Chapter Five

MAJOR ANTHROPOGENIC ACTIVITIES AND ITS ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

Chapter 5.0 Major Anthropogenic Activities and Its Economic, Social and Environmental Impacts

5.1 Introduction

This chapter examines the major anthropogenic activities that have intense influence on the natural environment. These activities are agriculture, tourism and hydroelectric power generation, which demonstrate strong interrelationship with the economic, social and physical environment of this remote mountain region. All these activities have their own significance with respect to the local as well as national economy. These activities are no less important one for the other in the social dimension of CH. However, these human activities exert each a different degree of environmental pressure on this mountain ecosystem. Therefore, it is important to examine the significance of these activities in the social and economic dimensions, as well as understanding the pressure exerted on the environment and its implications.

5.2 Agriculture

5.2.1 Background

The non-seasonal mild and cool temperature in CH is favorable for the cultivation of many sub-tropical and temperate crops, such as tea, temperate vegetables, ornamental plants, fruits and beverage crops (Ko *et. al.,* 1987, Midmore *et. al.*, 1996/a). The history of farming activities in CH can be traced back to as early as the 1930s when an access road was constructed from the town of Tapah in the lowland. In 1934, Chinese vegetable farmers settled in the Bertam Valley (Leong, 1992). The first tea plantation, BOH Tea Estate was established in 1929 (Kanan, 1999). On the other hand, floriculture started during the colonial days in 1930. In those early days, the pattern of development was set for hill resort, tea plantation and vegetable farming.

However, the development in CH was intensified during the 1970s and 1980s. Tourism and agriculture became the focusing sectors in the development plan of CH. Lately, vegetable farming is the most important agricultural activity, occupying 51.1% of a total of 5,192 ha of agricultural land in 1993. It is followed by 39.2% and 6.9% for tea and temperate cut flower cultivation in the same year, respectively.

Vegetable

Vegetable cultivation in CH is an important agricultural activity locally as well as in a national scale. Vegetable cultivated land in CH represents 14% of total land cultivated with vegetable in Peninsular Malaysia. CH produces more than 80% of some types of the vegetable in Peninsular Malaysia. These include Broccoli, Snow Pea, Butter Bean, Sweet Pea, Chinese Box Thorn, Chinese Cabbage, Sweet Pepper, Sweet Leek, Carrot, Chinese Radish, Spinach, Chinese Celery, Head Lettuce, Sawi Itik, Indian Lettuce, Green Ceylon Spinach, Watercress and Garland Chrysanthemum (**Appendix A: Table A-1**).

The most popular vegetable cultivated are English cabbage (395 ha), Chinese cabbage (367 ha) and tomato (398 ha). English cabbage is relatively easy to grow and farmers have long experience in cultivating English cabbage. Crop duration is three months for English cabbage, two to three months for Chinese cabbage and four to five months for tomato. After harvesting, most of the farmers obtain services from transporters to send their vegetables to the main road. Lorry operators will pick up the vegetables and send them to wholesale markets in Ipoh, Kuala Lumpur and Singapore. About 50% of the vegetables are sold in Selayang, the major wholesale market in Kuala Lumpur, 25% in Ipoh and 20% in Singapore.

Floriculture

The expansion of floriculture started in the late 1980s due to the increase in demand from oversea markets. Excellent export markets of flowers, which ensures a better income and stable price, encourages some vegetable farmers to shift to floriculture. Ko *et. al.* (1987) reported that flower farms occupied 200 ha of land, and there were 40 flower nurseries in 1987. FAMA estimated that there were 638.24 ha of floriculture land and 250 farmers in 1995 (**Appendix A: Table A-2**). Chrysanthemum, rose and carnation are the main flowers cultivated in CH. Based on the 1995 figure in **Appendix A: Table A-2**, more than 35% of the total floriculture area was devoted to chrysanthemum cultivation and it contributed more than 56% of total production of flower stalks in CH.

Tea

Ko *et. al.* (1987) reported that the area under tea plantation was about 2,500 ha. However, recent estimation showed a decrease in the total hectarage. In 1997, tea plantation in CH constituted 65.7% (2,036 ha) of total tea cultivation area of 3,000 ha in Malaysia (Kanan, 1998). However, the Department of Agriculture estimated 2,309 ha of tea plantation in CH (Department of Agriculture, 1999).

The decrease of tea cultivation is also shown in this study. The total tea cultivation area in the hydroelectric catchments of Telom and Bertam was 1,766.5 ha in 1974, and it was reduced to 1,237.5 ha in 1997, according to the respective land use map of the year. It is expected to further decline due to the conversion into other land use types that promise higher economic return such as vegetable farming, floriculture and infrastructure development.

5.2.2 Economic Impacts of Agricultural Activities

The importance of agriculture in Malaysia is clearly spelled in the National Agriculture Policy 1992-2010. One of the aims of the policy is to attain a targeted self-sufficiency level of 125% in vegetable production by 2010. Data in 1990 showed that the production of vegetable has increased by 4.2% per year to 224,000 tons. It is expected to increase at 9% and 7% per year during the period of 1991 to 2000 and 2001 to 2010, respectively. However, self-sufficiency of food commodities decreased from 93% in 1990 to 87% in 1995, despite the increasing local food production. The growth in production had not been able to meet the rising domestic demand, thus resulting in the escalation of imports. Total food import was RM3.5 billion in 1985 and increased to RM7.7 billion and RM10.0 billion in 1995 and 1997 respectively (Department of Agriculture, 1998/b). Import bills for vegetables in 1995 were RM575 million. This figure increased to RM882 million in 1998 and RM610 million in the first eight months of 1999 (Ministry of Finance, 2000).

The increase in deficit of vegetable production is expected to continue. Therefore, the pressure on vegetable production is intense. Thus, intensification of farming is required to meet the target and more land is required for this purpose. Consequently, it aggravates the competition for land among vegetable production and for other land use.

By sampling 10% of the farmers in 1992, Midmore *et. al.* (1996/a) estimated that the daily production of vegetable was 179 tons with an annual production value of RM56 million (off farm). It is in agreement with the estimation by the Malaysia Agriculture Research and Development (MARDI), which was 180 tons per day with a value of RM0.15 million (Dumsday *et. al.*, 1991). Thus, the annual value was about RM54 million. However, this figure is significantly below the estimated RM100 million by the Department of Agriculture (Dumsday *et. al.*, 1991). On the other hand, the annual production recorded by the Federal Agricultural Marketing Authority (FAMA) of CH for English cabbage and Chinese cabbage was 33,400 tons and 21,500 tons in the year 1999, respectively (FAMA, 1999). As the majority of the farmers only harvest crops 25 days a month, daily production of both cabbage was 111 tons and 72 tons, respectively. Thus, FAMA estimated a total daily vegetable production of 400 tons to 450 tons, which was significantly higher than Midmore's figure in 1992. Based on the wholesale market values, FAMA estimated that the total daily production value of vegetable was in the range of RM600,000 to RM700,000. This gave an annual market value of RM180 million to RM210 million. **Table 5.2.1** shows the various estimations discussed above. Note should be taken that the estimations by Midmore *et. al.* (1996/a), and MARDI were based on the price the farmers were paid, and the FAMA's estimation was based on the value at the wholesale market. Moreover, it is expected that the consumer pay much higher price than the wholesale price. Besides, the production quantity estimated in 1999 was double that of the early 1990s.

Vegetable is taken to the wholesaler market on a consignment basis. The farmers are only paid after the sale. Based on the market prices, the wholesaler will determine the price for the farmers. Thus, on top of the production risk, the farmers bear most of the risk of the fluctuation of the market price. At the wholesale market in Ipoh, the average price for English cabbage in 1997 and 1999 was RM1.39/kg and RM1.30/kg with a standard deviation of 0.28 and 0.37, respectively. **Table 5.2.2** shows the fluctuation of the prices of Chinese cabbage and tomato. However, farmers do obtain credit for production purposes in terms of cash, fertilizers, pesticides, seeds and other physical inputs. The study in 1991 by Lam (1995) showed that only 36.8% of the farmers used credit to finance an amount less than 20% of the production input. On the other hand, 15.8% of the farmers were totally dependent on credit to finance their production input.

Table 5.2.1.

Estimated Values of Vegetable Production in Cameron Highlands.

Sources	Year	Production Rate (tons/day)	Annual Value (RM million)	Remarks
Midmore *et. al.* (1996a)	1992	179	56	Farm Price
MARDI	1991	180	54	Farm Price
Department of Agriculture	1991	-	100	Farm Price
FAMA, Cameron Highlands	1999	400-450	180-210	Wholesale Price

The locally produced cabbage is more expensive than the imported cabbage, especially those from Indonesia (BT, 07/08/2000; NST, 31/03/2001). The production cost of cabbages in Indonesia is very much lower than in Malaysia. When vegetable supply flooded the market and the price dropped sharply, farmers resort to destroy thousands of tons of the vegetables in order to boost the price (BT, 07/08/2000; BT, 19/03/2001).

Analysis from Midmore (1996/a) indicated that, among most types of vegetable, manure and fertilizer are the cost drivers, which account for the largest portion of the material cost. Other major costs of farming include hired labor cost, building of plastic shelters, platform terracing and land rental. Midmore's calculation also indicated that about one-quarter of all the farmers interviewed lost money occasionally, as it was expected that the farmers on the whole make losses in some years and make profits in most years. The net annual income per farm is RM10,974. On the other hand, net return per hectare per year for most vegetables at average prices varies between RM9,000 and RM14,000, while onion and radish seem to generate low returns, whereas peas, tomato and capsicum generate above average returns (Midmore *et. al.* 1996/a).

Table 5.2.2.

The Average Price of Cabbages and Tomatoes at Ipoh Wholesale Market.

Price in Ipoh Wholesale Market	1997		1998		1999	
	Average RM/kg	Standard Deviation	Average RM/kg	Standard Deviation	Average RM/kg	Standard Deviation
English Cabbage	1.39	0.28	-	-	1.30	0.37
English Cabbage (Indonesia)	1.26	0.32	1.70	0.69	1.29	0.39
Chinese Cabbage	1.12	0.23	1.53	0.56	1.30	0.21
Tomato	-	-	2.41	0.86	2.68	0.89

Source: Federal Agricultural Marketing Authority (FAMA), Malaysia, *Market Information* in http://agrolink.moa.my/fama/maklumat%20pasaran.html, last updated in September 2000.

On the other hand, floriculture is a highly lucrative industry in CH. There had been a steady increase in the export of cut flowers from about RM18 million in 1988 to RM40 million in 1992 (Jaafar, 1995). In 1995, the export value of flower estimated by FAMA was RM80 million, which were about 75% of the total flower produced in Malaysia. However, the total hectare dropped from 638.24 ha in 1995 to about 264.3 ha in 1998 (Department of Agriculture, 1999) due to declining export market. The main importers of flower from CH, namely Singapore, Thailand, Hong Kong and Taiwan faced economic crises in 1997.

Even through floriculture is becoming more important and generates great profit, reliable data on the cost and returns of floriculture is not available (Midmore *et. al.* 1996/a). Among the important cost factors are fertilizers, fungicides, construction of rain shelters, and labor costs. For example, as flowers are grown under plastic roofed rain shelters, the construction of one acre of rain shelter is estimated at a cost of RM60,000 (Chiang, 1995) with a lifetime of two years (Midmore *et. al.* 1996/a).

The average annual tea production in Malaysia is 6,000 tons. Although Malaysia exports a small quantity of tea (about 300 tons), its local demand exceeds the production. Thus, the annual import of tea is about 7,000 tons. Tea production in 1998 was 3,850 tons per year. Tea is sold from the factories to wholesalers at an average price of RM7 per kg (Kanan, 1999). The total value of tea production in CH is estimated at RM27 million. However, the consumer at Kuala Lumpur purchases tea at RM10 to RM15 per kg depending on its grade.

5.2.3 Social Impacts of Agricultural Activities

As shown in the analysis of Chapter 4, the agricultural sector contributes significantly to job opportunities in this mountainous region. In the year 1980, the agricultural sector provided 7,305 employments out of 8,528 in the primary sector. It increased to 7,891 in the year 1995, which was 64% of the total available job in CH as in the CH Structure Plan (CHDC, 1996).

There were 2,182 farmer families, including floriculture and vegetable, in CH. The monthly income for vegetable farmers was in the range of RM601 to RM1,500 (CHDC, 1996). The average number of persons living in a farm household was estimated at 5.8. Most of the farmers depend solely on vegetable farming as their income (Midmore *et. al.* 1996/a). However, there is no reliable data on the income of floricultural farmers. Besides direct employment, indirect servicing industry of agriculture also provides job opportunities and helps to reduce out migration rate.

Information from the Land Office in CH (in the year 2000) showed that 2,150 ha of land tenure were under official Temporary Occupational License (TOL). The majority of farmers in CH cultivate vegetable under this TOL land tenure, 67% in the study by Midmore *et. al.* (1996/b) and 76.2% in the study by Taylor *et. al.* (1994).

Each TOL holder is given an average of 0.4 ha of land. However, average farm size was estimated to be 0.8 ha by Midmore *et. al.* (1996/a). No land survey is required in the process of TOL application. The application will be considered based on the location of land and the other state policies. The applicant is required to comply with the terms of TOL and Land Conservation Act, 1960. TOL is valid for five years. Extension of the TOL has to be reapplied for the sixth year. The State reserves the rights to reject the renewal of license. However, only a few cases of TOLs had been revoked (Midmore *et. al.*, 1996/a).

Under the state regulation, land trespassers can be fined not more than RM10,000. However, it does not seem to deter illegal farming on state land. There are frequent newspaper reports of illegal farming and enforcement needs to be enhanced (NST, 10/12/1994; NST, 30/05/1995; NST, 11//10/1996; NST, 19/11/1996; NSUNT, 27/04/1997; NST, 07/10/2000/b; NST, 19/12/2000). However, there is no documented research on the extensiveness of illegal farming activities in CH.

Midmore *et. al.* (1996/a) also reported that 16% of all sampled farmers rent some of their land from others with an average annual rental cost of over RM7, 000/ha/year. Farming under TOL land and rented land are among the reasons that the farmers are reluctant to invest into soil protection measures such as plastic shelters and irrigation systems.

Tea is mostly cultivated as an industrial crop by plantations like BOH Tea Estate, Bharat Tea Plantation and Blue Valley Tea Plantation. Tea factories and plantations offer more than 900 job opportunities in CH.

It is observed that there are significant number of foreign workers in tea plantations, floriculture farms and vegetable farms. The shortage of workers can be attributed to more attractive job opportunities in the urban areas and in the tourism industry. The social impacts of increasing foreign workers have not yet been determined.

Another social dimension of utmost importance is the health of the farmers and farm workers. Chronic health hazards where the farmers are exposed to excessive pesticides have not yet been assessed. There is also the possibility of respiratory dysfunction caused by the exposure to aerosol biocides and fumigation under the rain shelters of floriculture (Wong *et. al.* 2000).

5.2.4 Environmental Impacts of Agricultural Activities

Vegetable, flowers and tea production in highland areas of Southeast Asia (e.g. Baguio in Philippines, Bandung in Indonesia, CH in Malaysia, Dalat in Vietnam) has been a lucrative industry since the colonial era. With the increasing demand for quality agriculture products, new land areas are being opened up despite the unfavorable topography (steep slope), high and intense rainfall (2500 – 3000 mm per year) and enormous environmental problems. The dissected land morphology of the highlands is conducive to severe soil erosion. Consequently, it can cause a loss in soil fertility that result in the excessive usage of fertilizers, mounting costs and declining productivity. Besides, it may lead to silting of irrigation systems and hydropower impoundment, eutrophication of water body, loss of life, destruction of infrastructure and properties due to landslides, loss of wildlife habitat, damage to public health, and increase of water treatment cost (Pimentel *et. al.* 1995).

5.2.4.1 Watershed Scale Analysis

For CH, assessment of environmental impact of agriculture can be carried out in a framework consisting of two spatial scales, namely watershed scale and field scale (see ***Plate A***). Watershed scale comprises of an aggregate of farms and other types of land use in an area forming the agricultural landscape (Smith and McDonald, 1998). Agriculture requires materials and services from the surrounding environment, such as climate, air, water and soil, and also the processes of purification, nitrification, decomposition and recycling of these materials. At this spatial level, the cumulative effects of individual agronomic and economic practice can become apparent. Such impacts will gradually affect the ecological sustainability, which is crucial for the maintenance of the life support capacity of this landscape unit (Lowrance *et. al.* 1986).

Land use analysis for 50 years in CH sheds light to the trend of agriculture encroachment into the natural tropical mountain forest. Two periods of abrupt increases of market gardening land acreage from 653.5 ha to 1,595.4 ha and from 1,743.4 ha to 3,048.6 ha occurred in 1974 to 1982 and from 1990 to 1997 respectively (**Fig. 5.2.1**). Thus, the rate of increase between 1974 to 1982 and 1990 to 1997 was 117 ha/year and 189 ha/year respectively. Therefore, in 1997, 17.8% (3, 048.6 ha) of the total land area (17, 103.8 ha) in the hydroelectric catchment was under market gardening, compared to 1.7% in 1947. The rapid development was mainly due to government policy of encouraging farming, the increases in accessibility with the development of road network and the use of heavy machinery in earth works.

In this mountainous area, flat land, which is suitable for farming, is expected to be very limited. Based on the digitized topographic map, analysis by using ARCVIEW gives the result that only 8.6% (1,470 ha) of land is having a slope of less than 6% in the hydroelectric catchment. On the other hand, 76.7% of the catchment area has a slope of more than 12°. Moreover, land that is steeper than 35° has a total of about 31%. Therefore, there are a relatively small area of land that is suitable for cultivating of short-term crops such as vegetables and flowers.

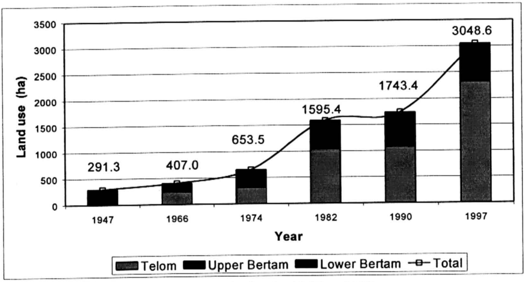

Fig. 5.2.1: Land use for Market Gardening in 1947 to 1997.

Comparing the land use for market gardening in 1990 and 1997, there were increasing trend of opening up higher gradient slopes. The total farmland on slope more than 12° had increased from 1,141.5 ha to 2,033.9 ha. It represented a 78% growth in a period of 7 years. Whereas, the total area of market gardening cultivated on the slope above 25° has expanded from 404.3 ha to 705.5 ha **(Table 5.2.3)**.

Steep slope farming for short cycle crops is susceptible to high erosion rates and landslides. The high erosion rates have not only reduced the soil productivity but have also generated tremendous impacts to the downstream waterway and water body. It is significant in view of the severe sedimentation problem in the Ringlet Reservoir, which requires immediate attention.

Tea plantation is a monoculture of tea, which normally grows until about a meter tall, and is planted systematically at hill slopes and matures in three to five years. Mature tea plantation forms a dense canopy that covers the surface soil. Due to the homogeneity of the bush, tea plantation has a beautiful landscape. Thus, this scenic landscape attracts numerous tourists to CH.

Table 5.2.3.

Distribution of Market Gardening (in ha and %) by Terrain Classes.

Slope	Land Area (ha and %)	Land Use for Marketing Gardening (in ha and in %)					
		1947	1966	1974	1982	1990	1997
0 - 2°	393.4 (2.3%)	17.0 (5.8%)	27.8 (5.1%)	21.1 (3.8%)	65.5 (4.1%)	65.7 (3.7%)	115.5 (3.8%)
2 - 6°	1,077.5 (6.3%)	37.3 (12.8%)	88.9 (16.4%)	60.4 (10.9%)	184.3 (11.5%)	196.5 (11.1%)	297.0 (9.7%)
6 - 12°	2,514.2 (14.7%)	65.5 (22.5%)	114.2 (21.0%)	108.6 (19.6%)	332.7 (20.8%)	372.1 (21.0%)	602.5 (19.8%)
12 - 20°	4,789.1 (28%)	67.6 (23.2%)	133.9 (24.7%)	145.2 (26.2%)	440.1 (27.6%)	495.7 (27.9%)	875.5 (28.7%)
20 - 25°	2,993.2 (17.5%)	31.7 (10.9%)	61.0 (11.2%)	80.1 (14.5%)	214.9 (13.5%)	241.5 (13.6%)	452.9 (14.9%)
> 25°	5,336.4 (31.2%)	72.0 (24.7%)	116.7 (21.5%)	138.3 (25.0%)	359.3 (22.5%)	404.3 (22.8%)	705.5 (23.1%)
Total	**17,103.8**	**291.1**	**542.5**	**553.7**	**1,596.8**	**1,775.7**	**3,048.8**
% of Total*	**100%**	**1.7%**	**3.17%**	**3.2%**	**9.34%**	**10.38%**	**17.82%**

Note: *Percentage of land area under market gardening of the total study area.

Source: Slope analysis for the three water catchment areas that contribute to the Ringlet Reservoir. Topographic map with 20 m contour from Survey Department was digitized. ArcView was used to generate slope classes and overlay with topographic map of 1947 and 1966 from the Survey Department, and land use maps of 1974, 1982, 1990 and 1997 from the Department of Agriculture, Ministry of Agriculture, Malaysia. However, further field survey is recommended to confirm the statistics derived from the various land use maps.

Tea plantation is mostly located in Telom and Lower Bertam catchment. **Table 5.2.4** shows the land area under tea cultivation in the hydroelectric catchment of CH during 1947 to 1997. In Lower Bertam, land use for tea cultivation was as high as 22.7% in 1974. However, in 1997, tea plantation only constituted 611.3 ha (45% of 1974) of land in Bertam catchment. The reduction was due to conversion of land use for farming and residential purposes during the 1980s and 1990s. However, the conversion was not completed and there remained a significant amount of scrub forest (935.4 ha in 1997) in the land formerly planted with tea.

Table 5.2.4: Land use (ha) for Tea Cultivation in 1947 to 1997.

Catchment	Total Area (ha)	1947	1966	1974	1982	1990	1997
Telom	10068	no record	586.5	645.6	626.5	606.8	626.2
		-	5.8%	6.4%	6.2%	6.0%	6.2%
Upper Bertam	2098	0	10	0	0	0	0
		0%	0%	0%	0%	0%	0%
Lower Bertam	4945	468.5	912.9	1120.9	952.7	914.8	611.3
		9.5%	18.5%	22.7%	19.3%	18.5%	12.4%
Total	17111	**468.5**	**1509.4**	**1766.5**	**1579.2**	**1521.6**	**1237.5**
		2.7%	**8.8%**	**10.3%**	**9.2%**	**8.9%**	**7.2%**

Thus, in the watershed scale, agriculture land use consisted of about 25% in 1997. The percentage is expected to grow, especially in Telom catchment, as vast new land was developed in recent years. The effects of an abrupt 25% change of land cover in this mountain region have not yet been studied.

In order to ensure continuous functioning of the essential life support system and productivity of the region, great precaution is required to maintain long-term sustainability. Despite this scientific uncertainty, development of agriculture is continuing to encroach into the forest and steeper gradient terrain in this mountainous catchment. In the light of heavy soil erosion problem, precautionary principle of sustainable development does not seem to be applied in the land use planning.

5.2.4.2 Field Scale Analysis

Besides watershed scale consideration of sustainability, field scale activities and management significantly dictate the fate of the catchment. Field scale is the basic management unit for agriculture land. Sustainability of the field involves maintaining or enhancing the productivity of the land resource base, which is predominantly biophysical in nature (Smith and McDonald, 1998). These factors include water use efficiency, nutrient balance, soil loss, pests and diseases management. However, if a field unit is presumably sustainable, it might also generate negative externality to the entire water catchment. The following analysis takes an approach to examine the environmental externality of the entire field management cycle, beginning from the forest clearing to the abandonment of the farm.

Vegetable Farming

During the process of opening up of a new field, the forest will be cleared and the undergrowth will be burned. Then, the farmer secures the service of tractors to level the steep terrain. As the average farm is relatively small, there is no requirement to perform Environmental Impact Assessment as prescribed under the Environmental Quality Act (1974). Therefore, there is no assessment whatsoever on the impacts of biodiversity, endemic species of flora and fauna, slope stability, water logging problems and soil erosion risk.

Terrain cutting involves mass removal of soil. This practice generates massive amount of loose soils that is vulnerable to erosion. Moreover, the fertile topsoil is also removed. Thus, high input of fertilizer is required to treat the soil. This will definitely increase the production cost of farming. Besides, modification of natural terrain, terraces will be constructed on the steep terrain. Other land plot formations for vegetable farming include flattened hilltop, gentle slopes at base of valley, wide terraces and irregularly shaped hills.

In order to minimize land degradation on steepland, the Department of Agriculture published guideline for highland cultivation of crops. The guideline also include conservation structures and agronomic measures for various crops and land slopes (**Appendix A: Table A-3**). However, the degree of compliance and enforcement is not known. Nevertheless, there are evidences of violation of the guidelines (see ***Plate B*** and ***Plate C***). These plates show that clearing of forest with heavy machinery, one-off land clearing without stages, no erosion protection measures that are all contradicting the guideline as recommended by the Department of Agriculture.

Terrain modification and land clearing are prone to severe soil erosion. Land was opened and left bared for a long period. Farmer cleared land in big scale in order for future expansion. Since farmers employ heavy machinery to open up land and modify terrain, it is cheaper to clear a large area of land. However, a long period is required to stabilize the soil and to plough the land for planting of vegetables, thus, severe erosion is expected during this lag period of bare land. ***Plate C*** shows bare land cleared for vegetable farming that suffered severe rill erosion. Based on the depth of the rill erosion, the land must have been cleared for more than a year.

Besides being a continuous process, soil erosion occurs at a few particular points in time, i.e. during land opening and events of extreme rainfall. Midmore *et. al.* (1996/a) estimated that soil erosion in one-off period of high erosivity is 155 tons/ha, comparing to an average soil loss in vegetable farm of 24 tons/ha/yr. On the other hand, Aminuddin *et. al.* (1999/b) estimated the soil loss in open vegetable farm could be as high as 40 tons/ha/yr. The filling of Ringlet Reservoir was more or less in line with the rate of the opening up of new land (Midmore *et. al.*, 1996/b). Thus, Midmore concluded that the major source of sediment was due to the initial soil loss at breaking of new land.

In CH, vegetable crops are grown on beds. The beds are on an average of 1 m wide, 7 to 15 m long, and are built out of soil from previous beds. Lime is used to increase the pH of the soil during bed making. Most of the farmers remade the bed every 22 weeks, because of poor soil (Midmore *et. al.*, 1996/a). Due to infertility of soil, resurfacing is required. It is done by covering the terrace with new soil from a face newly cut from the batter of the natural slope, or by scraping off the topsoil to expose the soil beneath. Midmore *et. al.* (1996/b) reported that platform terrace, which is constructed by heavy machinery and is prone to severe soil erosion, was occupying 92% of the farmland. Wong (1999) observed that 85% of sampled farms have erosion problems and Midmore *et. al.* (1996/a) reported that 73% of sampled farms have already experienced at least moderate rill erosion. Soil erosion also occurs from the back-slopes and the rises of terraces. Erosion will be more severe if there is no mulches or cover crops. Soil erosion commonly occurs in minor slumping, rill erosion, slumping and landslip.

Midmore *et. al.* (1996/b) also reported that farms suffer from water runoff from the higher altitude farms. Poor run-off water management will exacerbate soil erosion. On the other hand, there is no proper management of irrigation system too. Farmers built small dams to retain stream water for irrigation purposes. The safety of numerous small impoundments in a stream is not assessed. There are high possibilities of failure during heavy rain that cause flashflood and landslide. Moreover, competition for irrigation water is severe especially during the dry seasons.

CH does not experience extreme seasons throughout the year. Therefore, most vegetables can be grown year round. However, some seasonalities are encountered among species of vegetable, due to dry and wet seasons and also market driven factors. Midmore *et. al.* (1996/b) recorded that the harvesting time for cabbages is mainly motivated by the yearly market price cycle, and less determined by the dry or wet season. However, harvesting time is important in relation to soil exposure and erosion during pre-sowing, and before complete ground cover by the succeeding crop.

Farmer uses various types of organic and inorganic fertilizers as a basal dressing and also in post-planting applications. Chicken dung, Amina, Prawn dust and Meyfa are the common organic fertilizers used. It is used to compensate the degraded soil quality and to enhance yield. Expenditures for manure account for around 50% of the total material costs for cultivation of most of the vegetables (Midmore *et. al.*, 1996/a). There are also increasing usage of fertilizers in CH. High amounts of organic fertilizer ranging from 49 tons/ha/season up to 84 tons/ha/season (Wan Abdullah *et. al.*, 1999), which is significantly higher than 3 to 13 tons/ha as reported by Ko *et. al.* (1987). According to various surveys reported by Taylor *et. al.* (1994), the level of fertilizer application is very much higher than the recommended.

High fertilizer input has caused considerable pollution of surface water and ground water. However, it is not yet fully documented. Under open cabbage farming, up to 1.5% (43 kg/ha/season) of the applied N, and 5.5% (109 kg/ha/season) of the applied K are lost in the runoff water. The loss of N and K through leaching is about 7.7% (55 kg N/ha/season) and 16.8% (138 kg K/ha/season) respectively (Aminuddin *et. al.*, 1999/a). Thus, in 395 ha of cabbage farm, the total annual discharge of N and K to the surface water is 51 tons and 129 tons, respectively, and the total annual leaching to ground water is 65 tons and 164 tons, respectively. The impacts of this amount of pollution to the water quality have also not yet been determined. High-energy input of vegetable farming is not only unsustainable but also incurred higher production cost. This will jeopardize the competitiveness of farming.

The cultivation of vegetable crops is susceptible to a number of pests and diseases. Management of pest and disease is important to avoid losses and to preserve the quality of produces. However, the appropriate technology is crucial to ensure sustainability and effectiveness. Contradictory, in worldwide, the most used technology is the application of pesticide. Besides environmental (soil and water) contamination, the application of pesticide has direct impact on human being, such as the pesticide poisoning of farmers during application and consumer health hazard of the residue.

In Malaysia, the presence of pesticide residue on market vegetable is attributed to the failure of the farmers to restrain application before harvesting (Midmore *et. al.*, 1996/b). On the other hand, high pesticide residue has also generated significant trade implication (Lim *et. al.*, 1988; Jansen, 1994; NST, 08/01/1994; NST, 04/04/1994; NST, 20/07/1999; NST, 07/10/2000a). However, chemical control remains the most popular approach for pest and disease management (Lim *et. al.*, 1988; Midmore *et. al.*, 1996/b). In CH, the most common insect pests include the diamond-back moth, leaf minors, mites and aphids; diseases include early blight, purple blotch, anthracnose and other foliar problems. Although the relevant government agencies introduced and promoted Integrated Pest Management (IPM) technologies, the reception of IPM strategies is rather poor. Midmore *et. al.* (1996/a) reported that about half of the farmers heard about IPM but less than 10% of farmers used the package.

Floriculture

Flowers are planted on the valley floor, modified terrain or slope. Most of the farmers used heavy machinery to cut down the steep terrain to transform them into a flat piece of land as was done for vegetable farms. Mass movement of land is one of the major causes of sedimentation in waterways. Although Ko *et. al.* (1987) reported that permits have to be issued by the local authority for land leveling with heavy machinery, it does not seem to control the soil erosion problem.

Research finding shows that the cultivation of flowers under rain shelters introduces minimum soil erosion, runoff and leaching. Cumulative soil loss from three crop cycles (equivalent to one year) is only 0.75 tons/ha while total runoff was 93 mm (Wong *et. al.*, 2000). The study agreed with the findings of Aminuddin *et. al.* (1999/a) that the minimum loss of inorganic fertiliser in the surface runoff is the type of cultivation under rain shelter. Wan Abdullah *et. al.* (1999) also reported of low soil erosion rate (about 1.4 tons/ha/yr) for farming system under rain shelter. This minimum effect of soil erosion is mainly due to the minimum erosivity of sprinkle water.

Under the rain shelter system, the rainwater is guided to drainage and led to nearby river. There will be severe erosion outside of the sheltered area if the rainwater is not properly guided. However, the negative effect of rain shelter on the hydrological cycle, i.e. an increase in the speed of rainwater runoff and decrease of infiltration to ground water have not yet been determined. These will have impacts on the reducing ground water table; increase incidences of flood and modification of the drainage system.

On the other hand, the monoculture of chrysanthemum under rain shelter requires high-energy input. Pesticide application on flower is unavoidable (Chiang, 1995). Farmers resort to biocide sprays and soil fumigation to restore the health of the soil. However, the negative consequences of pesticide application require appropriate attention. Chronic health diseases and respiratory dysfunction are the threat to the health of farm workers. A more ecological sustainable farming method is required that reduces the heavy input of pesticide.

High fertilizer application is also required to sustain the productivity of the soil in floriculture. The typical rate of application of fertilizers are 7.5 tons/ha/season of poultry manure, 4.5 tons/ha/season of Amina, 1.25 tons/ha/season of NPK Green, 2.5 tons/ha/season NPK Blue and in addition, weekly sprays of high calcium nutrient solution during active growth stage (Wong *et. al.*, 2000).

Sustainability of farming system depends principally on the healthy state of the soil. Soil quality such as the soil physical-chemical properties, population dynamics of soil microorganisms and soil erosion characteristics are important to maintain its productivity. Wong *et. al.* (2000) reported of changes in pH and EC that are indicating a gradual soil salinization. There is also the build up of organic carbon, NO3- and P contents in soil under floriculture. High levels of trace metals, like Mn, Cu, Zn, and Cd, are also detected in that cultivated soil. The results agreed with the findings of Zauyah *et. al.* (2000) that high concentrations of Cu and Zn are detected in the topsoil of older terraces. Even though the new terraces also show indications of increase in heavy metal concentrations. However, it is still below the ecotoxicological intervention values proposed by the Netherlands standard (Zauyah *et. al.*, 2000). Nevertheless, the ecotoxicological intervention values mean hazardous contamination of soil that requires proper treatment, which is significantly a totally different scale of hazard.

Tea Plantation

Tea is planted systematically at hill slopes, and it takes about three to five years to mature. However, the life span of a tea tree is 100 to 130 years. The oldest trees in CH are 71 years old and are still producing leaf. Leaf is picked from the mature tree at an interval of 15 days. The pruning to maintain the leaf quality is only required every three years. As the tea bush provides a dense canopy to intercept rain, it prevents soil erosion.

Wan Abdullah *et. al.* (1999) reported that the soil loss in the tea sub-catchment is about 10 tons/ha/yr. This is comparatively much lower than vegetable farming. However, about 7.5% of tea land is subjected to rejuvenation and therefore, liable to erosion (exposed at any particular time) (Midmore *et. al.*, 1996/b). Experience from Sri Lanka showed that improper management of tea plantation might cause severe soil erosion (Mapa, 2000). Thus, without mismanagement, tea landscape generally suffers minimum soil erosion.

In tea plantation, fertilizer is sprayed four times a year by using aircraft. One hectare requires two to three bags of 50 kg Urea 45% N with muriate of potash. Lime is also added four times a year in order to increase the pH, i.e. by using the granular magnesium lime. There is no documentation on the environmental impacts of the aircraft spraying of chemical substances in CH. Nevertheless, tea bush is not spared from pests and diseases. Mosquito 'hellow pelthe' attack during the dry seasons. In January 1998 to May 1998, during the El-Nino period, tea production suffered a 50% loss. Blyster Blight fungus attacks during heavy rainy season. Other diseases are root disease and red spider mite. Thus, the production of tea is also dependent on the conditions and quality of the environment.

5.2.5 Discussions on Agricultural Activities

Agriculture activities in CH generate considerable economic development to this isolated mountain area. It is important as a means of livelihood for the mountain inhabitants. However, improperly managed agriculture activities and unplanned land use development for agriculture pose tremendous externality to the watershed. In a watershed scale, rapid expansion of the agriculture land use will threaten the proper functioning of this highland ecosystem. Agricultural land use is more than 25% of total land area in this high mountain. Moreover, more than 66% of the market gardening land, which is mostly planted with short-term crops such as vegetable, has a slope that is more than 12°. Thus, the risk of erosion and landslide is very high.

The management of vegetable farm has to be improved in order to be sustainable. Land clearing and terracing techniques, soil conservation technology and practices, soil health and fertility, environmental sound pest and disease management, water resources management with sound irrigation and drainage system, are among the pressing issues needed to enhance the sustainability of the farming activities environmentally, socially and economically.

As the natural ecosystem is interrelated, degradation of the ecosystem will also generate negative effects back on the agriculture system. Disintegration of regional ecosystem that severely reduces the productivity of the land is the common sign of unsustainable environmental management of agriculture land. The sustainability of the watershed is to ensure the continuous maintaining of the life support system, which besides benefiting human beings and their economic activities, of the natural ecosystem as a whole.

As food production is critical for national food security and the National Agriculture Policy is aimed to attain self-sufficiency in vegetable production, long-term sustainability of vegetable farming should be on the top priority of the development activities in this fragile highland ecosystem. Therefore, agriculture development should take a holistic approach with the stability of the local ecosystem taken fully into considerations.

5.3 Tourism

5.3.1 Introduction

Mountains of the world seem to be predestined for tourism. CH is famous for its excellent land-architecture, climate, flora and fauna, and for the recreational activities of men. CH, as one of the oldest and largest of hill resorts in Malaysia, was developed in 1926. A committee was formed to develop the highlands as a hill resort in order to provide the colonial European community with a substitute for temperate environment as well as for agriculture (Leong, 1992). By the early 1930s, tea plantations were established and vegetable farming were encouraged to furnish the supply to the residents of holiday homes.

Agro- and eco-tourism are the two important types of tourism in CH. Agro-tourism attractions include visits to the market gardening farms, floriculture and their products, tea estates, strawberry and bee farms. Agro-tourism is predominantly targeted at the domestic tourist. Western tourists are more attracted to the eco-tourism in which they participate in jungle trekking and explore the richness and the diversity of flora and fauna in the tropical jungle and montane forest. However, westerners comprise less than 12% of the total arrived tourists. Other attractions and activities in CH are vegetable and flower stalls, night markets, rose and cactus centers, butterfly farm, temples, golf course, waterfalls, aborigine (Orang Asli) villages, camping and mountaineering.

As one of the world's largest industries, tourism is always associated with many of the prime sectors of the world's economy. Any such phenomenon that is intricately interwoven into the fabric of life – economically, socio-culturally, and environmentally – relies on primary, secondary and tertiary levels of production and service. Mathieson and Wall (1982) see tourism as comprising three basic elements:

(a) a dynamic element, which involves travel to a selected destination;

(b) a static element, which involves a stay at the destination; and

(c) a consequential element, resulting from the above two, which is concerned with the effects on the economic, social, and physical subsystems with which the tourism is directly or indirectly in contact.

Further discussions will examine these elements in the perspectives of the economic, social and environmental impacts.

5.3.2 Economic Impacts of Tourism

Tourism in the mountain is mainly encouraged for economic reasons, as it promises cash-flow into remote mountain regions having little economic opportunity, creates local employment, holds back the process of depopulation in the marginal areas, and finally corrects for regional imbalance.

Tourism industry has been identified as one of the major industry for economic development in Malaysia. Since the early 1970s, CH has been actively promoted as a holiday resort and tourist destination for both domestic (60%) and overseas (40%) tourists. Hence, the development of hotels is encouraged especially those designed to cater for the upper end of the tourist market. Luxurious and large hotels with extensive recreational facilities such as golf courses were built on the highlands. Besides, there are a great number of holiday bungalows built mainly for the big companies and wealthy individuals (Leong, 1992). Nowadays, condominiums and apartments flourish with the increasing trend for seasonal tourist to own a medium cost holiday home.

According to the CH Local Plan (CHDC, 1998), the projected commercially available hotel rooms will be increased from 986 rooms in 1996 to 3,146 in the year 2005. The total commercially available accommodation will be increased from 1,344 in the year 1996 to 3,933 in the year 2005 (**Table 5.3.1**). Furthermore, land use requirement for hotels is projected to increase 257% from 17 ha in 1995 to 60.7 ha in the year 2020 (**Table 5.3.2**).

Table 5.3.1. Projection of Commercially Available Accommodation in the Year 2005 (Number of Rooms).

Type	Present (1996)	Under Construction	In Planning	% Increase	Total
Hotel	986	240	1920	56.60	3,146
Chalets	69	50	250	110.08	369
Bungalow	155	-	50	32.26	205
Apartment	134	78	2,000	843.40	2,213
Total Rooms	**1,344**	**368**	**4,220**	**146.50**	**3,933***

Note: *Estimated total number of room in the year 2005.
Source : CHDC, 1998

Table 5.3.2.

Estimate of Land Use Requirement for Hotel (cumulative hectare).

Type	Year					
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Hotel	17	25.7	34.6	43.3	51.4	60.7

Source : CHDC, 1998

The number of tourists arriving in CH in 1990 and 1994 is estimated to be 193,955 and 290,982, respectively. In the CH Structure Plan (CHDC, 1996), the projected tourist arrival for the year 2000 is 515,350 and for the year 2020, it is projected to increase rapidly to 3,467,130 (**Table 5.3.3**). However, the Structure Plan has over estimated the growth in the number of tourist arrival. The actual tourist arrival recorded for the period of 1995 to 1999 did not show a rapid increasing trend (**Table 5.3.4**). Annual tourist arrival is maintained at around 270,000. The tourist arrival recorded in 1999 was 278,800 compared to the projected 515, 350 in 2000 by the CH Structure Plan (1996).

Table 5.3.3.

Number of Tourists arrived in Cameron Highlands
for the Years 1990 to 1994 and Projection for the Years 1995 to 2020.

Year	Tourist (cumulative)	Tourist*	Local Population	Percentage of Tourist/Population
1990	193,955	-	-	-
1991	261,895	-	25,555	-
1992	258,805	-	-	-
1993	269,727	-	-	-
1994	290,982	-	-	-
1995	320,000	724	27,509	2.6%
2000	515,350	1,166	30,115	3.9%
2005	829,970	1,878	32,856	5.7%
2010	1,336,660	3,025	35,803	8.4%
2015	2,152,810	4,872	39,070	12.5%
2020	3,467,130	7,846	41,913	18.7%

Note: *Number of tourist overnight at any one time. Average staying days is 2.04 days.
Source: Cameron Highlands Structure Plan, 1996.

Table 5.3.4:

Comparison of Estimated and Recorded Tourist Arrival in Cameron Highlands

Year	Estimated * Tourist Arrival	Recorded ** Tourist Arrival
1990	193,955	193,955
1991	261,895	261,895
1992	258,805	258,805
1993	269,727	269,727
1994	290,982	290,982
1995	320,000	266,041
1996	-	275,106
1997	-	284,934
1998	-	253,701
1999	-	278,779
2000	515,350	-

Note: *Source : Cameron Highlands Structure Plan, 1996.
**Source : Fraser's Hill Development Corporation, 2000

Based on the 8-year average estimated by Fraser's Hill Development Corporation (the Pahang State Tourism Board), the total annual tourist receipts for CH is RM132.1 million (FHDC, 2000). **Table 5.3.5** indicates the reduction in tourist receipts for 1992 to 1999, which can be attributed to the shorter average length of stay. The average length of stay reduced from about 4 days in early 1990's to 1.75 days in 1999. Moreover, the average hotel occupancy rate dropped from 74.20 in 1992 to 35.74 in 1999.

Anyhow, tourism still contributes significantly to the economic well being of CH. The tourism industry creates about 10% of the job market in the district of CH (see **Table 4.3.7**). Besides, the supporting and service sectors, such as hotel construction, food and beverage industries, financial and transportation that are driven by the tourism industry, have also contributed to the economic development of the mountain region.

Table 5.3.5.
Average Occupancy Rate, Average Length of Stay
and Tourist Receipts in Cameron Highlands for 1992 to 1999.

	Year								
	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**Average**
Average Occupancy Rate (%)	74.20	74.24	74.32	51.00	53.00	47.40	32.35	35.74	55.28
Average Length of Stay (day)	4.00	4.20	4.36	4.10	3.90	2.51	2.00	1.75	3.35
Tourist Receipts (RM million)	134.6	152.9	177.6	158.2	160.9	110.9	81.2	80.5	132.1

Source: Fraser's Hill Development Corporation (FHDC, 2000).

5.3.3 Social Impacts of Tourism

Doxey (1975) encapsulated the evolving sentiments that local people expresses as tourism expands and occupies greater proportions of a local economy over time. Doxey suggested four main stages to be considered in the assessment of local feelings towards the tourism industry:-

(a) ***Euphoria***. Tourists are welcomed, with little control or planning.

(b) ***Apathy***. Tourists are taken for granted, with the relationship between both groups becoming more formal or commercialized. Planning is concerned mostly with the marketing of the tourism product.

(c) ***Annoyance***. As saturation in the industry is experienced, local people have misgivings about the place of tourism. Planners increase infrastructure rather than limit growth.

(d) ***Antagonism***. Irritations are openly displayed towards tourists and tourism. Planning is remedial, yet promotion is increased to offset the deteriorating reputation of the destination.

A notable impact of tourism on traditional values is the demonstration effect, where local patterns of consumption change to imitate those of the tourists. Alien commodities introduced into the host communities can become luxury items that are beyond the reach of most residents of the destination areas in the developing world. On the other hand, the process of commercialization of local products may ultimately erode the local goodwill and authenticity of the products, as identified by Britton (1977).

Fragmentation of local and aborigine culture has been found to occur on many levels within the tourist destinations. It is most notable from the standpoint of prostitution; crime; the erosion of language in favor of more international dialects; the erosion of traditions, either forgotten or modified for tourists. This also includes the changes to local music and other art forms; food, in the form of more international cuisine; architecture; dress and family relationship. These cultural impacts of tourism will modify the social order of the local communities. The local communities have to confront with a new set of social problem that might threaten the disintegration of the traditional social system. In the case of CH, there are a few indications on the stage of tourism industry and its impacts on the local communities as follows:

- *The number of tourists.*

  If there are too many people at one time/place, then it is hard to sustain the activities wholesomely, resulting in some stress to the local communities. In 1995, the mean number of tourists at any one time in CH was 724, and the ratio of tourists to local population was 2.6%. However, the forecast of tourist development by the CH Structure Plan (CHDC, 1996) for the year 2020 is 7,846 tourist present at any one time, which will be increased to about 18.7% of the population then (see **Table 5.3.3**).

❐ *Stage of tourist development.*

Based on Doxey's classification, tourism industry is on the "Annoyance" stage in CH. The number of tourist arrival primarily suggests the saturation of tourism industry, as the number of arrival did not increase from 1991 to 1999 (**Table 5.3.4**). Furthermore, over development in infrastructure and facilities for tourism is evident. The hotel occupancy rate and average length of stay dropped about 50%. On the other hand, the State Secretary of Pahang Government issued a circulation letter (Surat Pekeliling, Setiausaha Kerajaan Negeri Pahang, BIL: 6/98) to instruct the freezing of hotel development in CH for 3 years starting in 1st July 1997.

There are locals who complain of heavy traffic, air pollution due to dust, and rise in air temperature. Traffic volume during weekday and normal weekend is still within the capacity of the road. However, during the holiday seasons, the ratio of traffic volume to road capacity reaches about 3.4 (CHDC, 1996). Thus, the local authorities are planning to increase the number of access roads from the existing one to five, namely from Simpang Pulai, Gua Musang, Kuala Lipis, and Fraser's Hill. Existing road network is under upgrading and construction of a few expressways is on going right now (CHDC, 1998). **Table 5.3.6** shows that the transportation and traffic projects constitute 68% of the total cost of priority projects in the CH Local Plan (CHDC, 1998).

Table 5.3.6. Priority Projects in Cameron Highlands.

	No. of Project	% of Project	Total Project Cost (RM million)	% of Cost
Transportation and Traffic	42	29.8	155.6	68.2
Recreational Landscape	32	22.7	31.4	13.8
Public Amenities	18	12.8	26.5	11.6
Business	8	5.7	8.6	3.8
Housing	18	12.8	-	-
Infrastructure	14	9.9	3.0	1.3
Tourism	7	5.0	2.9	1.3
Institution	2	1.3	-	-
Total	**141**	**100.0**	**228.0**	**100**

Source: Cameron Highlands Local Plan, 1998-2010 (CHDC, 1998).

- *The degree to which incoming tourists purchases properties.*

A combination of real estate speculation and the prospect of a rapid payback on invested capital causes the accommodation sector to outpace the capacity of the resources required to support a balanced tourism development program. In CH, wealthy domestic tourists purchase properties such as bungalows and apartments as their holiday homes. Property price is increasing rapidly. Purchasers of property developed by the government, which is relatively cheaper, always required to provide proof of minimum years of residence in CH. However, data on tourist purchase of properties are difficult to be obtained. Nevertheless, the number of apartment rooms increases by 843.4% to 2,213 in 2005 (see **Table 5.3.1**).

Although there are some indications of unfavorable development of tourism in CH, the understanding of the social impacts is still very limited. Other important indicators that require detailed research include the extent of which tourism is serviced by the immigrant worker population; the degree to which local people retain the ownership of properties and tourist facilities. Other areas of important are the attitudes of governmental bodies; the physical size of the area which affects the densities of the tourist population and the images that are created for that destination.

5.3.4 Environmental Impacts of Tourism

There is a wide range of potential adverse impacts associated with tourist-oriented communities especially in the fragile mountain ecosystem. Pearce (1985) produced a framework for the study of environmental stress and included stressor activities, the pressure resulting from the activity, the primary environmental response, and the secondary human response or reaction of the stress. This framework is used in **Table 5.3.7** to assess the ecological impacts in CH.

The first stressor activity, which is the permanent environmental restructuring, was expanding at an incredible pace in CH. The projected buildup area by the Local Plan increases 56% from 593ha in 1995 to 928ha in 2020. Expansion in build up area includes building of apartments, hotels, schools, hospital and infrastructure. Hotel room availability in 1996 is estimated at 1344, which is expected to increase to 4220 by 2005.

Moreover, the expansion and upgrading of existing road has begun. In the CH Local Plan, 42 road related projects are planned for 1998 to 2010. A number of new access roads to CH are either under construction or in plan. Besides, major roads in CH are being upgraded and widened. Furthermore, there will be construction of new express ways to link up most of the major townships in CH. Others infrastructure development includes new shuttle bus services and new parking space (CHDC 1998).

Table 5.3.7: Framework for Assessing Impacts of Tourism and Environmental Stress

Stressor activities	Stress	Primary Response: Environmental	Secondary Response: Human (reaction)
1) Permanent environmental restructuring a) Major construction activity • Urban expansion • Transport network • Tourist facilities • Trek and campsite b) Change in land use • Expansion of recreational lands	Restructuring of local environments • Expansion of built environments • Land taken out of primary production	Change in habitat Change in population of biological species Change in health and welfare of man Change in visual quality	*Individual* • Impact on aesthetic values *Collective measures* • Expenditure on environmental improvements • Expenditure on management of conservation • Designation of wildlife conservation and national parks • Controls on access to recreational lands
2) Generation of waste residuals . Urbanization . Transportation	Pollution loadings . Emissions . Effluent discharges . Solid waste disposal . Noise (traffic)	Change in quality of environmental media . Air . Water . Soil Health of biological organisms Health of humans	*Individual defensive measures* Local residents . air conditioning . protests and attitude change towards tourists . change of attitude towards environment . decline in tourist revenue *Collective defensive measures* . expenditure on pollution . abandonment by tourist related industries . clean-up rivers
3) Tourist activities . Jungle trekking . Collecting . Purchasing of farming product . Enjoy the cool environment	Trampling of vegetation and soils Disturbance and destruction of species	Change in habitat Change in population of biological species	*Collective defensive measures* . expenditure on management of conservation . designation of wildlife conservation and national parks . controls on access to recreational lands
4) Effect on population dynamics Population growth	Population density (seasonal)	Congestion Demand for natural resources . Land . Water . Energy	*Individual* . Attitudes to overcrowding and the environment *Collective* . Growth in support services, e.g. water supply, electricity

increase of sedimentation in the Ringlet Reservoir is also one of the negative impacts. The secondary response by human includes the increase of maintenance expenditure by TNB in order to intensify the dredging programs in the reservoir and various intake points. Besides this response, there is no detailed study on the possible human responses.

Tourist activities are the third stressor in the framework. As most of the agro-tourists go for side seeing, visiting farms and purchasing of local craft and farm products, the activities incur minimum environmental stress. However, there is no data on trekking activities and the illegal collecting of flora and fauna by tourists. However, tourists do purchase rare species of flora from locals who sell it at the night market. In general, the impacts of tourist activities on the habitat and biological species have not yet been determined. Nevertheless, it is not expected to be severe.

The fourth stressor is population growth. Population density is high during the peak tourist season and weekend. Besides, the increase of employment opportunities due to the tourism industry also contributes to in-migration. Population growth induces stress in this mountainous region, where natural resources such as land is limited. Domestic consumption of water is expected to increase from 1.5 million gallon per day in 1996 to 3.5 million gallon per day in 2020 (CHDC, 1996). The demand on clean and fresh water can only be satisfied by protecting the pristine water catchment.

5.3.5 Discussions on Tourism

The interconnectedness of the tourism industry, and its economy, social and physical environment needs to be understood. Climate, natural scenery, mountain ecosystem, farming activities and products are the main tourist attractions of CH. Contradictorily, improperly planned and unsound management of tourism development will alter the climate pattern, will also introduce visual pollution such as soil erosion, landslide, deforestation and urbanization. On the other hand, over development and intensification of agricultural activities will also degrade the natural ecosystem. These in turn will damage the image of CH as a tourist destination. Thus, improperly planned tourism industry that exceeds the threshold and carrying capacity of the area will be unsustainable. Impacts will be significant on the environment as well as on the socioeconomic well being of the inhabitants.

The rise and fall of many mountain resorts demonstrate the truth that only well managed, controlled and integrated development of tourism can ensure sound health of mountain environment (Singh, 1992). Thus, the tourism industry must secure an equitable relationship between the planning and developing of the tourism industry and the needs of the local people as well as the carrying capacity of the mountain region. Britton (1977) recognized that the importance of small-scale, local own, gradual growth, reliance on locally produced goods and a diversification in the market would enhance the sustainability of the tourism industry.

5.4 Hydroelectric Power Generation

5.4.1 Brief Description of the Hydroelectric Scheme

The nature of mountain topology provides potential for hydroelectric power generation. Due to the difference in potential energy in mountain peak and valley, man utilizes the potential energy of water in higher ground to generate electricity. Thus, in order to generate hydroelectricity, the locality must demonstrate favorable topographic features, suitable bedrock and substantial quantity of water, amongst other important factors.

UM and TNBR (2001) reviewed the hydroelectric power generation scheme in CH and is summarized as the following. The power potential of the scheme in CH was recognized in a preliminary investigation in 1941. However, further progress was not made due to the commencement of World War II. After the war, another serious investigation was recommenced in 1948, but the progress was slow and halted due to guerilla activities of the communist in the region. In 1953, the Consulting Engineers (Messrs. Preece, Cardew & Rider in association with Messrs. Binnie & Partners) resumed the investigations. Recommendations were submitted to the Central Electricity Board in 1956. The principal recommendation was approximately 320 million kWh could be produced annually from the hydroelectric scheme and at cheaper operation cost than that could be obtained from a new steam power station. Despite the high estimated capital cost, and the distance between CH and the main areas of electricity demand, the recommendation was accepted. On the 26th of June 1963, the hydroelectric scheme in CH was officially opened (Central Electricity Board, 1963).

The hydroelectric scheme was constructed in the period between 1957 and 1964 and involved building reservoirs and diversion of water of streams. The main catchment of the scheme are Plau'ur River catchment in the State of Kelantan Darul Naim, Upper Telom River and Bertam River in CH district, State of Pahang Darul Makmur and Batang Padang River catchment in the State of Perak Darul Ridzuan. The scheme utilizes the combined headwaters of these rivers that originally drain eastward into the South China Sea by diverting them into Batang Padang River. The Batang Padang River drains westward into the Straits of Malacca (see **Fig. 4.2.5**).

Appendix A: Table A-4 shows the areas of various catchment in the entire Cameron Highlands-Batang Padang hydroelectric scheme, and **Appendix A: Table A-5** shows the technical summary of power stations. At an elevation of over 1,524 m, water from a catchment area of 9.6 km^2 of the Plau'ur River is diverted by gravity via a 469-m long tunnel into the Telom River. The water of Upper Telom River and Plau'ur River powers two hydroelectric stations of run-of-river type that are located some distance downstream of the Plau'ur diversion tunnel outlet. These two stations are the Kampung Raja Power Station (with gross head of 83.8-m, installed capacity of 0.8 MW and average annual power of 6.2 GWh) and Kuala Terla Power Station (with gross head of 39.3-m, installed capacity of 0.5 MW and average annual power of 4.2 GWh). Both power stations are constructed adjacent to natural waterfalls on the Telom River at the 53^{rd} and 51^{st} milestones, respectively. The combinated catchment areas for the Kampung Raja Power Station and Kuala Terla Power Station are 30.8 km^2 and 43.2 km^2 respectively.

The headwaters of two tributaries of Telom River (namely Kodol River and Kial River), which actually meet at further downstream, are diverted into the upper Telom River via the Kial Tunnel. The tunnel is 422.7 m in length with an equivalent excavated diameter of 1.96 m. The combined waters of all these rivers are then transferred through the

Telom Tunnel at 49th milestones (10,245.6 m in length) with an equivalent excavated diameter of 3.2 m to merge with the Bertam River. The Telom Intake collects water from a combined catchment area of 110 km^2 from Upper Telom River, Kial River, Kodol River and Plau'ur River.

The Bertam catchment can be divided into two sub-catchments that are separated by a natural waterfall, the Robinson Falls. At the Robinson Falls, water from a catchment area of Upper Bertam (21 km^2) is directed via a steel pipeline to the Robinson Falls Power Station. This power station has a capacity to produce an average annual energy of 7.6 GWh with an installed capacity of 3 × 0.3 MW and a gross head of 243.7-m.

Water discharged from the Robinson Falls Power Station merged with the water from the Telom Tunnel and flows into the Habu Tunnel (1,745.6-m in length) with an equivalent excavated diameter of 2.26-m to feed the Habu Power Station. As provision of diurnal storage was not economically possible for the Habu Station, it was designed as a run-of-river installation with two generator sets (2 x 2.75 MW with a gross head of 97.5-m) and a total output of approximately 34 GWh/annum (Dickinson and Gerrard, 1963). The combined catchment consists of an area of 132.1 km^2.

The released water from Habu Power Station goes into Ringlet Reservoir that is impounded by the Sultan Abu Bakar Dam with a gated spillway at Ringlet Falls on Bertam River. With a height of approximately 40-m, this concrete and rockfill dam impounds water from the Bertam River, Telom River and Ringlet River. The total catchment area for the Reservoir is about 181 km^2. This forms an integral part of the CH Hydroelectric Scheme. The reservoir has a surface area of about 60 ha and an original gross storage of 6.7 million cu.m. at a full supply level of 1,070.7-m (Preece *et. al.* 1963). But, the usable storage then was only 4.7 million cu.m. The combined catchment consists of an area of 181.7 km^2.

From the Ringlet Reservoir, the water is led into the Jor or Sultan Yussuf Power Station that lies approximately 573 m below the level of the reservoir with a 6.8-km tunnel. It has a total installed capacity of 4 × 25 MW and generates 320 GWh per year. Due to the small size of the Ringlet Reservoir, it cannot provide for seasonal storage of water. Thus, the Jor Station was regarded as a 'change of function' station, which means that it will only generate peak load power during the dry seasons, but both peak load and base load during the wet seasons.

There are a number of other hydroelectric power stations located downstream before the water flowing westward into the Straits of Malacca (Dickinson and Gerrard, 1963). These power stations are the underground Woh or Sultan Idris II Power Station (an installed capacity of 3 × 50 MW and annual generation of 480 GWh), the Odak Power Station (an installed capacity of 3 × 1.4 MW and annual generation of 20 GWh).

5.4.2 Economic Impacts of the Hydroelectric Scheme

The Malaysian electricity producer, TNB, operates a mixed hydro-thermal system. The generation/plant mix in the TNB system of about 12,000 MW as of August 1999 consists of 14.7% in oil/gas, 5% in coal, 15.6% in hydro, 14.4% in gas turbine, 13.0% in combined cycle and 37.3% from Independent Power Producers.

The economics of gas utilization depend on base load consumers of gas, while the economic characteristics of hydro plant are significantly different from fossil-fueled options. Compared to thermal stations, hydro stations are of low operating costs but high capital costs. On the other hand, power demand is not static. A typical week day load curve in Malaysia shows that the base load demand is about half of the peak load and the peak load occurs between about 8:00 a.m. and 8:00 p.m. (UM and TNBR, 2001). Load-peaking hydro stations such as Sultan Yussuf Power Station performs an important function in generating during the peaks in the daily demand curves. It is also capable to provide spinning reserve during other periods to accommodate minute random variations in the system demand profile. Hydro generating plant is capable of frequent fast start-stop and load variation with a high degree of reliability. Furthermore, hydro energy is clean and renewable as well as almost free of fuel cost escalation risk. Hydro stations with reservoirs would additionally generate other benefits such as flood mitigation, irrigation, aquaculture and tourism development potential.

Hydroelectric generation is important economically to the local and the nation. The economic contribution of the scheme will be calculated based on the assumption that the energy values for the base load and peak load is RM0.094 per kWh and RM0.225 per kWh respectively (UM and TNBR, 2001). The average annual revenue for the hydroelectric scheme is approximately RM172 million, on the basis of 85% of the Jor, Woh and Odak Power Stations are operated for load peaking operation. However, if the current problem of sedimentation in the Ringlet Reservoir is not overcome, it is foreseen that the reservoir and the Jor Reservoir will finally lose all their live storage capacities and be turned into run-of-river power stations. With this, the average annual revenue for the scheme will be reduced to RM78.5 million (see **Table 5.4.1**).

Table 5.4.1
Estimation of Annual Revenue for
Cameron Highlands-Batang Padang Hydroelectric Scheme.

Power Station	Annual Output (GWh)	85% Peak Load†		15% Base Load†		100% Base Load***
		Total† (GWh)	Value* (million RM)	Total† (GWh)	Value** (million RM)	Value (million RM)
Kampung Raja	6.2	-	-	6.2	0.6	0.6
Kuala Terla	4.2	-	-	4.2	0.4	0.4
Robinson Falls	7.6	-	-	7.6	0.7	0.7
Habu	34.0	-	-	34.0	3.1	3.1
Jor	320.0	272	61.2	48	4.3	28.8
Woh	480.0	408	91.8	72	6.5	43.2
Odak	20.0	17	3.8	3	0.3	1.8
Total	872.0	697	156.8	175.0	15.8	78.5

Notes: †85% of output assumed operated on peak load and 15% on base load.

*Peak load energy value at RM0.225/kWh.

**Base load energy value at RM0.094/kWh.

***The power generation is running on 100% base load due to lost of load peaking function.

Source: UM and TNBR (2001)

5.4.3 Social Impacts of the Hydroelectric Scheme

The construction of the scheme had involved resettlement of farmers and local people. The villages of the Lubok Tamang Valley were resettled at new villages in Telom Valley to make way for the impoundment of the Ringlet Reservoir. A total of 124 houses were built, in addition to shops, a community hall and a school. The affected communities were compensated by given a house and one hectare of land for cultivation (Dahlen, 1993).

The positive impacts include job creation and diversified the economy of this remote mountain region. Direct employment by the hydropower operation total to 130 workers. Operations of the hydroelectric power generation in this remote area also enables easy access to electricity supply and thus increase the social welfare of the mountain inhabitants.

5.4.4 Environmental Impacts of the Hydroelectric Scheme

The construction of CH Hydroelectric Scheme involved diversion of six rivers, building a number of underground tunnels with a total length about 18-km and a reservoir with a surface area of 60 ha. The diverted rivers are Plau'ur, Kial, Kodol, Telom @ miles 49, Bertam @ Robinson Falls, and Bertam @ Bertam Falls). The underground tunnels are Plau'ur Tunnel (469-m in length), Kial Tunnel (422.7-m), Telom Tunnel at 49^{th} milestones (10,245.6-m), Habu Tunnel (1,745.6-m), and Bertam Tunnel (6.8-km).

Alteration of the river-flow has definitely affected the stream ecology as well as freshwater flora and fauna. Unfortunately, there was no documented detail on the biological resources before the construction of the river diversion. Therefore, it is not possible to quantify the effects of those river diversions on the species, population, and diversity of freshwater biological resources in CH.

Destruction of stream ecology is evident at the point immediate after the diversion. Telom River downstream of the Telom intake is dried, as is also the case of Bertam River downstream of the dam. Moreover, the periodical flushing of sediment from the Telom desander filled the riverbed with fine and coarse sand (see ***Plate E***). The entire stream ecology at this point is damaged. However, the impact of reduced flow and intense sediment load during flushing operation to the downstream freshwater ecology has not yet been determined. As the disruption of stream flow is evident at all the diversion points, detailed impacts on the ecology such as migration of aquatic life are unclear. Nevertheless, the reduced flow from Telom River and Bertam River will not significantly threaten the river ecology of the larger Pahang River.

The impoundment of the Ringlet Reservoir flooded a relatively small area. The surface area of the reservoir is only 60 hectare. Nevertheless, the dam acts as a silt trap and retains most of the sediment. It also prevents flashflood. As siltation problem is expected in most of the tropical reservoir worldwide, Ringlet Reservoir is designed to have 80 years of useful life. However, the increasing rate of sedimentation and the loss of reservoir storage capacity has threatened the operation of the reservoir and the hydroelectric generation. Details of the problem will be discussed in a later chapter.

5.4.5 Discussions on the Hydroelectric Scheme

Hydroelectric power generation in CH is a pollution free energy source and is renewable. Although the generation capacity is low, the scheme is important in a few aspects. For example, it supplements the national generation capacity during peak load hour. Besides economic contribution, the ability to provide a consistent grid power supply to this remote mountain area is important to increase the social welfare of the local community. With the accessibility of power supply, other industries may also flourish and diversify the mountain economy.

It is undeniable that there were destruction of the environment and the generation of some social stresses during the construction of the scheme. The degradation of environment still persists today such as the dried riverbeds. However, this current man made structure with its social and economic contributions to the local and national community should be protected. It should not be left degraded and should ensure its sustainable operation.

The sustainability of the current scheme is an important issue. The improvement of the scheme, in terms of increasing efficiency and reducing operation cost, encounters various obstacles. In response to these threats, the management of the scheme initiated a few mitigation measures such as construction of silt retention pond, excavation operation, scientific researches to understand the situation and exploring effective management strategies.

Thus, the operational cost is increasing due to the implementation of mitigation measures to overcome the heavy suspended load and sedimentation in weirs and reservoir. Since the commencement of the sediment excavation operation, a conservative estimation of RM2 to 3 million was incurred by TNB each year. On the other hand, TNB is currently planning a large-scale excavation program on the reservoir, which is estimated to cost more than RM100 million. The excavation of sediment incurs economic losses and energy wastage. The disposal and transportation of the sediment also has due environmental impacts and visual pollution. The sustainability of the operation of the reservoir is under threats. Nevertheless, the loss of storage capacity not only has impacts on the power generation but also the capacity to control flood.

The externality created by the unsound management of the development activities in CH imposes negative consequences on the power generation scheme. The resultant impacts are not only caused economic losses but also create negative social and environmental implications to the mountain community.