CHAPTER - 9

CONCLUSIONS AND RECOMMENDATIONS
9.1. CONCLUSIONS

The Himalayas form an unstable zone. Being tectonically active, economically underdeveloped and the most densely populated mountain ecosystem, they are highly vulnerable to human intervention and impact. Here the natural factors cause more harm to environment but the human interface aggravates the situation. There has been serious imbalance in the Himalayan ecosystem brought about by over-exploitation of the natural resources. When the environment starts to deteriorate on steep mountain slopes, it deteriorates quickly far more so than on gentle slopes and on plains and the damage is far more likely to be irreversible. The major causes of environmental change in the Himalaya are various anthropogenic activities particularly land use not only those of present but also the impression of past activities. Land management objectives have changed with time with changing socio-economic conditions, technological innovations and policy interventions, leading to change in traditional land use practices.

The Lidder catchment is experiencing high growth rate of population, large scale deforestation, tremendous increase in degraded waste lands and pilgrimage as well as recreational tourism which is adversely affecting the carrying capacity of the region. If the current rate of population growth, the influx of tourism and deforestation continues, the Lidder catchment will become very fragile and might face an ecological disaster.

Socio-economic transformation and LULC change has impacted heavily on the regional environment, mainly manifested by the extension of cultivation into marginal lands and forested areas, degradation of cultivated lands, deterioration of grazing lands, soil erosion, landslides, increase in the mean monthly minimum and maximum temperatures and the development of tourism. The preceding analysis has revealed that the Lidder valley is undergoing an undesirable LULC change that poses a serious threat to its fragile ecological environment. Being the leading tourist node receiving more than 70 percent tourist arrivals of Kashmir valley accompanied with domestic anthropogenic pressure, the existing carrying capacity of the Lidder valley has been exceeded thus adversely affecting its sustainable tourism base. Thus the need of the hour is to explore and devise the sustainable tourism development strategies that would form a unique symbiosis and harmony with natural environment. In fact such strategies must focus on working for a regenerative ecosystem that should promise stability in economic, social and ecological environments.

The study area is experiencing an increasing anthropogenic interference as a result of mass tourist inflow which has changed the demographic and economic scenario of the catchment. This situation has stressed the already weak economic base of the area which is characterized by heavy reliance on agricultural sector and other natural resources especially the forests. The energy and food requirements of the native and floating tourist population are being met through local resource base which have mainly encroached the forest resource of the area. The high rate of fuel wood utilization on long term basis both in commercial and domestic sectors has posed a potential threat to the forest stock of the area which may lead to large scale deforestation and degradation of forests. Besides this the weak tourist infrastructure base, biased and unplanned economic
activities of the local dwellers and non-existence of government tourism policy, have resulted in a continuous and fast change in the LULC of the catchment from forest to non-forest uses and the consequent degradation of the various available resource potentialities of the catchment. The tourist carrying capacity has been assessed in order to attain sustainable tourism development by limiting the number of tourist arrivals as the present tourist flow exceeds the tourist carrying capacity of the region in summer season.

Environmental issues should be dealt together. Isolated measures to cope with one of them can sometimes make others worse. There is the need to develop an integrated interdisciplinary methodology for the investigation of sustainability in its three major dimensions- ecological, social and economic. The watershed is the smallest unit where the evaluation of human-induced impacts upon natural resources becomes possible. The resource development programmes are applied generally on watershed basis and thus prioritization is essential for proper planning and management of natural resources for sustainable development. Remote sensing and GIS are very useful in assessing the spatio-temporal dynamics of various socio-economic and geo-physical characteristics of an area over a given period of time. This study has shown that remote sensing and GIS can be used as appropriate tools for watershed prioritization.

The magnitude and intensity of the human impact is not same throughout Lidder catchment. The analysis has revealed that some of the watersheds are experiencing growing anthropogenic pressure beyond their carrying capacity which has resulted in unhealthy changes in their ecological framework. The prioritization of the watersheds has enabled to assess the varying degree of human impact these regions are prone to, if not utilized rationally with respect to the environmental carrying capacity. The resource potentialities of the catchment need to be evaluated objectively to identify the potential sectors of development and their carrying capacity which would help in the integrated development of the catchment and its stakeholders in an eco-friendly and sustainable manner. Therefore any conservation and management strategy of the Lidder catchment needs to be formulated on the basis of the watershed prioritization.

9.2. FINDINGS

The inferences and findings not only lead to vital insights possible for enhancement of scientific knowledge in the area of research on environmental change, but also to local decision making by identifying new approaches for analysis of natural resource management practices and its associated impacts at watershed level. The main inferences drawn from the present study are summarized as follows:

I. The Lidder catchment with an area of 1159.38 km² constituting about 10 per cent of the total catchment area of river Jhelum is predominantly a mountainous one bounded on all sides by lofty mountains except on south. The upper parts of the catchment comprise of exposed rock surfaces and cliffs mostly overlaid with recessional moraines and a number of prominent glaciers and high altitude lakes. The middle part of the catchment has a considerable area under dense forests and large sized meadows. A number of small terraced alluvial fans and cones have been formed along the main drainage channel. The lower parts of the catchment are covered with flood plain of river
Lidder and a sporadic presence of Karewa lands could be observed in this part of the catchment. The general elevation ranges from 1596 meters (Gur Village) to 5425 meters (Kolahoi peak) with the average altitude of 3510 meters. Out of the total area only 22.4 per cent has moderate slope while more than 60 per cent has steep to very steep slope.

II. Lidder river which is formed due to the confluence of East and West Lidder streams is one of the major right bank tributary of river Jhelum. It is a 6th order stream comprising of 3857 lower order streams. Horton’s law of stream lengths and Law of stream numbers holds good in Lidder catchment.

III. The climate of the catchment is governed by altitude, topography and amount of rainfall received. The valley experiences temperatures varying from as low as -9.8°C in the winter to as high as 27°C in summer. The mean minimum as well as the mean maximum temperatures have increased considerably (1.1°C each) during the last three decades. The catchment receives 124 cm of average annual precipitation with its considerable share in the form of winter snowfall. The precipitation has decreased by 12 cm associated with a corresponding decrease in the number of rainy days by nine days during the last three decades.

IV. Lidder river has 914 cusecs with the highest discharge recorded for the months of May and June (1733 cusecs and 1729 cusecs respectively). The discharge has initially increased by 120 cusecs from 890 during the decade 1961-70 to 1010 cusecs in 1971-81. However the discharge has registered a decreasing trend from 1971-81 to 1981-90 where it has decreased by 40 cusecs and has remained constant (834 cusecs) from the last two decades. The discharge has decreased for only those months which experience relatively higher temperature (June to November) with the highest decrease of 772 cusecs recorded for June while it has increased in the months which have relatively low temperatures (December to May) with the highest increase of 368 cusecs recorded for the month of May.

V. The Lidder catchment comprises of eleven watersheds among which six watersheds are inhabited by 120 rural settlements and three urban centers of Pahalgam, Aishmuqam and Seer Kanaligund while five watersheds are uninhabited.

VI. The catchment is inhabited by a population of 2.34 lac persons (Census of India, 2011) distributed among 35.8 thousand households with the average household size of 6.5 persons per household. The number of households has registered a growth of 197.3 per cent from 1961 to 2011 with the average annual household growth of 3.95 percent. Urban population constitutes 9.7 percent which has shown a growth of 1080 percent from 1961 to 2011 mainly because of the addition of two new urban centers in 2011.

VII. The distribution of population is highly uneven as 89 per cent of the total population is residing in only two watersheds while five watersheds are uninhabited. The sex ratio is 947 females/thousand males which is higher than the sex ratio of 883 females/thousand males for the state of Jammu and Kashmir and 914 females/thousand males for the country as a whole (Census of India, 2011). Literacy rate is 53.3 per cent with the male literacy rate of 64.2 per cent and female literacy rate of 41.8 per cent.
against the literacy rate of 68.74 per cent for the Jammu and Kashmir state with the male literacy rate of 78.26 per cent and female literacy rate of 58.01 per cent (Census of India, 2011).

VIII. Population density is 201 persons/km² which is much higher not only than the state average of 124 persons/km² (census of India, 2011) but also than that of Indian Himalayan Region as a whole (74 persons per square kilometer). The physiological density is very high in Lidder catchment (1597 persons/ km² of net sown area) owing to high growth rate of population on one hand and constant net sown area available on the other hand.

IX. Population of catchment has grown more than 3.3 fold from 69.3 thousand persons in 1961 to 2.34 lac persons in 2011. The highest population growth rates in the watersheds 1E7B1 and 1E7A7 are directly related to tourism. The proportion of the population in the age-group of less than 14 years is 25.4 percent whereas 6.3 per cent is in the age group of 60 years and more. The economically productive population in the age group of 15 to 59 years age constitutes 68.3 per cent of the total population.

X. The occupational structure is dominated by primary sector (45.7 per cent) followed by service sector (44.7 per cent) while the secondary sector is quite insignificant as only 9.6 per cent of the working population is engaged in small scale household industrial sector. The primary sector is dominating in the lower parts of the catchment where agriculture land is available while tourism dominates in the upper parts of the catchment. About 68.3 percent of the population is in the economically productive age group that could be fully utilized as a human resource. The percentage of actual workers is 41.8 percent with the employment gap of 26.5 per cent while as participation rate of workers is 61.3 per cent with the dependency ratio of 0.46. The average household income has been estimated at Rs. 7250/month.

XI. The magnitude and pattern of energy consumption for both households and hoteliers reflect a high degree of dependence and use of fuel wood as a source of energy for different purposes especially for cooking and heating purposes. The average consumption of fuel wood has been worked out to be about 430 quintals/day comprising of 280 quintals/day by households and 150 quintals/day by hoteliers and guest houses. The average consumption of fuel wood for the households is about 10 kg/household/day. Easy access to firewood, lower levels of household income, commercialization of fuel wood and limited availability and lack of accessibility to procure LPG are among the leading causes responsible for heavy dependence on fuel wood. The commercialization of fuel wood has contributed towards the augmentation of household income for a number of rural households. It is mostly the women folk and the unemployed youth who are involved in the collection of fuel wood which is being supplied to the hotels and guest houses mostly comprising of low and medium category hotels. A considerable part of fuel wood is also converted into charcoal which is in high demand throughout the Kashmir valley used as a heating fuel during the winter season.

XII. Live stock constitutes one of the significant ancillary primary economic sectors of the entire catchment. It has a livestock population of 3.05 lac units with the highest
number found in watershed 1E7A1 (1.6 lac) because it covers more than 48 per cent of the total villages of the catchment. This huge livestock population is mostly fed on the meadow and grazing lands of the catchment which may lead to their degradation in the absence of proper regulation and management strategy.

XIII. The per capita land availability is 5.5 kanals/household. The expansion of commercial farming of apple orchards and steady growth in the tourism industry have initiated a series of developmental impulses to facilitate the improvements in the regional economy which is largely subsistence based. This has brought drastic change in land and resource use. The household economy strongly depends on access to common or state owned forest or grazing land as private agricultural holdings are small and many are land less in Lidder catchment.

XIV. Lidder valley receives more than 70 per cent of the tourists visiting Kashmir valley which has boosted the process of urbanization in the area. The three months of May, June and July constitute about 83 percent of the total tourist flow to Pahalgam. These three months bare more than seven lac tourists (including yatrees) which is certainly beyond the carrying capacity of the region which has been estimated at 4300 tourists/day for summer season. The tourist flow to Pahalgam is well below the carrying capacity for most part of the year. The growth of tourist flow has been associated with a corresponding growth in tourist accommodation infrastructure. There are presently 231 accommodation units comprising of 84 hotels and 147 guest houses having about 2907 rooms with a capacity of 5763 beds which exceeds the exiting threshold number of daily average carrying capacity of 4300 tourists/day. The comparative analysis of bed capacity, room strength and tourist flow to Pahalgam and primary survey of tourists has revealed that there is shortage of accommodation during the months of July and August as daily tourist flow during these months is higher than that of the available accommodation because of Yatris. However the availability of accommodation at Nunwan base camp which provides accommodation for yatrees has considerably reduced the pressure on the hotels and guest houses. While as during the remaining part of the year room occupancy levels are significantly low in all categories of accommodation sector which suggests that the existing tourist accommodation capacity is not only adequate but also in excess to the existing average tourist carrying capacity.

XV. The tourist accommodation sector generates about 2682 metric tons of solid waste annually comprising 975 metric tons from hotels and 1707 metric tons from Yatri (Pilgrims) base campuses. The three months of June, July and August constitute about 83 per cent (2231 metric tons) of total annual generation with an average generation of about 24.77 metric tons/day. The per capita generation of solid waste is about 2.40 kg/day.

XVI. Three tourist potential regions were identified in Lidder catchment on the basis of tourist attraction, infrastructure and tourist activity.

XVII. The varied topography of Lidder catchment greatly determines the degree of variation in LULC pattern within the region. The LULC pattern has been changing since 1960’s as a result of the mounting pressure on the natural resources. The increasing
anthropogenic pressure mostly on account of growth in tourism sector and agriculture developments has lead to undesirable LULC change in the catchment.

XVIII. The area under dense forests has decreased by 191.53 km$^2$ from the year 1961 to 2010 with the average annual loss of 3.91 km$^2$ per year. The sparse forests have registered a variable trend throughout the study period. They have initially registered an increase of 13.62 percent from 1961 to 1992, but in the decade of 1992 to 2001, they showed a slight decrease of 0.67 percent. However from 2001 to 2010, they have decreased by 9.79 percent. This could be attributed to the fact that the dense forests were initially changed into sparse forests and in the later stage these sparse patches were utilized for agriculture and residential purposes.

XIX. The area under glaciers has also decreased from 42.49 km$^2$ in 1961 to 20.59 km$^2$ in 2010 registering the negative growth of 51.54 percent with the average annual loss of 0.45 km$^2$. The area under horticulture has registered an increase of 49.96 km$^2$ from 1992 to 2010 with the average annual increase of 2.78 km$^2$ which amounts to the average percentage growth of 7.58 percent. Waste lands have increased from 154.69 km$^2$ in 1961 to 307.2 km$^2$ in 2010 registering a growth of 98.59 percent with the average annual growth of 2.01 percent. While as the area under water bodies has decreased from 1961 to 2001 but has increased from 2001 to 2010 registering the overall negative growth of 9.74 percent from 1961 to 2010 which amounts to the average annual loss of 0.2 percent. Area under meadows have initially decreased from 1961 to 1992 but then increased from 1992 to 2010 with the overall increase of 12.67 km$^2$ which amounts to the average annual increase of 0.26 km$^2$ (0.72 percent). The area under scrubs has also shown an increase of 13.22 km$^2$ from the last fifty years with the average annual increase of 0.27 km$^2$. They have decreased from 1962 to 1992 but increased from 1992 to 2010.

XX. Built-up area has increased from 0.5 km$^2$ in 1961 to 2.22 km$^2$ in 2010 thus registering a growth of 347.05 percent with the average annual growth of 7.08 percent. The area under agriculture is decreasing from 187.9 km$^2$ (in 1961) to 113.27 km$^2$ (in 2010) on account of the land use change from agriculture to horticulture and partly due to the conversion of agriculture area into residential areas. The area under waste lands, horticulture, meadows and built-up has increased at the cost of the area under forests, water bodies, agriculture and glaciers. In case of the uninhabited watersheds the trend of LULC change is that of decrease of dense forests, water bodies and glaciers and increase in waste lands.

XXI. The Lidder catchment has been divided into three priority regions. The high priority region is under tremendous tourist pressure while as in the medium priority region demographic drivers have a major role in environmental destruction. The low priority region constitutes the uninhabited watersheds of the catchment.

9.3. SUGGESTIONS

The Lidder catchment being mountainous area is characterized by diverse physiographic disposition comprising of immature landforms and fragile ecological set up which are highly susceptible to various natural and anthropogenic influences. The
catchment is undergoing through unprecedented and undesirable LULC changes mostly driven by the processes resulting in the rapid expansion of agriculture related activities, unplanned urbanization and development of mass tourism related infrastructure which have also lead to adverse impacts on the Lidder watershed system leading to the degradation of its vital natural resources. The symptoms of deterioration are quite noticeable in the form of deforestation, deteriorating aquatic system and changes in hydro-meteorological regime, degradation of meadow and pasture resources and highly undesirable changes in the various LULC categories. The following set of recommendations framed on the basis of the inferences drawn from the present study have mainly focused to address the key concerns of watershed degradation driven by a wide range of anthropogenic influences. These recommendations are expected to serve as vital inputs for formulating the sustainable natural resource management strategy to ensure the sustainable development of the available resource potentialities of Lidder catchment.

I. The Lidder catchment being a mountainous one is very fragile and every development programme must be viewed in terms of its environmental impact before implementation. A comprehensive land use plan must be formulated for Lidder catchment in order to avoid the negative effects of haphazard and unplanned development. It is important to mention here that the undesirable LULC change has not only resulted into increase in mean minimum and mean maximum temperature but has also caused reduction in annual precipitation and glaciers in the catchment. The cultivation on the higher slopes must be stopped or at most the cultivation of only permanent tree crops must be encouraged there. The agricultural land is under tremendous impact as physiological density is very high in Lidder catchment. Employment opportunities must be provided in other sectors in order to reduce burden on agricultural lands and to raise standard of living of the inhabited population.

II. Though the regional economy is largely a subsistence agrarian economy with its roots in agriculture and livestock pastoral activities, it has also a heavy reliance on tourism sector. Tourism industry constitutes the main source of substantial portion of household income and also provides a wide range of employment opportunities to the bulk of its work force. Though given the huge potential of tourism in employment and revenue generation, the developmental benefits of this sector have not trickled down to the gross root level. The economic benefits especially with regard to reasonable levels of income generation are yet to be shared by the larger sections of the rural common population of the area as these have remained largely confined to a section of the affluent urban class from Anantnag and Srinagar city. This inequitable share of economic benefits may lead to social unrest in the local population which needs to be addressed as they constitute an important component in capacity of local stake holders whose involvement and participation is quite significant in the process of promotion and growth of sustainable tourism industry in the region. The seasonal character of tourism sector, low level of social development of local population and the lack of integration of local economy with tourism sector constitute the plausible causes for lower levels of economic benefits of tourism sector for the larger sections of the local population. It is
pertinent to propose here that the tourism policy in the region should be adopted as a useful and relevant strategy for alleviation of poverty of the masses. All the possible forward and backward linkages of the local economy need to be explored and strengthened in order to integrate it with the tourism sector necessary for the generation of higher levels of employment and income for local masses. It is also proposed that the local population may be encouraged and also facilitated by way of offering short term social and technical training programmes to equip them with necessary professional skills needed in carrying out various activities in the tourism industry.

III. The high rate of fuel wood utilization both in commercial and domestic sectors needs to be curbed by taking appropriate measures as it could pose a serious threat to the available forest stock of the area. There should be easy availability of LPG in the villages in order to encourage its domestic use by the households. And at the same time mandatory restrictions shall be imposed on the use of forest firewood consumption by hotels and guest houses.

IV. It is imperative that the daily tourist flow needs to be regulated during the peak months as per the carrying capacity limit as a part of sustainable eco-tourism strategy. It is therefore proposed that the existing tourist accommodation infrastructure of hotels and guest houses need not to be expanded, instead a moratorium on the construction of new hotels, guest houses and tourist huts should be put in place for a reasonable period of time. Efforts should be focused to improve the quality of the available accommodation infrastructure by way of ensuring the suitable management of sewage and solid waste a much desired activity not only for maintaining a safe public health and hygiene but also to preserve aquatic ecological system of this picturesque tourist node. Pahalgam has got a huge winter tourism potential which needs to be promoted. A well developed comprehensive infrastructure like accessibility, uninterrupted power supply, winter sports infrastructural facilities needs to be provided for promotion of winter tourism.

V. A number of ecologically sensitive areas such as dense forest areas, meadows and pasture lands and river fronts have been marked for construction of hotels and huts for tourists. This process of encroachment on forest and other ecologically sensitive areas is proposed to be curbed effectively. The construction of hotels is also taking place along the sloppy foothills which could activate the process of destabilization of these vulnerable foot hill slopes. Any type of constructional activity on slopes more than 30 degrees may not be allowed. Instead both agronomic and engineering measures need to be initiated for the stabilization of these steep slopes for the stability of landforms.

VI. The existing practice of both solid waste collection and disposal is not only unscientific but inadequate as well. The collected solid waste of the town is dumped openly at Sarbal, a site located on the right bank of a stream flowing into Lidder river which poses a potential threat to pollute the river waters especially during the torrential rainfall. An alternative site needs to be selected away from the water body for its safe disposal preferably in the vicinity of downstream area outside the limits of PDA. Subsequently an Integrated Solid Waste Management may be put in place for efficient
waste management for the area focusing on waste prevention, recycling and composting and combustion and disposal in properly designed, constructed and managed landfills.

VII. The Yatra base camps of Nunwan, Zagipal, Chandanwari and Sheshnag are not also adequately equipped to deal sufficiently with the collection of solid waste during Yatra period. Considerable quantities of unmanaged solid waste from these camps and also huge quantities of solid waste have been found in the form of trail garbage all along the route to Amarnath cave which finally get their disposal in the main water body of Lidder river. All these problem need to be attended on priority basis in order to avoid its hazardous effects on the land resources and aquatic system of the area.

VIII. The per capita land availability in Lidder catchment is very low (5.5 kanals/household). The region being the mountainous one is not that suitable for agricultural purposes. Adequate measures must be taken to reduce soil erosion as it was found that agricultural is practiced on higher slopes. More over irrigation facilities are lacking especially in the upper watersheds which depend on rainfall only. Irrigation facilities need to be provided so that people may enjoy higher returns from agriculture. Assistance must be given to the farmers to grow such vegetables that are extensively used by hotels and guest houses.

IX. The livestock population outnumbers human population in the Lidder catchment. Overgrazing of the meadows must be stopped and the recent range management techniques must be adopted.

X. Where population pressures do not permit a return of mountain slopes to forest, which might be the ecological ideal, the introduction of permanent tree crops like apples, apricots, nuts or timber plantation may be a good compromise. Horticulture is important in Lidder catchment as it provides not only the higher income per unit area of land but also more employment and can be practiced on marginal lands which are otherwise unsuitable for the production of field crops.

XI. An agro-forestry programme is urgently needed to support watershed management and to meet the growing demand for fuel and fodder which is otherwise met by deforestation. The problem of waste lands has not been perceived properly in the hills especially in view of their large scale expansion, community participation for rehabilitating waste lands should receive top priority.

XII. Lidder catchment is an educationally backward area. Special care must be taken to make this area educationally sound so that people can respond positively to the changing social, economic and physical environment. The position of woman in the society should be improved by providing them education as woman literacy is very low as compared to male literacy in Lidder catchment.

XIII. Demographic attributes figure among the prominent drivers of watershed degradation in the catchment. People should be sensitized about the various consequences of over population as the population growth is very high in Lidder catchment.
XIV. Participatory approach involving local stakeholders should be adopted in the management and development of natural resources. This would not only help in easy implementation of various development programmes but would also generate public acceptability. For every watershed a people’s committee should be formed comprising representatives from every village of the watershed.

XV. The watershed prioritization carried out in the present study must be adopted as it would act as a means of sustainable development by identifying the various causes of environmental degradation in Lidder catchment.