemble the computers within the country. Today almost all offices in Bhutan have the computers made in that country at a very low cost and of very high quality. Similar breakthroughs can be achieved in other sectors as well.

The agronomic research on several crops is showing that experiments designed without analysing the basis of diversity in the existing cropping systems may not make the best use of time and critical resources - human or material. It was found that seed rate or method did not make much difference to the yield of mustard. Likewise the line sowing over broadcast made hardly a difference of 100 kg./hectare which given the cost and unavailability of labour was not remunerative.

Introduction of new crops is indeed fraught with risks particularly if the indigenous technological capabilities are limited . Observers have taken a very critical note of the seed multiplication programme of blackberry plants (Rubus sp.) in Bumtang. It is considered a noxious weed in many parts of the world due to its rapid spread by both seed and vegetative canes, rendering large

areas of pasture land forest quite useless . Australia is spending millions to eradicate it . Scientists have suggested that since logan berry, young berry, boysenberry etc., have similar fruit ,seed multiplication programme of black berry should be terminated .Such cautions imply that Bhutan and other 'late starter 'countries have to deliberately seek advice which can let them have multiple interpretations and choices particularly from the point of view of sustainable development .

Most of the new maize lines introduced by CIMMYT have unacceptably high number of exposed years and higher incidence of year rot under wet condition besides having the problem of lodging. Only a few lines were found worth further testing . The irrigation research for maize was considered not necessary. In the absence of fertilizer most improved varieties did not out yield the local ones. The technological package tried in Western Bhutan could not be replicated in the Eastern or Southern parts. The mustard fields not harvested on time face the problem of shattering with the result that the seeds germinate in the next season ,

In addition to the technical aspects, the gender aspects deserve serious attention. In Gyalphug women ploughed the land reportedly because they were 'stronger 'than the men and not because the men had migrated away. In most mountainous regions, mail emigration is almost a rule. Therefore, technologies which build upon the strengths of the women and help in overcoming their limitations need to be carefully screened. Women play a very major

role in selection of fuel, fodder leaves, water, handloom, agriculture and livestock management.

medicinal herbs :preserving unique knowledge wealth

There has been some concern expressed in the National Assembly on the issue of regulated access to medicinal herbs from the forest and pastures . The mountainous regions abound in the availability of these herbs. There is a need for international thrust towards preserving this knowledge reserve. In the absence of a careful strategy aimed at managing selective collection of the herbs, some herbs might become extinct and others might disappear because of ecological principles of succession and dominance. For instance, if elephants are killed in a particular forest then the grasses and herbs which grow in the micro environment produced by the trampling of the grasses by elephants feet is not available. Likewise in certain forests livestock had been browsed ' suddenly when that is stopped it would also affect the dominance patterns of different species. The result would be excessive growth of some species and total suppression of others. This is a subject which requires very careful monitoring. ICIMOD should mount in collaboration with IUCN and National Governments a programme to monitor the changes in ecological succession and dominance patterns due to closure or other major changes in the socio-ecological environments.

Reduction of the death rate in livestock particularly control of tapeworm cyst infection in yak has led to changes in the growth rate particularly in alpine regions. Effect of these changes on bio-diversity with specific reference to herbal wealth need careful attention.

In the issue of seed multiplication interesting experiments have been done in Bhutan. Farmers are expected to return 250 grams per kg. of seed so that it could be provided to other farmers. This helped in building decentralised sock of seeds .

Consumption patterns both formal and informal have an important bearing on the technological change. The formal channels include markets, kind payment for labour and distribution through Food Corporation of Bhutan. The informal channels include exchanges during [illegible]ion, non-market neighborhood exchanges, reserves with monasteries, ritualistic feeding of community, dedication to special shrines, individual sponsorship of religious retreat of other individuals for three-four years etc. Since monasteries are an important institution not only for administrative and legal purposes but also for credit and cultural practices it might be useful to involve them in the process of technological change and dialogue . In olden times much of the trade was financed by monasteries. Even at present Lamas have complained that recovery of their loans to farmers has deteriorated. The involvement of monasteries in reinforcement of conservation ethics and a pragmatic evolution of this ethic towards a more fair society remains to be tried on any systematic basis. The ban on culling of low productive animals is one issue on which

religious representatives in the National Assembly have been most vocal.

Part-six
Environmental Risks and Social Response

Farmers, pastoralists and artisans face several risks which vary over space, season, sector and social groups. The Southern part receives more heavy rains and some regions face the problem of floods. In Northern regions, the landslides, snow fall, hail storm and strong winds cause various type of damages. The wild life damage is also much more serious in central and lower parts of the country. Repertoire of response to different type of risks reflects the strengths or weaknesses of the indigenous institutions as well as of the modern market and public institutions.

In an informal panel enquiry, we identified following nine risks in the order of importance which people had to devise ways of dealing with:

i) Heavy or too little rains;

ii) Damage by wild life;

iii) Hailstorms;

iv) Snow fall;

v) Landslides leading to road blockage , choking of irrigation channels or dispersal of stones on a grazing pasture etc.;

vi) Strong winds;

vii) Disease or epidemics;

viii) Fire; and

ix) Drying of streams.

It may be useful to ascertain the composition and order of risks perceived by different social groups, stakeholders like Lamas, administrators, members of National Assembly etc., in different parts of the country.

(a) Spatial, seasonal, sectoral distribution of hazards

Spatial hazards pertain to those that are area specific .Seasonal hazards refer to over time risks mainly concerned with climate and location interactions .Sectoral hazards broadly refer to risks associated with economic activities. Transport, communi-

cation and agriculture sectors face greater incidence of sectoral hazards. Seasonal hazards consist of abnormal monsoon, flood, stormy wind, hailstorm etc. Spatial hazards would require quantification of territories which suffer from region specific hazards. One obvious example for spatial hazards is that Southern Bhutan is more prone to heavy rains than Northern Bhutan. Forest degradation in Tashigang and Southern Bhutan also make these areas more vulnerable to erosion.

(b) Traditional Risk Adjustments: Animal Disease

Yaks are found roughly 2500m above sea level. This would be the lowest height that yaks descend to even during the winter. They move to pastures at much higher elevation during the summer, giving way to cattle who are driven up after their winter grazing in sub-tropical parts of Bhutan. The migratory cattle naturally mingles with other herds during their grazing with cattle from the South and crisscrosses their path with other herds on their migratory route. While doing so, herds are likely to pick up animal diseases and transmit it to yaks, who are possibly more delicate animals than cattle. To avert contacting any diseases from either side, yaks are moved further up in higher pastures a month ahead of the arrival of cattle. Herders of yak and cattle do not exchange messages about their movements. They coordinate their behaviour almost with ritualistic precision through ecological signals or other means. The yak herder expects the cattle herder to be there on time and the cattle herder expects the yak herder to have gone.

(c) Coping with Lean Harvest: Risk Adjustment Against Famine and Food Shortages

No famine has been experienced on the scale of community or nation in living memory of Bhutan. This may have to do with pure run of good fortune or a greater production stability of the farming system or on the elaborate traditional food security system operated by the State. Probably all of these factors dampened the effects of any incipient famine but which of these factors played more dominant role than the other remains to be examined.

Until the 1950s, the State maintained enormous grain silos in each of its massive dzongs (fort-monasteries), i.e., district headquarters. The ultimate use of the kind taxes, including grain-taxes was to build up reserves to support the state officials and monasteries and to avert any crop failure. The food stock - butter, cereals, meat, mustard oil etc. - was replaced with new grains by exchanging the old stock with the farmers every six years or so. Until the kind taxes were commuted to cash taxes in 1950s, farmers suffering from crop failures could either get grains free or on interest free loans from the state grain silos. There were also remission of taxes in a bad year.

There are localised bad harvests of varying degree. One hears about insects destroying the crops and hailstorm dislodging the

crops with distressing frequency through the news letter (Kuensel). But not of disasters. The households historically maintained a buffer stock on which they can draw on in bad period. This may still be true for households which are more remote. The first course of action is to call on the kith and kins of gifts of food stuff on the basis of reciprocity. Grains can also be borrowed from those who have larger food stocks.

The farmers can travel to other places on alms-round or work for food for villagers in distant places. There always seems to be enough work in exchange for food according to some observers. It is considered unusual that the farmers would take drastic measures of disposing their animal, jewels or other assets to tide over a period of food insecurity. Strong safety nets are supposed to prevent them from becoming assetless in the aftermath of a bad harvest. In recent years the government has begun to build food security stocks equivalent to country's six weeks of total requirement of essential commodities like wheat and rice. Real efficacy of these measures remains to properly evaluated .

Gathering of wild food is an important element of supplementing

food shortages in some parts of Bhutan . In some districts of Bhutan such as Kheng, yields from the forest contribute substantially to the food basket. There are wild yams, wild avacadoes, wild taro, young frons, young buds of rattan, flowers of orchid and various kinds of mushrooms to name a few fruits and roots for the table. Wild yams, which achieve giant sizes - as long as four feet - are collected even as a normal part of food. Since it lies a metre or two below the surface, appropriate extractive tools are there for wild yams. Nowadays, the forest food gathering is a growing petty business for the farmers. The forest offers various raw materials like bamboo and rattan for baskets, neetle yarns for making clothes, natural dyes and many other more obvious products.

(d) House Construction and other Non-monetised Exchange - Reciprocities

A community is bound by norms of reciprocity and sharing. The members of a community have a network of obligation enclosing ones extended family, kith and kins, the fellow villagers and so forth. Indeed, these thick social network of obligations and reciprocity is something of a mixed blessing. Redistribution and equality seems to be a natural outcome of such a social system, where the better-off kins must pull the worse-off ones. The levelling effect of such a sharing society is summed up in this ironic Bhutanese saying: "The relatives will prevent me from destitution; the relatives will prevent me from getting rich."

There are a large number of norm oriented behaviour, among which contribution of labour for the construction of private houses is a good example. The size of houses, especially in the alpine

settlements of Bhutan, are in excess of what one could afford to build, if it were not for the community's free labour contribution. The reasons for comparatively larger structures may be found in the sheer availability of timber, stones and mortar, but also in the stronger norms of reciprocity and co-operation possibly fostered more easily in clustered settlements in the alpine regions. It remains to be studied whether all the labour contributed for such purposes was voluntary.

Each household usually allocates a person for some part of the duration of construction. The result of strong norms of reciprocity ensures an adequate housing for all. Any family in the village gets to build a house beyond its means because of others joining the work. The average housing condition of the village is better off than without the norm of reciprocity. It is also a social adjustment under the condition of labour shortage and non-monetised labour market. While the more wealthier may choose to build bigger houses and thus benefit greater from the norms of reciprocity. On the whole it seems to be a strategy for collective optimization.

The norms of cooperation have been relied upon for a variety of civil works ranging from upkeep of highways and footpath and bridges to construction of monasteries. In the case of repairing some portions of road or bridges, the burden of maintenance need not be equally shared by all since that route may also not be used equally .In such cases, only special clientele groups will be bound by norms of cooperation. It is of course easy to appeal to community labour mobilization for the construction of a community temple. There is no apparent differential benefit or vested interest for any section of the village. The benefits are diffused, incomputable and intangible.

Such solidaristic sacrifices of labour would be less spontaneous, without a leader to organize them and without occasionally using the threat of social sanction.

Part-seven
Policy Framework for Sustainable Mountain Development

(a) Livestock

The crucial dependence of cultivation of crops on livestock through manure and draft power is well understood. Not so well appreciated is the nourishment of forest regions by the livestock dung. Livestock is viewed as the most serious enemy of the environment today in most parts of the world but particularly in fragile desert and mountainous regions. The improvement in prices of dairy products would give impetus to the increase in herd size. The improved vaccination and other disease control programme also increase the population pressure. At the same time, closure of certain forest areas and pastures (estimated to be about 25 per cent) for livestock, firing and collection of leaves etc., shifts the pressure on lesser area of grazing land.

In the short run, the number of livestock is unlikely to go down. Thus supply of manure to crop fields may remain at the existing levels except on certain migration routes modified due to closure.

Supply of high yielding exotic breeds like jersey and Swiss Brown coupled with improvement in the quality of pastures is making slow progress. Ultimate policy aim of replacing migrant herds of local breeds by sedentary herds of improved breed does not deal with the manure problem. Nor does it deal with the issue of bio-diversity and stability offered by the same. Whether it is feasible at all in the unique geo-physical and cultural setting of Bhutan remains to be seen.We doubt it .

It may be added that cultures that have evolved through movement and exchange of livestock have also provided legitimacy to the efforts of state regulating different resource use strategies of people. The ecological basis of this exchange may also not be any less vital for sustainability of society. Politically, the pastoralists have suffered in most societies in the process of economic transition. But Bhutanese culture and eco-sensitive public administration might resolve this problem provided international aid agencies can invest in the learning and experimentation process. Bio-diversity of forests and pastures influenced by livestock movements are global heritage. Cost of maintaining it should not be borne by the poor pastoralists alone. (It should be noted that majority of herders in several regions do not own any pastures.)

(b) Agriculture

Mountainous societies generally do not depend upon cereals as the primary source of consumption. Some of the most popular dishes of Bhutan require cheese, potatoes and chillies - the ingredients which could continue to be in sufficient supply if the policy shifts in favour of cereals are corrected. Bhutan's cereal food basket has 50 per cent rice, 13 per cent wheat, 24 per cent maize and 13 per cent other cereals. Rice was never a major staple diet. Import of cheap rice has lead to this shift.

Self sufficiency in cereals particularly rice as the preferred food, is the main focus of agriculture policy. How the self-sufficiency programme is pursued in practice, which is not decided yet, would have ramification for the land use pattern in Bhutan. The policy package includes fiscal and institutional measures to change the consumption pattern. Input supply, extension and training among the farmers are being given increased emphasis in every plan period to increase productivity. There is also some possibility for new lands to be brought under cultivation. On the other hand, some agriculture land was lost to urban settlement and industries before the National Assembly passed a resolution in 1988 prohibiting construction in wet lands. There is considerable pressure on forest from the expansion of orchards. Ecological implications of expanding apple

sion of orchards. Ecological implications of expanding apple orchards on steep slopes and lands close to the roads remain to be worked out.

The agricultural research is yet to be reoriented towards the strengths of Bhutanese endowments of organic agricultural technological base, lesser diseases and pest problems, higher yield potential of local varieties through better management; very strong institutional base for managing common properties like irrigation channels, pastures, forests etc. Some efforts have been made to identify scientific basis of eco-adaptive fodder, mulching practices; crop mixtures etc. Much more remains to be done.

Genetic wealth of the country is unique in several respects. We don't know where else wheat varieties suitable as fodder are available. The Consultative Group of International Agricultural Research Institutions have not contributed adequately towards building up dispersed decentralised germ plasm banks. The aid for this must be available as an investment in global heritage and security of genes required in future.

Participatory research approaches do not necessarily require advanced degrees.

(c) Forest

Core policies regarding forest are embodied in the Forestry Act of 1969 and many other legislations such as Land Act, Pasture Grazing Policy and National Assembly Resolutions. The National Forestry Policy, 1974 lays down that the country should have a minimum forest cover of 60%. Remote sensing survey actually show that the country has 64% forest cover and cropland is estimated to cover 8% of the country. About 20% of the country is declared as national parks and reserves; though there are no effective management strategies because of the ever present constraints of resources and manpower. Bhutan has launched a wildlife and forest conservation programmes from a much stronger start-off point.

The policy of the government is to afforest the degraded areas and harvest the forest close to the road heads on the basis of sustainable yield. A few companies which extract timber for raw material are required to carry out planting at the same rate as felling. Knowing the tendency of the private companies to over-exploit the forest resources, logging is monopolised by the public sector corporation (Bhutan Logging Corporation).

Debate in National Assembly between conservationists and Monetarists have been quite intense. When foresters demand further slowing down of revenue extraction, finance ministry people consider it as an excuse for masking their alleged inefficiency. On the other hand, the fact remains that timber extraction rates have been considerably slashed.

people and Bhutanese cultural ethos with conservation as a way-of-life are becoming stronger. Bureaucratic barriers have seldom proved helpful in insulating natural resources from human greed. Indian and Nepalese experience is quite instructive in this regard. With best of the technical skills, trained manpower and coercive authority available with the state, the degradation has continued to increase over time in these countries. If a culture can generate indigenous technologies and institutions capable of maintaining forests, water streams , bio-diversity and ecological balance for so long, why should it be found wanting now.

Some people consider ban on cutting of livestock as a rare case of non-sustainable feature of otherwise sustainable Buddhist ethic. They miss the point altogether. The disease and death balanced in Nature's own way the population sizes for a long time. However, improved health changed the growth rate. But if consumption patterns and social institutions are not renewed, the imbalance was inevitable . The 'principles' and 'rules' must be distinguished. Non-culling is a principle. The sanctity of non-violence remains. The rule is about limited cutting necessary for survival. There is a need for debate and discussion in monasteries and dzong, schools and pastoral groups about the new rules required to uphold cherished and eternal principles.

Summing Up

The whole range of institutional norms and social values have regulated the behaviour of people regarding use of renewable resources without compromising its long term availability. To some extent these norms and institutions evolved in recognition of (a) individual behaviour being subordinated to the community's welfare and (b) human beings having rights at par with other components of nature. The homeostasis inherent in the norms of one group was contingent upon the respect of the boundaries of norms and institutions by another group. Thus a very co plex network of inter-institutional interactions guided the conservation efforts.

Consumerist's culture and commercial interest are indeed making sharp inroads into the traditional culture of conservation. Some of the ethnic groups which compare themselves with other cultures of the plains perhaps do not appreciate as much as necessary the need for restraint on wants. Question has been asked about the ability of traditional institutions to withstand the pressure of increasing imbalances in certain parts of the environment. To us the answer seems to be yes. We believe that if policies require careful study of the variability in the institutional arrangements and ethical norms across different ecological regions it would be possible to revitali e technological and institutional basis of society.

The global concern for sustainable development and conservation of bio-diversity is dominated by the strategies and styles suitable for essentially the degraded environments. Since degrada-

tion in environment inevitably is accompanied with the degradation of the institutions, these policies take absence of institutions as given. Much greater reliance is placed on public interventions which in turn mean bureaucratic interventions. In Bhutan's case government has already realised the need for limiting the size of bureaucracy and decentralising more and more so that variability in local socio-ecological system was taken into account while designing policies and programmes. However, the problem is not of taking awareness to the grassroots, but from the grassroots. Recent convention on Environment organized with the help of UNDP identified a long list of measures that were required to maintain the environmental variability. However, the context was of degradation and consequent cautions. The strengths were given relatively speaking much less attention .

How much of danger forest and forest-based agriculture faces from the livestock has to be compared with the danger emanating from private forest based industries. While in the case of other resources there is some community control available, these industries lie outside the sphere of traditional regulatory community institutions. It is believed that discouragement to otherwise profitable but extractive enterprises in areas where they pose danger to the environment is necessary. If efforts aimed at altering the micro-economic behaviour of small subsistence and deficit budget farmers and pastoralists have to carry conviction.

The continued functioning and the strength of the institutions, that kept the environment protected, depends on how successfully the future citizens of the country are introduced to the heritage which generates respect for these institutions . The viability of these institutions depends on the inculcation of these values in the children especially in schools and urban areas. Environmental studies are now part of the primary school syllabi in the so-called New Approach to Primary School. Among its many objectives are the understanding of "the importance of forest and wildlife and appreciating the need for taking proper care of them" and the identification of "various plants grown in their locality and classify them into food, cash and fodder crops".

'Education' of the next generation has of course to be accompanied with 'unlearning' by the present generation. Certain paths of development are not sustainable. Administration and policy

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maker in several countries are recognizing it belatedly .The need for correspondence between spatial, sectoral, seasonal and social institutional vectors is slowly being realized.

The culture provides a 'grammar' while technology provides new 'words'. The meanings of life which is ecologically sustainable and economically just can be discovered only through blending of both. Conservation is after all just an issue of " a drop of water ".

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