

## CHAPTER IV

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### 4.1 Introduction

The fast growing population and their impact in terms of unplanned land use, cultivation on steep slopes, overgrazing, exploitation of forest resources and unplanned tourism, all are affecting Himalayan biogeophysical, socioeconomic, cultural and religious environments. These are leading to degradation of landscapes, drying up of natural springs, eutrophication of the aquatic water bodies, reduction and disturbance in the habitat of the wildlife.

Livelihood in the rural areas of the Himalayan region depends on subsistence farming. These farming systems are location and niche specific and highly dependent on surrounding natural resource base (Sharma *et al.* 1992). The population of Sikkim is predominantly agrarian, with more than 80% being engaged in subsistence agriculture. The state is likely to face natural resource availability problem with limited area for cultivation to meet the requirements of ever rising population. The growth in population and limitation in job opportunities in recent years is yet another dimension that will have impact in the region. Pandey and Singh (1984) have described in detail how the surrounding forest ecosystem provides considerable amount of energy for the operation of the hill agroecosystems in the form of animal fodder and wood. Wyatt-Smith (1982) came to much on the same conclusion placing emphasis on the need for a multidisciplinary approach, rather than the current narrow sectoral approach to the hill mixed farming, if ecological disaster is to be avoided.

Khecheopalri lake lies in the mountainous region that is revered as seat of sacredness possessing huge biodiversity. The landscape change resulting from the growing human population in last 35 years has caused tremendous impact on the biodiversity and hydrology. Pilgrimage and tourism to the lake have increased the demand for basic resources such as firewood for cooking and fodder for rearing livestock that yield animal products for floating population. The extraction of firewood and fodder, and grazing and trampling have adversely affected the lake surroundings. Tourism has considerably increased the garbage accumulation and littering in a serene area which is a distinct negative impact. Thus the present chapter focusses on the socioeconomic status of the people, tourism growth, cultural diversity, and human-forest interaction in the context of pressures in the lake basin.

## **4.2 Materials and methods**

### **4.2.1 Sampling design and survey**

The socioeconomic data was generated by comprehensive primary survey of households covering the entire settlement. Information on the population structure, agriculture practices, livestock population and its types, and resource utilization pattern were collected. Participatory Rural Appraisal (PRA) technique was also applied for information on species preference for fuel wood, fodder and timber. Fuelwood use pattern of the local community was generated by random sampling of 45 units that included 34 households, 2 tea stalls, 3 lodges and 6 restaurants during the fete survey. The fuelwood requirement per day by a family was quantified using a physical balance of the sample households, and was repeated three

times a year i.e. spring, rainy and winter seasons. Visitor's record was made by collecting information at the entry gate of the Khecheopalri lake through primary survey and from the tourist hut records. A local resident was engaged in collection of data on tourist and pilgrim arrivals on daily basis. Questionnaires were also used for information collection, and formal and informal interviews were made with the tourists.

Khecheopalri festival is a very important activity and therefore environmental impact assessment of pilgrimage on the lake in 1997 and 1998 was made during the festival. Fuelwood use was assessed by interviews with the communities and shop owners for the festival period. Solid waste surrounding the lake was quantified and categorizing into biodegradable and non-biodegradable waste after the festival and tourist seasons. The local community was fully involved in these activities. The past history about the lake sacredness was also collected through the PRA exercises. The Khecheopalri Holy lake Welfare committee (KHLWC) was a key organisation that conducted most of the activities, and their support and help was always rendered specially in community related activities.

Woody biomass of the standing trees in the lake watershed was estimated using allometric relationship specific to each species using diameter at breast height and tree height (Sundriyal and Sharma 1996; see Chapter V). The head loads of fuel wood collected by the villagers from the lake watershed forest were recorded every month and then pooled for annual estimates. The villages of the watershed were ethno-botanically surveyed and the techniques of Bye (1986) and Croom (1983) were followed.

The removal of forest floor phytomass was calculated on the basis of apparent bite size and bite rate of each type of animal (Personal communication, H.B.K Singh). Fodder collected by the local community was also estimated based on the head loads on yearly basis from the watershed forest of 91 ha where the pressure of grazing and the collection for stall-feeding was immense.

Carrying capacity of the watershed with regard to fuelwood extraction of the total dependent population was calculated following Singh and Singh (1992) for the entire watershed forest and in the area falling directly to the lake. The net ecosystem productivity was calculated by subtracting removed biomass from the productivity of the standing trees (Binkley and Arthur 1993; Sundriyal and Sharma 1996).

The conservation activities done during the project providing the information on the types of training, number of days and participants trained are listed.

## **4.3 Results and Discussion**

### **4.3.1 Human Drivers**

#### **4.3.1.1 Population structure**

The Ramam watershed has an area of 12 km<sup>2</sup> in which the two revenue blocks 'Kecheopalri' and 'Chojo' are present. These two blocks comprised of 80 households with 488 population. This included a few settlements residing at the lake watershed of which the Puthung village comprised of 5 households having 28 people while Ringdara and Gaucharan area with 3 households having 18 people. Parts of Khecheopalri block with 10 households and Tshelling dara from Chhojo

block with 17 households fall at the upper ridge of the lake watershed in south - west direction. Hence a total of 35 households reside in the lake watershed practicing farming in the form of agriculture and livestock rearing. An average household size is 6 persons. The density of the population is 41 person per sq. km. The male contributes 53% and female 47%. The number of females per 1000 males is 873. The local people live in ethnic style in wooden houses having main livelihood from traditional agriculture and follow typical culture. Lepchas are the ethnics comprising of 90% of the total population in Khecheoplari and Chhojo blocks (Table 4.1). The village literacy was 41.85% to which male contribute 57% and females 43%. Basic amenities such as preprimary school, one health ICDS center and two monasteries are available (Table 4.1).

#### **4.3.1.2 Occupational structure**

The main livelihood of the people is subsistence farming. Out of 80 households only 11 households were involved directly in tourism (Table 4.2), 2 households in making handicrafts and 2 household members employed in government service. Most of the families grow large cardamom as a cash crop, which provides substantial income.

#### **4.3.1.3 Agricultural production**

Agriculture is the main occupation of the people more strongly following the agroforestry practices. Cereals from the main crop used primarily for household consumption. The rain-fed cultivation of millets, buck wheat and maize were commonly observed. Ginger and cardamom are the two cash crops widely cultivated in the Khecheopalri area. Ginger is sown in the month of March-April and harvested in October-November. The large cardamom is a perennial crop harvested during September-October. Maize

is generally sown in the month of March and millet in the month of May. Potatoes are grown twice a year in the month of February and October. The green vegetables are grown seasonally for their own consumption.

#### **4.3.1.4 Animal husbandry**

The total livestock population was 362, which belonged to almost all families, and comprised of cattles (115), sheep (45), goat (106) and pigs (96) (Table 4.1). They are reared for their own use except for milk for tourists and three families specially practiced poultry on a small scale for meeting the requirements of tourists.

#### **4.3.2 Tourism growth**

In the past few decades the promotion of tourism in the state of Sikkim has triggered arrival of large number of tourists that has been bringing both social and economic changes. Tourists are mainly attracted for nature and biodiversity (Rai and Sundriyal 1997). Therefore a new dimension of tourism linked with economic development and vis-a-vis biodiversity conservation has been evolving. Khecheopalri lake has also been recognized as an important tourist destination in the recent past. Pilgrimage is also another form of tourism and the Khecheopalri is a destination of high value for both pilgrimage and nature lovers. Since tourism to Khecheopalri has been started only recently the families involved in the tourism are very less in number and have been increasing slowly. The domestic tourists are mainly day visitors that has limited the scope of diversification as an occupation to the local people. The data on the tourist inflow prior to this work was not properly recorded and maintained for Khecheopalri. In 1998 out of 1,43,410 visitors coming to

Sikkim only 13% arrived Khecheopalri. There is a general perception that the majority of the tourists come for recreation but in the case of Khecheopalri, like the visitors came mostly for pilgrimage. Visitor numbers have grown from 16,068 in 1997 to 18,713 in 1998 (Fig. 4.1). During 1998 visitor arrivals comprised of 10,913 tourists and 7,800 pilgrims (Fig. 4.1). About 3336 visitors came for the Bhumchu festival in 1997 of which three thousand were pilgrims. In 1998 the total number of Bhumchu festival visitors increased to reach 5042 having around 4500 pilgrims (Table 4.3).

Tourism in Khecheopalri lake is distributed through out the year, however two peak seasons are between spring (March to May) and fall (October to November). Fall season (October to November) was badly affected in 1998 especially with the domestic tourists due to a major landslide on the approach road. Majority of the domestic visitors come from West Bengal state of India and were day visitors spending 2-3 hours at the lake site, while the foreign visitors spent about 2-3 days and trekked in the area. Most of the foreign visitors were free and independent trekkers. Although the numbers of international tourist arrivals have been low they contributed higher income to the local community (Personal communication, Iyatta Maharana). The tourism in Khecheopalri has been gaining ground recently and increased by 14% during 1997 and 1998 inspite of road disruption for long time, and it is expected to draw more visitors in the near future.

### 4.3.3 Religio-cultural feature

The two main festivals associated with the lake are “Cho-Tsho” and “Bhumchu”. The local communities perform regular rituals during the full moon day and new moon day. The rites and rituals are performed by communities and pilgrims on their own or aided by Buddhist monk or a Hindu priest (see Photoplate 3).

“Cho-Tsho”, falls in the month of October after the cardamom harvest which is a thanksgiving festival basically for providing them food. The villagers group together and collect the money from each household and perform rituals in the lake and enjoy the feast together. The other festival is “Bhumchu” where the lake goddess is worshipped to maintain peace and harmony in the village for the forthcoming year. This festival falls in the month of February/March. Idols of gods made up of flour; colours and butter were seen arranged beautifully with lighted lamps and offerings. The monks and the local communities performed the rites and rituals for three days. Pilgrims generally put the prayer flags around the lake (about 11-108) in bamboo stick or the small trees of *Symplocos thaefolia* or *Eurya acuminata* in which the prayers are inscribed in the name of dead relatives or sick men, and also for the fulfillment of wishes, or for maintaining peace in the family. Rituals on the lake are performed traditionally since time immemorial as stated by the senior citizens of the area. This festival is a major attraction for the pilgrims of Sikkim and Darjeeling and also from adjoining countries like Bhutan and Nepal.

### 4.3.4 Garbage

The heavy inflow of visitors during the religious festival showed some negative impacts on the serenity of the lake specially in the form of noise,

littering, garbage dumps, motor vehicle pollution, resource extraction and the offerings made in the lake water. The estimated garbage showed that non-biodegradable waste was generally contributed by toffee wrappers, biscuit foils, soft drink cans, and mineral water bottles. These were mainly contributed by domestic tourists although their stay was for a few hours.

Garbage quantification in 1998 after the festival showed that the total garbage collected was 452 kg out of which 62% was biodegradable and 38% non-biodegradable wastes (Fig. 4.2). The total garbage collected during the tourist season was 2375 kg in and around the lake, comprising 87% biodegradable and 13% non bio-degradable (Fig. 4.2). Around 3000 kg of solid waste were deposited annually in the watershed area that was categorized as 81% biodegradable and 19% non-biodegradable wastes.

#### **4.3.5 Resource extraction**

##### **4.3.5.1 Fuelwood**

Although the local communities and the pilgrims have strong beliefs for the lake, this is limited to the sacredness of the lake and water. The exploitation practices in the watershed in the form of extraction of trees for fuelwood and timber has led to maximize the growth of secondary species (*Symplocos*, *Eurya* and *Viburnum*) and thereby changing the forest composition and types. Besides, the dependency of local community on certain plants has led to squeezing of certain canopy species (see Chapter V). The open mixed forest has mainly the pressure of timber extraction, whereas the fuelwood collection was found more on the degraded forests that is located just above the lake and bog. Mostly the ladies and children collect the fuelwood and fodder (see Photoplate 2). The pressure of

grazing was also found immense in this area which is mostly due to easy accessibility and nearness of surrounding villages.

Biomass removal from the lake watershed by harvesting the entire tree was estimated to be 1042 Mg/yr from the degraded forest and 646 Mg/yr from the open mixed forest in 1998 (Table 4.4). The collection of fuel wood was for six months from November to May except one month in between (February or March) when the extraction was completely restricted due to the "Bhumchu" festival. The collection through chopping down of branches accounted 99 Mg/yr and total removal was 1787 Mg/yr from the lake watershed forest (Table 4.4).

The utilization pattern of the removed biomass from the watershed accounted 52% as fuelwood, 41% as timber and 7% for 'other purposes' such as in making handicrafts, field implements, weapons, for putting prayer flags and funerals (Table 4.4). The timber was used mainly for construction and repair of houses, and animalsheds. Family wise construction generally takes place once in 10-25 years. A few households even practice illegal trade of timber. The entire watershed forest falls under the reserve category of the Department of Forest, Govt. of Sikkim.

Firewood is the only source of energy for cooking. The daily consumption of the fuelwood by the local community ranged from 16 to 25 kg/day/ household depending on the season. The lodge consumed 105 kg/day for cooking food for tourists. During Bhumchu festival teashops used 420 kg of firewood every day. Out of total fuelwood used about 93% was by the community households, 0.3% for 'Bhumchu' festival, 3% for tourism and 3.7% for curing of large cardamom.

Out of the 9.5 Mg/ha/yr of net woody biomass production (see Chapter V), 2.5 Mg/ha/yr was removed in 1997-1998. Hence a net balance of 7 Mg/ha/yr remained as net ecosystem productivity. The ecosystem productivity is 1.29 times higher as compared to the productivity of the Mamlay watershed of south Sikkim (Sundriyal and Sharma 1996) which may be due to the difference in altitude, higher rainfall and humid climatic conditions.

The carrying capacity of the region with regard to fuelwood requirement was calculated both for the entire watershed area and area falling directly to lake and bog. The fuelwood availability from the entire watershed forest was 4.84 times more than that of the fuelwood demand of the existing population if the sustainable harvest rate was considered at 0.3 level and it is 8 times higher when the sustainable harvest rate was considered at 0.5 level. However if only 91 ha area was considered where the pressure of resource extraction was immense it was only 0.43 times higher than that of the fuelwood demand at 0.3 level and 0.72 at 0.5 level sustainable harvest rate. The carrying capacity of the Khecheopalri lake watershed in terms of fuelwood requirement showed 3.5 times less as compared to the central Himalayan forest (Singh and Singh 1992) when the pressure of fuelwood is considered for the area falling to the lake is calculated.

Besides, the removal of timber and fuelwood, and fodder collection the forest has a pressure of non-timber forest product (NTFP) collection (see Photoplate 2). Most of the NTFPs collected are for the household consumption. State Forest Department has planted trees of *Cryptomeria japonica* at certain locations in north western direction of the lake where

the area was denuded by the local community. It has been observed that plantation of such species has tremendous effect on the growth of floor phytomass and very sparse vegetation came under *Cryptomeria* (Sundriyal 1995).

#### **4.3.5.2 Fodder, grazing and browsing**

Fodder demands for the livestock are met from the lake watershed forest. Some households even let animals free for grazing. The annual fodder production was 299 Mg/yr (see Chapter V) from the 91 ha area of the watershed which falls directly to the lake and bog, and where the pressure of livestock was immense. The fodder consumption by cow was 16.5 kg/day/animal and sheep 6.1 kg/day/animal. Total fodder removed by the grazing animal through free grazing was 18 Mg/yr of which 21% removal was recorded from the bog mainly by cattle. The remaining 79% grazing occurred in the watershed forest. In the forest 74% of the removal was by cattle and rest by the sheep. The stall-feeding was 121 Mg/yr. The total removal of fodder was 139 Mg/yr that accounted as 47% of the annual primary production of the herbaceous biomass (Table 4.4). The net ecosystem productivity for the herbaceous biomass was 1.75 Mg/ha/yr. Around 47% of the herbaceous biomass and 26% of the woody biomass was extracted annually from the watershed forest. Thus the Khecheopalri watershed forests are within the carrying capacity for firewood and fodder extraction.

#### **4.3.6 Conservation initiatives**

A number of conservation initiatives were taken by the local communities in the lake and watershed area. (see Photoplate 3) An action plan for various conservation activities were developed by involving local

community and the lead role was taken by 38 community members (Table 4.5). Various trainings related with ecotourism were imparted by our project that included 'Guide cum teahouse operator' and 'vegetable growing' trainings. The operators were trained on the capacity for better services to the visitors. A co-financing by each participant for a training was ensured for meaningful participation. The seed production and vegetable growing trainings were given to the farmers for encouraging entrepreneurship to local community and there by providing fresh vegetables to tourists as well as opportunities of economic development. The video shows and the slide shows were arranged during the Bhumchu festival for 5 days for general awareness on environment and health of the lake. The activities carried out by the local communities as conservation work during the year was also shown. This ensured more participation by local local communities. Awareness shows of conservation and ecotourism prospects of other sites were also organized for community benefits. Nearly 450 people that included old, young and children of both the genders from the community participated.

Khecheopalri is a unique destination, which has a large number of attraction attributes for visitors. It being a sacred lake, having an important religious festival also attracts pilgrims. The pilgrimage and tourism to the lake can be associated with the economic development of the local populace apart from their sedentary farming. The uniqueness of the destination is also attributed to a rich biodiversity. Therefore economic development associated with conservation of forests and biodiversity in the form of ecotourism can be one livelihood option that can be sustainable and can equally tranquillize the nature lovers ■

**Table 4.1** A socio-economic profile of the Khecheopalri area

Parameters	Value (s)
<b>Total area (ha)</b>	1209
<b>Revenue villages (Chojo and Khecheopalri)</b>	2
<b>Households</b>	80
Total population	488
Persons/household	6
Population density	41
<b>Sex ratio (%)</b>	
Male	53
Female	47
<b>Ethnic composition (%)</b>	
Lepcha tribe	90
Others	10
<b>Literacy rate (%)</b>	
Total	41.85
Male	57
Female	43
<b>Livestock</b>	
Total	362
Cattle	115
Sheep	45
Goat	106
Pig	96
<b>Amenities</b>	
Preprimary school	1
ICDS	1
Monastery	2

ICDS = Intergrated child development scheme

**Table 4.2** Occupational structure of the people in Khecheopalri

Primary occupation	Male	Female	Total
Agriculture and subsidiary laborer	50*	16	66
Handicraft products	5*	-	5
Tea shop	2	1	3
Grocery shop	2	2	4
Beetle shop	1	-	1
Lodges for tourist	3	3	6
Monk	5	-	5
Porters/Guides	6*	0	6
Government services	2	2	4
Poultry farming	3	3	6

\* Involved in both tourism related activities and agriculture

**Table 4.3** Bhumchu festival survey during March in Khecheopalri

Year	1997	1998
<b>Duration (Days)</b>	4	6
<b>Shops</b>	15	21
Tea stalls/Restaurants	8	10
Puja items	4	4
Vegetable	2	2
Hosiery goods	1	2
Exhibition shops	0	3
<b>Hawkers</b>	12	34
<b>Visitors</b>		
Total presence	3336	5042
Tourist (International)	51	62
Tourist (Domestic)	285	480
Local Pilgrims	3000	4500

**Table 4.4** Production, removal and utilization pattern of woody biomass and the production and removal of herbaceous biomass from the Khecheoplari lake watershed forest

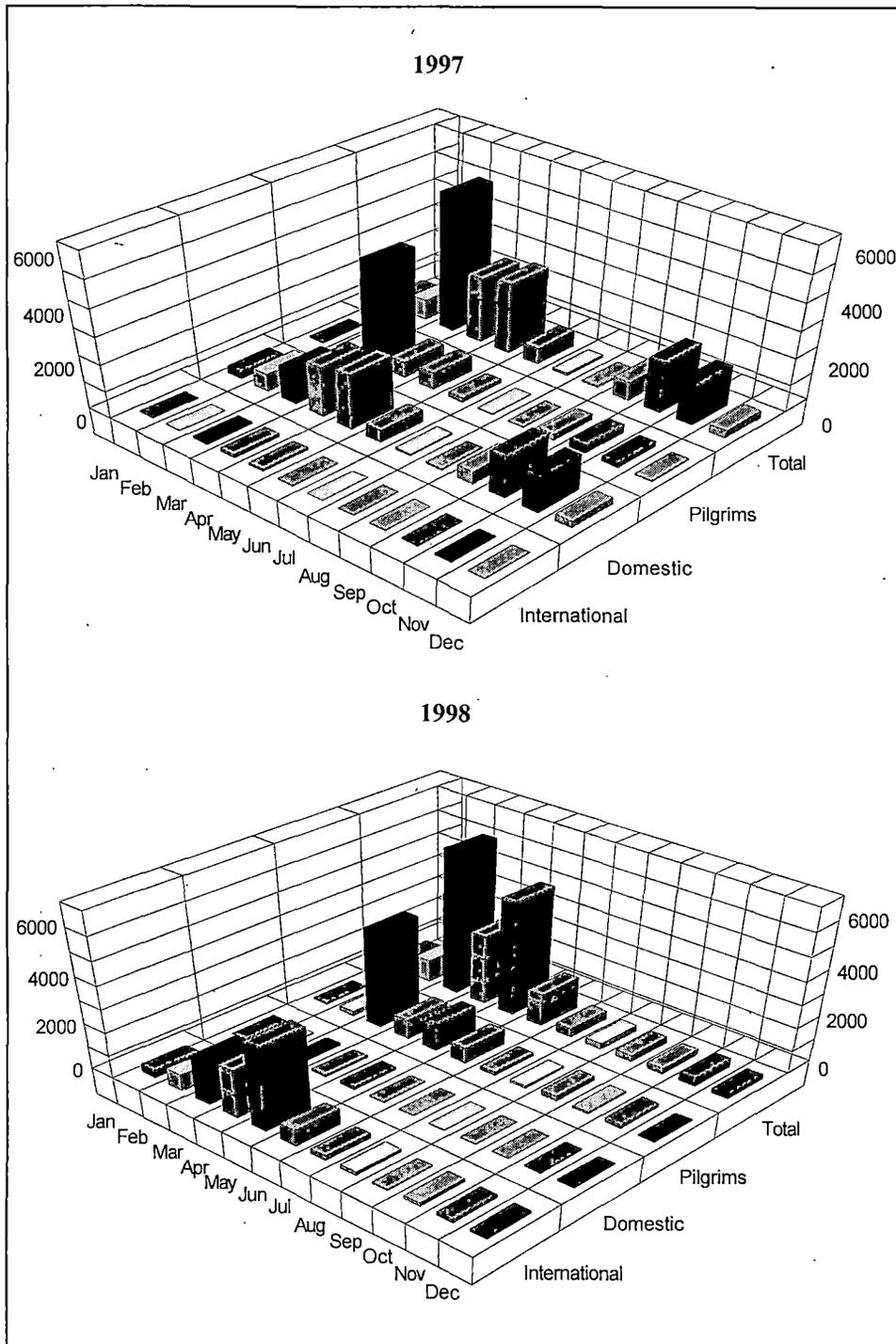
Parameters	Unit	Total lake watershed (Mg/yr)
<b>Production</b>	9.5 Mg/ha/yr	9673 <sup>a</sup>
Removal pattern		
Removal of tree		
<sup>b</sup> Degraded forest	4.1 Mg/ha/yr	1042
Open mixed forest	1.5 Mg/ha/yr	646
Chopping of branches	0.39 Mg/ha/yr	99
Total annual removal		1787
<b>Utilization pattern</b>		
Fuelwood		
<sup>c</sup> Annual household use	7.5 Mg/household	866
Annual tourist use	15.75 Mg/lodge	45
Festivals (Bhumchu)	0.42 Mg/day	2.5
Cardamom curing		35
Timber		
Household use	6.29 Mg/yr	724 <sup>d</sup>
Others		115
Total		1787
<b>Forage production</b>	3.28 (Mg/ha/yr)	299
<b>Removal pattern</b>		
Stall feeding	1.33 (Mg/ha/yr)	121
Open grazing	0.20 (Mg/ha/yr)	18
Total		140

a = Total production calculated from 1018 ha which includes degraded and open mixed forest; b = Degraded forest includes the 91 ha area falling directly to lake; c = Total household number dependent on the lake watershed forest 115; Forage production and removal calculated for 91 ha forest area; d = Timber generally used at a period of 10–25 years, besides few households also practice illegal commercialization.

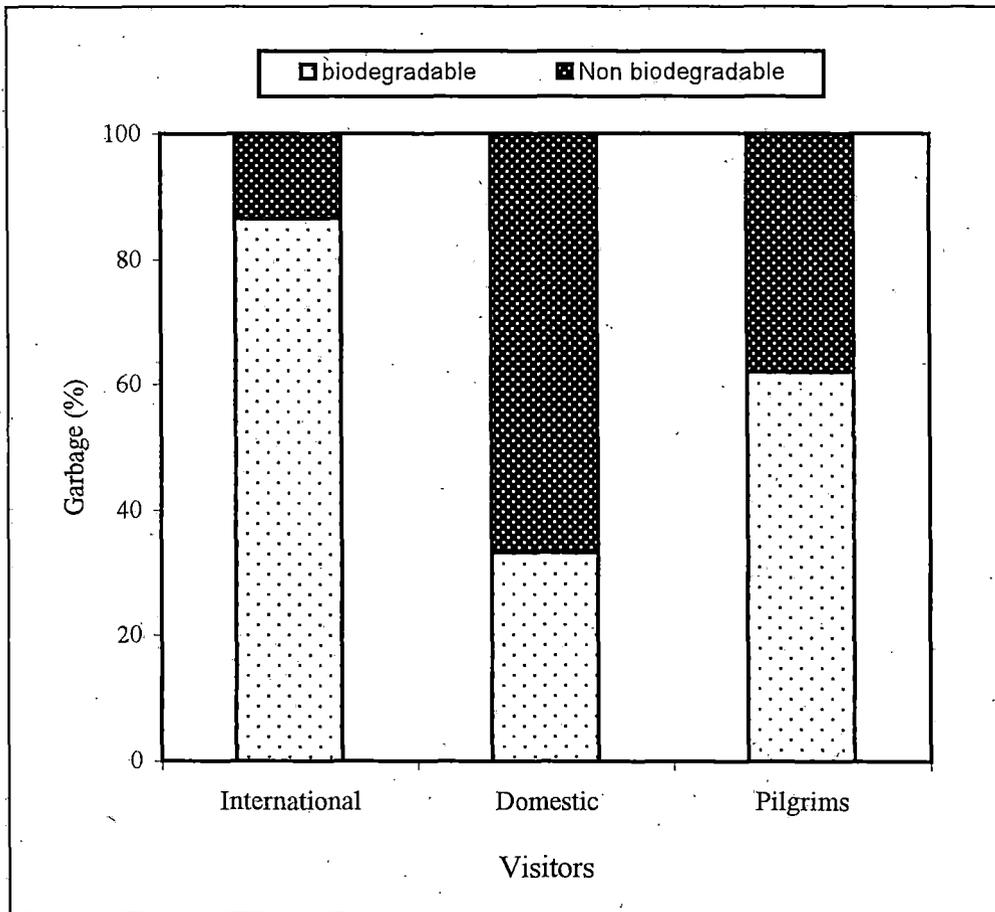
**Table 4.5** Conservation activities initiated during the project in Khecheopalri.

	Activities No. of days	Participants		
		Male	Female	Total
Participatory Rural Appraisal	7	37	19	56
Action Plan for conservation	2	19	19	38
Placement of Signboards	2	6	3	9
Afforestation in the lake watershed	1	18	2	20
Installation of smokeless cooking furnace	1	3	1	4
Guide & Tea house operators training	4	7	0	7
Video and slide show on conservation	5	200	250*	450
Vegetable growing training	3	5	3	8

\* Also Includes children



**Fig. 4.1** Tourism growth in the Khecheopalri during 1997 and 1998



**Fig. 4.2** Solid waste deposition in the lake watershed from pilgrimage and tourism