

# Chapter 1

## Water Harvesting Policies and Institutions in Bhutan

*K. Tshering*

### 1. BACKGROUND

Bhutan is a mountainous country, covering a total area of 40,500 sq. km. To the north it is bounded by the Tibetan Plateau of China and the rest of Bhutan's borders are contiguous with those of India. Bhutan is classified into three geographical zones as follow.

- The foothills, a 20 km wide strip in the south adjacent to India that rising to an elevation of 1,500 m
- The middle or intermediate range, rising to an altitude of 5,000 m
- A high mountain area, with altitudes exceeding 7,500 m

Flat land is limited to a relatively few broad river valleys in the mid-country and a small area immediately below the foothills (Figure 1.1)

The population of Bhutan was estimated at 600,000 in 1993. Crop production and livestock rearing are the main occupations of 86% of the people and contribute some 41% of the Gross Domestic Product (GDP). Labour is limited and hence intensified agricultural production is difficult. The traditional, self-sustaining farming system integrates crop and livestock production and the use of forest resources.

Upadhyay (1995) comments on the fragile geology and immature soils in Bhutan. In the foothills, factors such as steep slopes and loosely consolidated bedrock lead to severe surface erosion in spite of thick vegetative cover. In the high mountains, rocks are resistant to weathering, and, because of low rainfall and temperature, chemical weathering is also slow. Soil formation is therefore slow, leading to shallow soil depths with high percentages of rocks and stones. In the middle mountains, most rock types are extremely weathered.

The country is dissected by fast, south-flowing rivers running through deep, narrow gorges and steep-sided ravines. The high mountain areas, which are snow-bound throughout the year, are the source of the main rivers. The rivers, fed by perennial snow and summer rains or both, form four separate drainage basins: the Amochu (Toorsa), the Wangchu (Raidak), the Puna Tsang Chu (Sunkosh), and the Dangmechu (Manas).



Bhutan has a wide diversity of climates compared to other regions of similar size, ranging from hot and humid sub-tropical in the south to perpetual snow and ice in the high Himalayas. Because of the wide variations in physical features within short vertical as well as horizontal distances, each valley can have unique climatic characteristics from differences in altitude, rainfall, and exposure to radiation and wind. The predominant climatic feature is the southwest monsoon which sweeps in from the Bay of Bengal during June, is intense in July and August, and finally fizzles out by the end of September. Occasionally, post-monsoon rains occur in October. They last for a few days only but can be severe. Precipitation decreases as altitude increases and from west to east. Average annual rainfall ranges from 2,000 to 5,000 mm in the foothills, while the middle mountains receive between 500 to 1,000 mm, and precipitation is less than 500 mm in the high mountains.

Mean temperature logically follows altitude. Temperatures range from the subtropical belt at about 15-30°C, to middle altitudes of 1,500 m where the climate becomes cool and misty much of the year, to the high mountains at 3,500 m and above where the climate becomes increasingly severe with limited precipitation, short cool summers, and long cold winters.

Given the climatic and topographical diversification described above, exact delineation of agro-ecological zones is problematic. Nevertheless, six major agro-ecological zones have been identified from north to south, based on altitude, rainfall, and temperature: alpine, cool temperate, warm temperate, dry sub-tropical, humid sub-tropical, and wet sub-tropical (Table 1.1). The warm temperate and dry sub-tropical zones have been subdivided into east and west dry sub-tropical zones because of differences in cropping patterns in the two parts of the country.

Table 1.1: Agro-ecological zones of Bhutan

Agro-ecological Zones	Altitude Masl	Temp Max	Temp Min	Temp Mean	Rainfall mm
Alpine	>3,500	12	-1	5.5	<650
Cool Temperate	2,500-3,500	22	1	10	650 – 850
Warm Temperate	1,800-2,500	26	1	13	650 – 850
Dry Sub-tropical	1,200-1,800	29	3	17	850 – 1,200
Humid Sub-tropical	600-1,200	33	5	20	1,200 – 1,500
Wet Sub-tropical	150-600	35	12	24	2,500 – 5,500

Source: FAO (1990)

Agricultural production is largely governed by altitude and climatic factors. The most important crop is rice which is grown in irrigated or rainfed banded fields throughout the country at altitudes ranging from 150 to 2,600 masl. National yields average between 2.0 to 2.4 MT/ha with the highest yields in the mid-altitude ranges (1,200 to 2,500 masl) and lower yields in the southern districts. Maize is another popular crop and is found mainly in the eastern and southern parts of the country. While most of it is used as a substitute for rice, considerable amounts are converted into an alcoholic beverage. Wheat has traditionally been an important part of the diet in various parts of rural Bhutan. It is mainly grown on dry land and to some extent as a relay crop after paddy in a wide range of agro-ecological zones.

## 2. REVIEW OF POLICIES ON WATER

In the early days, the Land Act was the only legislation that laid down the statutes on water use, mainly for agriculture. As explained below, it is mainly confined to rights and responsibilities involved in the process of construction and/or rehabilitation of irrigation channels. At the time of its formulation, it embodied the government policies on the principal uses of water at the national level. However, since the clauses are specific to individual channels, it serves at all levels. Likewise, the National Irrigation Policy has been formulated to cater to the local level while meeting the national objectives. Micro variations of water availability are not unknown but have not been documented as yet.

As in most other countries, the government has a predominant role in water use. The state is the owner of all water bodies in the country. The government has the responsibility of providing safe water for domestic use. Thus, in its Health For All programme (RWSS 1998) a key objective is to provide universal access to safe drinking water and sanitation facilities by the year 2000. Similarly, in order to meet the food self-sufficiency goal, irrigation development has been a key component of the government's drive to boost agricultural production. A strong role for the state has also become necessary for environmental reasons to control pollution of surface and groundwater and maintain aquatic eco-systems (Meinzen-Dick 1998).

Because water is necessary for life, the private individual has long been using it with or without government support. In fact, government involvement started only with planned development, long before this individuals or groups managed water for their daily requirements. Water for domestic purposes has mostly been organised through individual efforts and still continues to be so. For irrigation, due to its communal nature, groups were mobilised to construct and maintain channels and the tradition has been passed down to modern times.

### The 'Land Act'

Traditionally, water use in Bhutan was limited to domestic and agricultural uses and, to some extent, as a source of energy. Irrigation was and still is the prime user of water resources in the country, as a consequence of which national policies on and programmes for water relate only to irrigation. Prior to the adoption of the National Irrigation Policy, the Land Act (1979) was the only document dealing with water.

The Land Act is based on the '*Thram Martham Chenm*', a register maintained by the rulers of the Kingdom containing land records of every tax-paying household. The sizes of land holdings were measured in units called '*Sondrey and Langdo*'. This register was started in the 17<sup>th</sup> century and reviewed in 1919 during the reign of the first King, His Majesty Gongsa Ugyen Wangchuck (MoHA Guidelines 1998).

In keeping with the needs of planned development, the Act has been supplemented by several resolutions of the National Assembly and orders issued by the government. At the same time, the system of calculating land-holding sizes also underwent changes from chain to cadastral surveys.

The Land Act grants permission to harvest water for irrigation provided that the person doing so does not cause damage to other's landed property, house, and plantations. The Act empowers him/her to maintain an existing channel and its related structures even if

these affect somebody who does not benefit from the system. However, if a new construction is proposed and this affects another party, it must be cleared by a local court. In case of default, the offender will be fined and his/her activities treated as null and void. For the purpose of avoiding ambiguity, a channel that has not been used for the last five years is non-existent and any work proposed on the system will be considered to be new.

Use of water that is jointly harvested is to be shared among the beneficiaries of the system, by either mutual understanding or by existing practices. Otherwise the water is divided among the land-holders according to the land-holding size and the amount of water in the system. Likewise, the system maintenance responsibility in labour terms is also based on the size of the holding.

The Act bars individuals wanting to increase their share of water from a system unless it has been upgraded to carry more water. Water sufficiency must be considered before staking a claim for an additional share of water, notwithstanding the individual's labour contribution. However, if the water supply is adequate, any new member, whosoever he/she is, can become a beneficiary and the older members cannot object. The new member (s) will share the maintenance responsibilities along with the others.

Neglecting one's channel with the intent of acquiring water from another channel closer to one's fields is strongly discouraged. This is only permissible if there is sufficient water in the other channel and the users' own cannot be made functional.

Having devoted a whole chapter of the Land Act to irrigation channels elucidating the rights to and responsibilities for them, it is only logical that paddy land is protected. The Act prohibits conversion of terraced wetland to other forms of use. Until recently, the government also provided a nominal subsidy to farmers for terracing land.

### **The 'national irrigation policy'**

In 1992 the government approved the National Irrigation Policy to lay down the procedures for irrigation development. The policy was formulated based on inputs from field; experiences drawn from model schemes and from the results of the farmer-managed irrigation systems' study. The evolution of the National Irrigation Policy thus emerged through testing procedures, programmes, and as a result of a number of interactions at the local and national levels (Pradhan 1998).

The policy outlines the procedural requirements for farmers requesting government assistance for construction and/or rehabilitation of irrigation channels. Pradhan (1998) concludes that many components of technical and social interventions for irrigation development have been streamlined. The National Irrigation Policies covers the range of activities beginning with selection, survey and investigation, construction and operation and maintenance. Farmers are required to form Water Users' Associations (WUAs) and encouraged to take the leading role in the entire process.

One of the basic premises of the policy is that irrigation is a complex activity with interacting physical, agricultural, and social aspects. Assistance to irrigation development, therefore, calls for a multidisciplinary approach combining the concerted efforts of engineers, agriculturists, sociologists, and others. Another key feature is the emphasis on long-term sustainability which allows the implementing agencies more time to iron out the problems

with the policy and expand them as appropriate. At the same time, the process takes into account development of the institutional capacities of the different agencies involved.

### **Drinking water supply**

There is no formal policy to guide the development of drinking water supplies. However, the Rural Water Supply and Sanitation Unit of the Health Division has formulated several guidelines to facilitate their activities. The overall goal of this programme is to improve public health by reducing the incidence of water borne and filth borne diseases through provision of safe drinking water and adequate sanitation facilities (RWSS 1998). Other objectives include the provision of universal access to safe drinking water and sanitation facilities by the year 2000; improving the understanding of beneficiaries regarding relationships between water-borne diseases, hygiene, water quality and sanitary conditions; and institutionalising implementation and maintenance procedures and human resource development.

### **3. CRITICAL ANALYSIS OF IMPACTS**

The Land Act legalised the water rights of an individual vis-à-vis the community. He/she is entitled to draw water from a source provided it does not adversely affect others. It favours rights of priority on disputable matters. Membership of irrigation channels is well defined. Water sharing is to be based on principles of equity irrespective of social and gender considerations.

The Act recognises the existence of beneficiaries (groups) for management of irrigation systems. It confers authority on the group to take decisions regarding construction, operation and maintenance, and system management. The group can resolve internal conflicts, failing which the affected party can go to court to redress their grievances. However, the court cannot force its ruling in all circumstances. Then, the decision of the beneficiaries is final in such cases.

While the intra-system rights of a channel are defined, a system's right to a water source is only implicitly addressed. Clause Ka. 7.5 of the Land Act states that, for new constructions permission of the court must be sought. This implies that water rights have to be secured prior to construction. Again, the water rights of one system vis-a-vis the others in the same watershed are indirectly defined in Ka. 7.4, where it states that if a new construction affects others, this can be stopped by the court. It would simplify matters if the Act contained specific clauses on a topic like water rights.

The National Irrigation Policy (NIP) has succeeded in institutionalising the participatory approach in government assistance to community irrigation systems. The policy premises are that development should be demand-driven, promote active beneficiary participation, enhance the institutional and managerial capabilities of the beneficiaries and be sustainable (IAP 1994).

In the foreword of the NIP, it is mentioned that 'although it is the core document around which the national policy has been developed, it is not a book of rigid rules and regulations.' Again, the policy measures herein are relevant only to irrigation as it relates to cereal crop production, mainly rice. That too is only applicable to gravity-fed irrigation systems, suggesting a narrow focus on one crop and a limited range of technology. The policy has not considered the requirements of other types of irrigation technologies and cropping systems.

It is the contention of this paper that the National Irrigation Policy is not fully comprehensive enough to cover the whole gamut of irrigation development. The scope of the policy needs to be broadened from assistance to rehabilitation and/or renovations to irrigation sector development. It appears that one of the objectives is to make government assistance more cost-effective by minimising government expenditure on construction and subsequent operation and maintenance of irrigation channels. Another objective that might be added is "to ensure that sustainable and productive use be made of scarce labour, land, and water resources". Amongst others, the policy could stress the need for protecting watersheds to ensure sustained water supplies. The policy would also be strengthened if appropriate measures to avoid environmental degradation, occurring as a result of irrigation development, are included (IAP 1994).

The principle of equity is not specifically mentioned in the policy document. It is elementary to the success of a participatory approach that water users contribute to the development in proportion to the gains they stand to make. It would mean that resource contributions are in accordance with the size of their land holdings; that the positions of men and women are strengthened equally, and that water users in all schemes contribute proportionally (IAP 1994).

Pradhan (1998) points out that as irrigation diversifies from cereals to high-value cash crops, the policy will have to incorporate appropriate modifications. These will include other methods of irrigation, the role of the Irrigation Agency, and the capital investment strategies.

For another couple of years, the government will still remain the sole donor of assistance. Given the implementation capacity of its Irrigation Agency, the number of schemes receiving assistance will not be high. The figures will be lower as the inventory did not include all of the innumerable, small indigenous schemes (Figure 1.2). However, the policy does not provide for priority setting based on a certain rationale. In order to provide equal opportunities to all, options must be made available for farmers to pursue other venues for assistance or choose different types of technology.

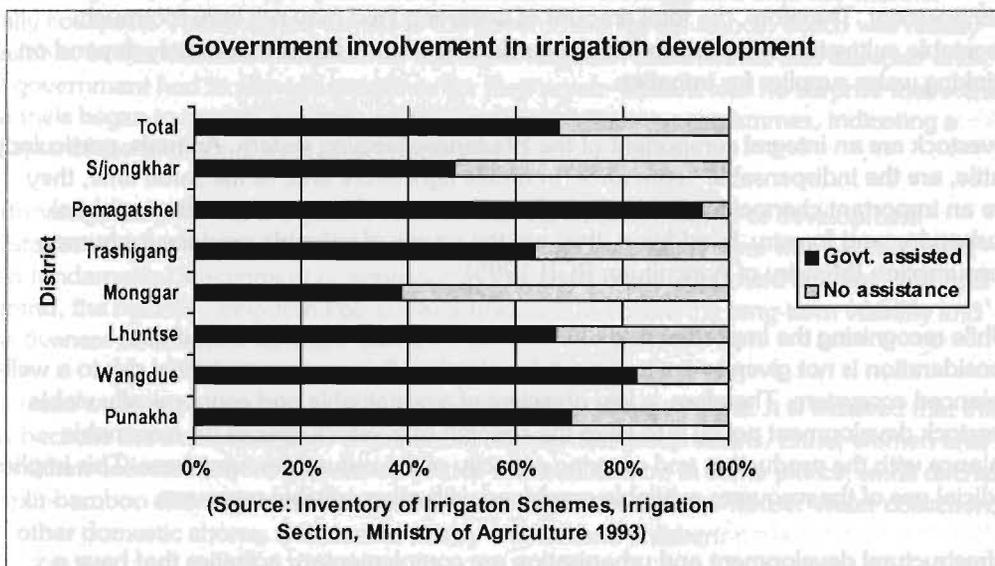


Figure 1.2: A random sample of districts showing percentage of government assistance received

One of the biggest problems in the water supply programme is the spatial distribution of communities benefitting from it. Villages are spread far apart from each other and, in the village itself, houses are scattered all over the place making it very difficult to build common supply points. Drinking water supplies that have traditionally been organised individually are new to community management and are yet to receive the support required, as is the case with irrigation, and hence, there is no management system. This has led to a high percentage of non-functioning schemes. Where such schemes have either failed or are non-existent, the individual has had to resort to his/her own means. In the past, this would have meant using split bamboo pieces laid end to end and supported on wooden stakes to form an open 'pipeline' drawing water from a stream or a spring. Others would have simply made a ditch in the ground. Nowadays, most of these bamboo structures are being replaced by plastic pipes.

#### 4. REVIEW AND ANALYSIS OF OTHER POLICIES AND PROGRAMMES

Of the other policies and/or legislation, the Forest and Nature Conservation Act of Bhutan, 1995, and the Livestock Development Policy and Strategy, 1995, contain topics related to water. The Forest Act stipulates that water is the property of the state and individuals or groups must acquire rights by obtaining permits from the Ministry of Agriculture. It prohibits felling of trees within 100 feet of the bank of a water body. Pollution control measures are also specified in the Act.

The Forestry Division is given the responsibility of managing government forest in keeping with the policy of maintaining about 70% of the country under forest cover. Timber extraction is allowed on a limited scale based on a sound management plan. Thus forest destruction is not a big problem except for in certain pockets where shifting cultivation has led to clearing of patches for food production.

Demand for water for agriculture has gone up with rapid expansion of plantation crops, viz., apples and oranges. However, if one were to assess the quantity of water used in traditional wet land cultivation, substantial quantities could be saved with proper management. Therefore, the total amount of water required may not vary too much. Vegetable cultivation is limited to kitchen gardens and small farms that mainly depend on drinking water supplies for irrigation.

Livestock are an integral component of the Bhutanese farming system. Animals, particularly cattle, are the indispensable 'work force' in arable agriculture and, at the same time, they are an important channel for the multiple flow of nutrients between agriculture, animal husbandry, and forestry. In addition, they are the source of valuable produce for human consumption (Ministry of Agriculture, RGB 1995).

While recognising the important role of livestock, the policy cautions that, if due consideration is not given to environmental protection, it can pose a potential risk to a well-balanced ecosystem. Therefore, a key objective of a sustainable and economically viable livestock development policy is to keep the strength of livestock species, in reasonable balance with the production and carrying capacity of the natural resource base. This implies judicious use of the resources available combined with other suitable measures.

Infrastructural development and urbanisation are complementary activities that have a direct bearing on water utilisation. Land is buried under the sprawl of urban and industrial development, hampering groundwater replenishment. Competition for water between

agriculture and other uses leads to shortages in supply. Roads open up access into watersheds, which more often than not leads to human settlement. Eventually, there is a rise in demand for social services, increasing the pressure on resources.

Even projects for harvesting water have similar consequences. Power projects require huge quantities of water, which, unless the water can be used for other purposes as well, does not necessarily optimise water use. Then, with the increase in available power, growth of industries takes place rapidly, further aggravating the supply situation. Similarly, big irrigation projects are plagued by problems of low water use efficiency, inequitable water distribution and undesirable environmental effects. Thus, there is a strong case for proper design of infrastructure complemented by good management for water harvesting.

Urbanisation is an inevitable consequence of economic progress and development. While it has its own merits, its impact on the environment is far from desirable. Rapid and unplanned urbanisation is a strain on the natural resources. Competition for land and water increases dramatically, further widening the gap between the resource-poor and the well-endowed.

## 5. INSTITUTIONS IN WATER HARVESTING

In the context of an agrarian society, the farmers, either singly or in groups, are the key players in water-harvesting. The Land Act empowers every citizen to make arrangements for the rational utilisation of water for his/her benefit. On the strength of this legal fillip, farmers took the initiative of building channels. Given the nature of the local terrain, farmers were compelled to organise themselves into groups to put their collective efforts to good use. However, in certain cases, individuals built private channels with their own resources. There was no or very little support from the government.

With the onset of planned development programmes, the Government took up new construction as well as rehabilitation of farmer-built irrigation channels. As the number of such schemes climbed steadily, the farmers began to see it as an easy way out of a demanding task. Routine operation and maintenance were neglected until the channel finally collapsed. Then farmers turned to the government for assistance, which was readily available. In this manner, many farmer-managed irrigation channels fell into disrepair and the government had to provide assistance for their repair. Thus, it was no surprise that some channels began to appear regularly on the list of rehabilitation programmes, indicating a collapse of the traditional institutions responsible for their upkeep.

Fortunately, the government quickly realised that the chosen method of development assistance was having a negative impact. It became apparent that there was a strong need for a fundamental realignment of approach in the irrigation development strategy. With this in mind, the National Irrigation Policy was introduced to ensure the long-term viability and effectiveness of investments made.

Domestic water supplies were usually arranged through private efforts. It is believed that this was because the small quantities required did not warrant group efforts. Either women and/or children collected it from a common source in containers or, in some places, small ditches or split-bamboo channels were used to bring the water closer to the house. Water collection, like other domestic chores, was carried out by women and children.

Although the quantities involved were not significant, provision of safe drinking water was seen as a key element in the socioeconomic development of the people. Thus, the Public

Works' Division of the Ministry of Communications launched the Rural Water Supply project and many villages were provided with piped water. Tanks were built and tap-stands installed at central locations. It is estimated that 58% of the rural population and 75% of the urban population have access to water supplies (RWSS 1998). Of the over 1,700 schemes built, 30% or so fell into disrepair because farmers were not used to the idea of working collectively for repair and maintenance.

## 6. CONSTRAINTS AND OPPORTUNITIES

Sustainable water harvesting at the local household level can be achieved with the right blend of policies and programmes. However, such a conducive environment can be offset by a lack of resources. Shortage of funds and lack of appropriate technology are constraints to water harvesting. Technology, *per se*, is available, but it either comes at a high cost requiring continuous government support or it is relatively inexpensive but unsuitable from an environmental and/or managerial point of view. Irrigation development in the highlands faces mounting pressure from declining economic justification.

Another constraint is the geo-physical environment of the country. The young Himalayan mountains are vulnerable to erosion hazards. Landslides are a natural phenomenon in the fragile ecology of young mountains. This is further accelerated by human activities. Slopes that have attained some degree of stability are disturbed by construction of channels and clearing of land for cultivation. Natural drainage patterns are changed and the additional water introduced into the area causes erosion and eventually landslides.

There is a tendency to favour infrastructural development over institutional building. While infrastructure is essential, it has to be complemented by adequate support mechanisms in the form of functional institutional arrangements. This is commonly ensured through training local government staff and farmer organisations, either to promote new local organisations, or to improve the way existing ones work. Formally constituted local organisations are the means by which the state and farmers assign rights and responsibilities to each other.

Different training techniques, *inter alia*, use of social organisers and farmer-to-farmer training, can be adopted. However, training should not be confined to operational management of infrastructure but should also highlight concerns for resource mobilisation for their maintenance (Vincent 1995).

Almost all the development policies and programmes are intended for the country as a whole. Therefore, there are no special programmes aimed at marginal farmers, though these would be desirable from the perspective of ensuring social equity among all users. Marginalised farmers are on the fringe of society and need special attention to draw them into the mainstream.

It is taken for granted that water will always be available in limitless quantities. Adequate quantities of good quality water are no longer freely available in quite a few places. There is growing competition for water, and it is inevitably the marginalised farmers who feel the brunt of such developments. It is essential to adopt appropriate technology to increase the efficiency of water-harvesting systems.

Considering that women are the ones directly involved in water collection and/or use, gender concerns need to be addressed in a proper light. Policies and programmes must be

gender-sensitive so that women have equal opportunities to participate in planning, execution, and monitoring and evaluation of water development programmes.

In Bhutan we are fortunate that the population is still within manageable limits. Most of the problems associated with water in more populous countries are absent. This and the bountiful water resources have ensured that there is no crisis at the moment. However, with a high rate of population growth and expansion of industries, the situation may quickly change to an unfavourable one if appropriate measures are not taken. It is more or less accepted that, in view of the limited land resources available, horizontal expansion is not an easy option. This means that the increase in food production has to come from vertical expansion or by intensifying use of the available land. Efficient use of land and water has to be stepped up; improved seeds and modern irrigation techniques need to replace the present lot.

People's participation is the underlying principle of the decentralization policy of the government. Thus, there is active involvement of stake-holders with the *Gewog Yargye Tshokchung* (GYT) or Block Development Committees and *Dzongkhag Yargye Tshokchung* (DYT) or District Development Committees in all policy and programme formulation, providing the forum to voice their wishes and aspirations. This has been reinforced by the government's commitment to strengthen their institutional capacity. It has launched the 'Gewog' (Blocks) Development Fund (GDF) programme to make limited funds available for the Gewog to enable farmers to plan and implement projects prioritised by themselves. These would, if required, receive assistance from the districts and central agencies (Kammeier 1998).

With devolution of power to the village and block level, farmers can now choose where to invest their resources. The GYT has the authority to decide on the utilisation of resources available within the Gewog (Block). If, however, resources have to be mobilised from outside the block, then it should be addressed at the DYT at the district-level for their equitable distribution and allocation. Again, any change in the utilisation of a shared resource requires the consent of the other party (s) or can be taken up by the DYT.

## 7. RECOMMENDATIONS

Since all surface and sub-surface water-related activities are closely interlinked through upstream-downstream relations, the whole river basin or the watershed must be considered in all water development policies and programmes (Abernethy 1996). In order to achieve this goal there is a need for a central organisation to coordinate such activities. This can be achieved by setting up a National Water Resources' Authority to conserve, develop, and allocate water resources.

Although water may not be a scarce resource, the cost of its abstraction is becoming increasingly more expensive. Cheaper alternatives like rain water harvesting, mulching, and collection of runoff need to be promoted for use. Mulching as a substitute for irrigation in apple and orange orchards is already being studied. More research is required on this and other methods of water supply.

Notwithstanding the present efforts initiated to promote stake-holder participation in the allocation and management of water resources, this has to be strengthened. The participatory approach can be used to reconcile multiple or contradictory objectives and to reduce conflicts over ownership and control of water.

Poor management of water can have devastating effects on the environment. Introduction of irrigation has led to large-scale clearing of natural land, pollution from intensive fertilizer and pesticide use, and introduction and spread of water-borne diseases (Oj 1996). Landslides caused by irrigation channels are a common sight in many mountain areas.

Schemes for conservation and delivery of water should take into account all ecological and societal considerations. Studies must be initiated to determine the choice of technology. Where appropriate, modern techniques like drip and sprinkler irrigation should be promoted by providing technical support.

The key objective for all policies and programmes should be sustainability. Relevant institutions and livelihood strategies must be promoted while protecting the environment.

Improving the capacities and capabilities of personnel involved is a prerequisite. Farmers need to be trained in operational management as well as resource mobilisation. Cost-sharing of infrastructure and their maintenance should be mandatory for farmers. Agency staff should be equipped to carry out proper planning, monitoring, and evaluation and to work more effectively under the user-participatory environment. Policy makers can also be sensitised to issues concerning water rights, equity, service improvement, and user participation.

Development activities for water supplies require substantial resources. Funding is required to develop programmes, set up and evaluate water databases, and provide support to user groups. Local resources may not be sufficient to cover the entire range of activities, necessitating recourse to external assistance. Some of the funds can be raised by involving the private sector in domestic water supply systems, for example; and these efforts could be supported by the government by providing subsidies and technical cooperation.

#### **BIBLIOGRAPHY (NOT NECESSARILY CITED IN THE TEXT)**

Abernethy, C. L. (1996) *Strategies for Inter-sectoral Water Management in Developing Countries: Challenges and Consequences for Agriculture*. Report of a DSE-ATSAF International Workshop. Berlin, Germany. Berlin: DSE

FAO (1990) 'Terminal Report, Accelerated Food Production Programme', Bhutan. UNDP/FAO Project BHU/89/001. Thimphu, May 1990

Irrigation Action Plan (IAP) (1994) 'Technical Assistance to the Kingdom of Bhutan', Draft Final Report Phase 1., TA No. 1956 – BHU. Manila: ADB

Kammeier, H. D. (1998) *Towards Standardised Projects ('Templates') under the Gewog Development Fund (GDF)*. Thimphu: UNDP/Ministry of Home Affairs

Ministry of Agriculture (1995) *Livestock Policy and Strategy Document, 1995*. Thimphu: Ministry of Agriculture, Royal Government of Bhutan

Ministry of Home Affairs (MOHA) (1998) *Guidelines on Various Types of Land Transactions, 1998*. Thimphu: Ministry of Home Affairs. Royal Government of Bhutan

- Meinzen-Dick, R. S. (1998) 'Managing Competition for Water Resources'. In *Agriculture and Rural Development*, Vol. 5. No. 2, 6-9
- Oi, S. (1997) 'Introduction to Modernisation of Irrigation Schemes'. In *Proceedings of the Expert Consultation on Modernisation of Irrigation Schemes: Past Experiences and Future Options*, RAP Publication 1997/22, *Water Report 12*, 9-16. RAP
- Pradhan, P. (1998) 'Draft Final Report on Asian Development Bank Technical Assistance to the Kingdom of Bhutan for Irrigation Programme Strengthening Project'. Thimphu: ADB/Ministry of Agriculture
- Ministry of Health and Education (1998) *Rural Water Supply and Sanitation (RWSS) Intensification Proposal, 1998*. Thimphu: Health Division, Ministry of Health and Education
- Upadhyay, K. P. (1995) *Shifting Cultivation in Bhutan: A Gradual Approach to Modifying Land Use Patterns*, Community Forestry Case Study Series No. 11. Thimphu: FAO
- Vincent, L. (1995) *Hill Irrigation: Water and Development in Mountain Agriculture*. London: Intermediate Technology Publications

## ANNEX 1

### Relevant Organisations/Institutions/ Programmes

1. Land Record Division, Ministry of Home Affairs, Tashichodzong, Thimphu
2. Research, Extension and Irrigation Division, Ministry of Agriculture, Thimphu
3. Forestry Services Division, Ministry of Agriculture, Thimphu
4. Crops and Livestock Services Division, Ministry of Agriculture, Thimphu
5. Rural Water Supply and Sanitation Unit, Health Division, Ministry of Health and Education, Thimphu
6. Division of Power, Ministry of Trade and Industries, Thimphu
7. Gewog Yargye Tshokchung (GYT), or *Block Development Committee for each of the 202 Gewog (blocks) in the country*
8. Water User Associations (WUA) ; formally constituted for government-assisted schemes and informal ones for the rest.