4.3.7 Agricultural Supporting Services

(1) Agricultural Research

Agricultural research in Sri Lanka is carried out by a multitude of government organizations. Department of Agriculture (DOA) and the Department of Export Agriculture (DEA) under the Ministry of Agricultural Development and Research (MADR) have the responsibility for organized research in food and horticultural crops and in export crops, respectively. Research on coconut, tea, rubber and sugarcane is handled independently by the Coconut Research Board, Tea Research Institute, Rubber Research Institute and Sugarcane Research Institute, respectively.

(i) Research Division: DOA

The Research Division of the DOA has its Central Agricultural Research Institute (CARI) located in Gannoruwa, Kandy, and runs eight Regional Agricultural Research Centres (RARC) including Gannoruwa, 10 Agricultural Research Stations (ARS) and two Agricultural Research Units (ARU) covering the major agro-ecological regions of Sri Lanka. Of these, RARC Bandarawela (Badulla district), ARS Sita-Eliya (Nuwara-Eliya district) and ARU Pelmadulla (Ratnapura district) are located within the Study area. CARI consists of seven sections, namely, Botany, Chemistry, Entomology, Food Technology, Horticulture, Plant Pathology and Soybean Food Research. Current activities are centered on crop improvement involving varietal development, varietal evaluations, varietal maintenance and micropropagation by tissue culture, crop production, crop protection, and post-harvest technology. The main crop groups are the root and tuber crops, cereals, grain legumes and horticultural crops. At the RARC Bandarawela, the crop priorities are in exotic vegetables, potato and in fruit crop research. The centre has six research sections. Research needs of the farmers in drier parts of Matale, Badulla, Ratnapura and Moneragala districts are served by RARCs of Mahailuppallama, Aralaganwila/Girandurukotte and Angunukolapelessa, respectively, but located outside the Study area. In these areas, the research work relates primarily to chilli, onion and subsidiary food crops, dry farming systems, and crop diversification. In addition to the above research activities, the Research Division of DOA carries out research on farm machinery, land and water management and plant genetics at centers located at Mahailuppallama, Peradeniya and Gannoruwa, respectively, on a national basis.

(ii) Export Agricultural Research Project: DEA

The Central Research Station of the DEA is located at Matale is responsible for research on spice, condiments and beverage crops classified as the export agricultural crops. These consist of cinnamon, clove, cocoa, coffee, pepper, cardamom, nutmeg/mace, citronella, arecanut and beetles. The Station also operate four research sub stations, three of which are located within the Study area in Kandy, Nuwara-eliya and Ratnapura districts.

(iii) Sugarcane Research Institute

Established in 1988, the Sugarcane Research Institute located at Uda-walawe in the Ratnapura district, is responsible for sugarcane research in Sri Lnaka. Varietal improvement is the theme of the current research plan and efforts of all departments are co-ordinated towards reaching this goal.

(iv) Research on Plantation Crops

Research work on tea is carried out by the Tea Research Institute located at Thalawakelle in the Nuwara-Eliya district. The research needs of the mid-country region are catered to by the sub-station of the Institute located at Hanthane in the Kandy district.

The Rubber Research Institute situated at Agalawatta in the Kalutara district of Western province is the responsible organization for rubber research in Sri Lanka. Its sub-station located at Kuruwita in the Ratnapura district serves the research needs of the Study area.

Research on coconut is carried out by the Coconut Research Board located in the main coconut growing area of Puttalam district of North Western province.

(v) Co-ordination of Agricultural Research

The activities of the different organizations involved in agricultural research are co-ordinated by the Council for Agricultural Research Policy (CARP). Established in 1987, its role in the formulation of national agricultural research policy and planning of national agricultural research programmes has contributed greatly in rationalizing agricultural research and has minimized the constraints and costs of unco-ordinated programme planning. Membership of CARP includes representatives of institutions carrying out research on perennial crops, annual crops, livestock, forestry and fisheries.

(2) Agricultural Extension

(i) Food and Horticultural Crop Extension

The research divisions of DOA and DEA, the Coconut Research Board and the Tea, Rubber and Sugarcane Research Institutes are all linked individually to their separate extension services, and are active in the Study area. In addition to these institutions, extension services are also provided by the private sector organizations, non governmental organizations (NGOs) and by special donor funded extension projects.

The extension arm of the DOA, the Technology Transfer Division, plays the leading role in providing agricultural extension as majority of the farmers in the Study area are engaged in growing food crops. DOA in 1979 adapted the T&V extension system under the World Bank assisted Agricultural Extension and Adaptive Research Project (AEARP). The salient features of the system were: (a) systematic and regular training of extension workers; and (b) time bound field visits to contact farmer/farmer group by the extension personnel. The project established close research-extension linkages, strengthened adaptive research facility and the institutional framework for an effective extension system. Each village level extension worker (KVSN) served about 750-1000 farm families and had a single line of command with the DOA through the Agricultural Instructor (AI) at the Agrarian Service Centre (ASC) area level and the Assistant Director - Agriculture (ADA) at the district level.

Sustainability of the extension system became a crucial issue since the termination of AEARP in June 1986, due to its prohibitively high operational costs. The levelling off of paddy yields seen during the 1980s and only simple

messages focused on paddy to extend, the cost effectiveness of the system became questionable. The devolution of authority from the center to the provinces under the 13th Amendment to the Constitution in 1987, followed by the transfer of 2,400 KVSNs to the Ministry of Public Administration as village level administrators (GNs) further weakened the extension system. This move, cut off the front line of the extension service and badly disrupted the village level extension activities. The AI has now become the front line extension worker with no supervisory role as in the past. Agricultural extension function being fully devolved to the Provincial Councils, the Technology Transfer Division of DOA had no control over extension activities carried out in the field. The Provincial Directors of Agriculture as the heads of Provincial Departments of Agriculture under the Provincial Ministries of Agriculture/Animal Husbandry have taken over the operational responsibility for agricultural extension. However. agricultural extension at all levels in the major irrigation schemes, excluding the Mahaweli Development areas, continues to be the responsibility of DOA.

The Second Agricultural Extension Project of the World Bank under IDA funding (1993-2000), which is being implemented by the DOA, seeks to resolve some of these issues. The project envisages a farmer centered farming system approach which is focused on: (a) consideration of farm family goals; (b) their relation to the adoption of agricultural technology; and (c) the consequent need for close contact between extension agent and household members within the village community and on the farm. The extension approach is locality-specific and would depend on: (a) identification and use of existing farmer groups (the reference group) with similar resources and technological requirements for extension activities; (b) use of problem census technique to identify extension activities that most farmers need; and (c) applying a holistic approach to extension. Deployment of mass media for extension is stressed and strengthening of the research-extension linkages at all levels emphasised.

(ii) Subsidy Linked Extension Systems

Extension services to small holders of tea, rubber, coconut and export agricultural crops are primarily linked to the provision of Government subsidies. These subsidies cover replanting, new plantings, infillings, and in the case of coconut, intercropping and underplanting. Tea and rubber subsidies are financed out of the cess on export while those of coconut and export agricultural crops are funded by the treasury.

- Tea extension services to the small holders are provided by the Tea Small Holders Development Authority (TSHDA) through its Extension Officers and Tea Inspectors. The officials follow a monthly work programme that equally divide their time between extension work and subsidy administration.

- The Advisory Services Department(ASD) of the Rubber Research Board (RRB) provides extension and advisory services to the rubber small holders. District and divisional level field staff in Ratnapura and Kegalle districts, attached to the Development and Processing Divisions of ASD, provides agronomic and process technology advice. The ASD works in close collaboration with the Rubber Control Department of RRB which administers the subsidies.

- Extension services on export agricultural crops are provided by the Department of Export Agriculture (DEA). Subsidy administration and somewhat limited field extension are carried out in all districts in the Study area by the respective Assistant Directors and Extension Officers. Farmer and officer training is conducted at the Training Centre at Matale.

- Coconut small holders in the Kegalle and Ratnapura Kandy, Matale and Moneragala districts are served by the Coconut Development Officers of the Coconut Cultivation Board who are responsible for coconut extension. Their work schedule, however, is mostly devoted to subsidy administration.

(iii) Private sector Extension Services

- Ceylon Tobacco Company provides free extension services to the small holder tobacco growers in the Study area. The package offered include short term credit, crop insurance, and guaranteed price and market.

- Extension services to the sugarcane allottees and outgrowers in the Moneragala district are provided by the two privately owned sugar companies.

- Private sector seed and agrochemical suppliers implement limited but regular field programmes for farmer training, particularly as a means of product promotion.

(3) Input Supply

(i) Seeds and Planting Materials

The Seeds and Planting Material Division (SPM) of DOA produces and supplies paddy, subsidiary food crop, and vegetable seeds and seed potato to the farmers through the Agrarian Service Centers throughout the country. The SPM also supplies planting materials of a range of fruits in the budded, seedling and rooted cutting form. Requirements of seeds and planting materials on a divisional basis is computed well ahead of the forthcoming season by the respective Agricultural Instructor and requisitioned for supply to the SPM through the district/provincial offices. Production and issues of seeds and planting materials by SPM Division in 1992 are shown in Table 4.3-15.

Seeds materials that are in short supply or are not produced by the SPM, particularly those of exotic vegetables, and seed potato, are imported to the country and sold to farmers through numerous outlets in the provinces. Involvement of the private sector in commercial seed production is encouraged by the Government and to assist the process, some of the seed import restrictions have already been relaxed and the subsidies given to the DOA for seed production has been cut down to ensure fair competition.

(ii) Fertilizers

The supply of fertilizer except for a small amount of Rock Phosphate (30,000 mt) and Dolomite is entirely through imports. In 1992, 12 wholesalers distributed fertilizers imported by 15 organizations from both private and the

public sectors. Retailing of fertilizers to the farmers has been through the Agrarian Service Centers, co-operative outlets and the private outlets. The supplies throughout the Study area during the current year, according to district Agricultural Officers, has been satisfactory without any major breakdowns.

(iii) Agro-chemicals

Importation and distribution of agro-chemicals is handled entirely by the private sector organizations. The network of retail outlets are well established to cater the farmer needs effectively.

(4) Agricultural Credit and Subsidies

Agricultural credit system in the Study area is operated by both the formal or institutional sector as well as the informal or non institutional sector.

(i) Institutional Credit

Central Bank under the New Comprehensive Rural Credit Scheme (NCRCS) provides 100% refinance to commercial banks for granting of cultivation loans for paddy and subsidiary food crops. The refinance loan to the commercial banks carries an interest rate of 8.5 % while an interest rate of 16 % is presently applicable to the cultivation loan. A cultivation loan is repayable by the farmer within 240 days of the withdrawal of the first instalment. The refinance loan is advanced for a period of 270 days or for the duration of cultivation loan plus additional 30 days whichever is shorter. Paddy and 27 other crops are included under the NCRCS. The list is reviewed periodically to add new crops or to delete existing ones depending on their economic viability. The crops covered and the scales of financing under the NCRCS are shown in Table 4.3-15.

Loans granted under the NCRCS in the Study area for the seasons Yala 1991 to Yala 1992 are shown in Table 4.3-16.

Term loans are provided for periodic replacement of existing assets and for new investments. Term loans too, are refinanced by the Central Bank under the Medium and Long-term Credit Fund (MLCF).and are granted for the acquisition of agricultural machinery, establishment and rehabilitation of tree crops, etc. Term loans are generally repayable within a period of 3-5 years. This period may be extended upto 8 years in the case of export agricultural crop production projects where the gestation period is longer.

(ii) Credit Delivery

A number of organizations are involved in the delivery of formal credit in the Study area. These include the following:

(a) Commercial Banks-
The two state owned banks, namely the Peoples Bank and the Bank of Ceylon operate their branches distributed throughout the Study area and administer both cultivation and term loans.

(b) Co-operative Rural Banks
Cultivation loans are provided by the Co-operative Rural Banks from loans advanced by the Peoples Bank under the NCRCS and from their own resources as well. As a rural bank, it has some advantages over the

commercial banks; an intimate knowledge of the local community and low operational costs.

(c) Thrift and Credit Co-operative Societies (TCCS)
TCCS are semiformal organizations which play an important role in financing the rural sector. They are mainly financed by their membership contributions, foreign funds and Central Bank refinancing.

(d) Regional Rural Development Banks (RRDB)
The main purpose behind the establishment of RRDBs by the Central Bank in 1985 has been to concentrate more on the poor and the weaker segments of the rural community who in general did not have access to bank credit.

(e) The Agricultural Trust Fund administered by the MADR was initiated in late 1990, to assist amall farmers (holding size less than 1 ha) who are unable to obtain cultivation loans from formal credit sources. The Fund provides such farmers with credit for production, processing and marketing, in cash and production inputs in kind. The scheme is in operation in five districts in the Study area; Kandy, Matale, Nuwara Eliya, Badulla and Moneragala.

(f) Apart from the above institutions, several other Non Governmental Organizations (NGOs) are also engaged in the credit delivery system. The areas covered by such NGOs are limited and essencially operated on project basis.

(iii) Non Institutional Credit Sources

The unorganized money market plays a significant role in the supply of rural credit to small borrowers. The credit supliers include:

(a) Professional money lenders who lend money even without proper colateral.

(b) Semi-professional money lenders comprising of shop and boutique keepers, produce dealers, landloads, relatives, etc.

(c) Informal credit societies, pawning shops, etc.

The interest rates charged by the informal sector is high when compared with the formal sector. Yet, some farmers prefer the unorganized money market for credit due to its easy accessibility and the informal deelings.

(iv) Subsidies

Subsidies are granted to the tree crop sector through funds made available by doner agencies and the Government treasury for new planting, replanting and in some instances for intercropping. Following subsidy schemes are in operation at present.

(a) Export Agricultural Crops
Cocoa, cardamom, cinnamon, pepper, coffee, clove and citronella are covered by the subsidy scheme. The rates applicable to each of these crops are shown in Table 4.3-17.

(b) Fruit Crops
Subsidy scheme for the fruit crops cover ten crops and the rates payable are shown in Table 4.3-18. It is coupled with a term loan avilable from commercial banks under NCRCS and is supervised by the Perenneal Crop Development Project.

(c) Plantation Crops
Subsidy schemes for tea, rubber and coconut are administered by the Tea Small Holdings Development Authrity, Rubber Control Department and the Coconut Cultivation Board, repectively. The rates of subsidy payments are shown in Tables 4.3-19 , 4.3-20 and 4.3-21.

4.3.8 Agro-industries

Agricultural produce of tea, rubber, sugarcane and tobacco cultivation provides the raw materials for major agro-industries in the Study area. Industries based on other crops, with the exemption of paddy, is limited to small scale enterprises.

(1) Tea

Tea factories are concentrated in the main tea growing districts of Kandy, Nuwara-eliya, Badulla and Ratnapura in the Study area. The tender leaves plucked from tea plants are passed through a process of withering, rolling, drying and grading in the factories to manufacture the black teas. Depending on the elevation at which the tea plantation and the factory is located, the manufactured tea is termed high, mid or low grown owing to its distinct quality characteristics. Tea factories in the Study area are owned by both the private sector and the state sector. The state sector factories along with the plantations were devested to private sector organizations under management contracts in 1991. The supply sources of green leaves for processing are: own plantations, tea small holdings or both.

(2) Rubber

The rubber manufacturing factories are concentrated in the main rubber growing areas of Ratnapura and Kegalle districts. The latex and scrap collected from the rubber trees are processes in the factories to manufacture ribbed smoked rubber (RSS), crepes (thin, thick, pale, sole and scrap), technically specified rubber (TSR) and centrifuged latex. Each factory usually specializes in manufacturing one or two products. Ownership of rubber factories, like tea, is held by either the state or the private sector and the supply sourecs are own plantations, rubber small holders or both.

(3) Sugar and Spirits

Two sugar manufacturing plants located at Sevanagala and at Pelawatta in the Moneragala district produce sugar of plantation white quality . The Sevanagala industry, including the sugarcane plantation was managed by Sri Lanka Sugar Corporation until 1991, when it was incorporated into a public holding company as a prelude to privatization. The factory has a mill capacity of 1,430 tcd and is proposed for expansion to 5,000 tcd on a 5-8 year phased out programme. Sugar molasses, a bi-product, is processed at the distillary to manufacture potable alcohol. Pelawatta industry is owned by a private sector organization and has a mill capacity of 3,000 tcd.

(4) Tobacco

Tobacco leaves produced in the Study area are flue cured in 1821 barns owned by private owners who are under a contract agreement with Ceylon Tobacco Company, a private sector organization, manufacturing cigarettes and pipe tobacco. The cured tobacco is further processed at the Company owned factory in Kandy.

(5) Paddy

Two large scale paddy processing mills were operated by the Paddy Marketing Board (PMB) at Mahiyangana (Badulla district) and at Embilipitiya (Ratnapura district), two of the main paddy growing regions of the Study area. Both the mills are non-operational at present due to the scaling down of the activities of the PMB. A large number of privately owned paddy mills that ranges from large commercial enterprises to small domestic units processing paddy for local consumption are found throughout the Study area.

(6) Coconut

Coconut production being primarily for domestic consumption, only one processing mill exist in the Study area at Rambukkana in Kegalle district. The mill producing coconut oil depend to a larger extent on the supply of nuts from the adjoining Kurunegala district which is a major producing area.

(7) Other Products

Small scale manufacturing of fruit cordials and jams, soybean products, packeting chilli and grain legumes, etc for the local market constitute the present industries based on other agricultural products in the Study area.

(8) Other Industries

Other major industries in the Study area include the garment factories constructed under the 200 Garment Factory Programme of the Government and the businesses registered with the Ministry of Industries Science and Technology. There are a large number of minor industrial enterprises concentrated largely around the cities, but are not formally registered.

Information on the industrial concerns in the Study area are tabulated in Tables 4.3-22 and 4.3-23.

4.3.9 Constraints and Prospects

(1) Constraints

(i) Arable land in the Study area is a limited resource and substantial production increases by bringing in additional lands under cultivation cannot be expected. Farm size in the small holder sector averages less than 0.4 ha., and has been subjected to fragmentation due to populaion growth and land pressure. Land classes not suitable for sustainable agriculture have been brought under cultivation thereby necessitating extensive conservation and consolidation measures. Landless farmers who either work on leased lands and as farm labour are common in the Study area.

(ii) Productivity of lands under most minor irrigation schemes has not reached their full potential due to poor operation and maintenance of the storage and/or diversion facilility and delivery system.

(iii) Agricultural extension system operated by the Department of Agriculture has failed following devolution and decentralization of its field operations to the Provincial Councils and Divisional Secretariats. Extension services that are linked with subsidies for tree crop sector do not reach all farmers needing advise unless they are subsidy recepients. It is generally the case that a single farmer grows mixture of crops that he selects from a range of suitable annuals and perinnials. Because of the compartmentalized nature of the extension services, the farmer is compelled to deal with a number of officers with regard to his extension needs. Farmers lack proper orientation required for the transformation of susbsistance level farms into viable economic bases. The technological information and management skills development is yet to reach down to the farm level. Officer and farmer training, particularly in the Sabaragamuwa province was affected due to non availability of a Regional Agricultural Training Institute.

(iv) Despite the very high interest rates charged, the informal sector continues to be an important source of rural credit in the Study area. Land and other economic assets are acceptable to the commercial banks as colateral, but are owned by relatively few people. When colateral is not available, the banks require guarantors who again are difficult to find in rural areas. Further, the banks follow a cumbersome procedure on documentation often incurring high transaction cost to the burrower and delayed loan processing. It is stated that the persistence of the informal market for credit has resulted in rural indebtedness.

(v) Unstable farm gate prices for agricultural produce, particularly vegetables and subsidiary food crops, arising from local/terminal market supply levels and exchange relationship between the producer and the trader has tended to prevent resource optimization in crop production. Lack of proper market information and intelligence that is easily accessible has left the farmer to his own devises with regard to crop selection and planting times. Poor produce transportation and handling has resulted in excessive wastage estimated to be in the region of 30-40%.

(vi) The available facilities in weekly fairs (pola) and in regional markets in the Study area are usually inadequate and unsatisfactory. As an important link in the flow of agricultural commodities, it shoud offer the basic infrstucture facilities to attract both traders and farmers alike to conduct their transactions conveniently.

(vii) Non-availability of proper storage facilities for farm produce at the farm or community level has compelled the farmers to dispose their output almost immediately after harvesting. The situation often puts the farmer at the mercy of the trader due to product perishability and market gluts. Little attention has been paid to post harvest handling and processing.

(viii) Production is very often constrained due to total lack, shortage and/or non-availability at the required time of seed material and agricultural inputs.

(2) Prospects

(i) The present average yield level of nearly all crops cultivated in the Study area remains below what is achievable under farmers field conditions. A comprison of the recorded yield and potential yield show that a wide gap exists between the two. Proposed crop budgets based on crop recommendation, possible yield and current prices are shown in Table 4.3-24. These data clearly establishes that there is scope for substantial improvement in the present crop yields and farm incomes.

(ii) An increasing demand trend is anticipated for locally produced food crops due to the natural growth as well as increased nutritional awareness among the people. Further, there is the need to produce crops, particularly chilli and onions for import substitution.

(iii) There is also a growing demand for vegetables and fruits in the export market. Value of exports of fresh and processed fruits and vegetables from 1985 to 1991 are shown in the Table below.

Year	Fruits, Vegetables & Root Crops		Total
	Fresh Rs Mn.	Processed Rs.Mn.	Rs.Mn.
1985	63.1	11.4	74.5
1986	71.1	29.3	100.4
1987	75.1	61.6	136.7
1988	96.0	50.9	146.9
1989	138.2	140.0	278.2
1990	170.0	306.0	476.0
1991	285.5	299.7	585.2

Source: Sri Lanka Custom Returns

Floricultural export earnings from export of cut flowers, live plants, leaves and propagatory materials too have shown a three fold increase from Rs.43.67 Mn.in 1985 to Rs.145.04 Mn.in 1989.

(iv) Devolution of power and decentralization of administration to the Provincial Governments and Divisional Secretariats is viewed as an oppertunity to plan and implement area specific development strategies more effectively at the field level. The formal farmer organizations that are currently being instituted at varrious levels would play a vital role by participation in the process as direct beneficiaries.

(v) Handing over the management of State held plantations to private secor management agencies is expected to revitalize the plantation economy and thereby to contibute substantially to the regional economy.

(vi) The recent policy decision of the Government to ban importation of rice and big onions from 1993, and some of the grain legumes from next year onward will have a positive effect on the pricing of these commodities in the local market. The re-activation of the Paddy Marketing Board as the Government purchasing agency to procure buffer stocks at guarenteed prices would ensure price stability.

(vii) The Goverment is offering an incentive package to investors on agro-based export oriented business ventures under the Board of Investment (BOI) promotion scheme.

4.4 Animal Husbandry

4.4.1 General Situation on Animal Husbandary in Sri Lanka

Livestock raising has a long tradition in Sri Lanka. Cattle, buffalo, sheep and goats, pigs, chicken and ducks have been raised throughout the Island for hundreds of years. Animal husbandry in Sri Lanka, as in most Asian developing countries, is integrated with agriculture. Animal husbandry today plays an increasingly important role in the national economy. The economy of Sri Lanka is principally based on agriculture with a large farm population as well as a high population growth rate. The limitation in the available agricultural land has made attainment of self sufficiency in livestock products a difficult task.

Of the total farm population of 10 - 11 million, about 3.5 million are involved with livestock and poultry in all the three major agro-climatic zones; namely the wet, dry and intermediate. The rich animal resources of the country are however, are unequally distributed geographically. In the northern dry areas, local breeds of cattle and buffaloes, sheep and goats are raised while the exotic cattle are mainly raised in the central highland and western wet zones. Pigs are concentrated in the western coastal area. Although extensive poultry raising is found throughout the island, intensive commercial poultry production is largely confined to areas close to Colombo and Kandy conforming to geographical concentration of the population.

Livestock sub-sector contributes about 1.2 percent to the national GDP, and about 5-6 percent to the agriculture sector GDP, The ratios have remained relatively constant over the past decades.

The buffalo and local indigenous cattle are a main traction and tillage power source for agriculture. Milk production of these animals, except for family consumption, has been insignificant while beef production is sporadic. Rearing of dairy cattle for milk and milk products has a tradition among farmers throughout the country.

The consumption of milk in various forms has been a very long standing tradition among the Sri Lankan people with strong religious culture. While the major foodstuffs are cereals (mainly rice) and starch-rich tuberous crops (cassava, potato), coconut milk is an important lipid source in the Sri Lankan's diet. The average per capita consumption of livestock products in Sri Lanka are estimated as 2.48 kg of meat, 14.79 kg of dairy products and 2.6 kg of eggs. This low consumption rates exacerbate a serious protein deficiency of average diet. The estimated current consumption of animal protein is 5.6 grams per capita per day which is far below the FAO's recommended level of 35.0 grams. (Table 4.4-1)

As of 1991, the Sri Lanka has an animal population consisting of 1.47 million cattle, 0.82 million buffaloes, 0.48 million sheep and goats, 84 thousand pigs, 8.26 million poultry and negligible number of ducks. But the data on the livestock population indicates a stagnation of the numbers over the past decades. (Table 4.4-2)

On the other hand, there has been an increasing trend in the broiler sector since 1980's, associated with the establishment of some industrial zones and the fast growing

cities such as Colombo and the west coast area. In the rural areas, farmers have got used to new breeds in crosses with local animals and artificial insemination in cattle.

A vigorous increase in the output of the livestock sector, except broiler production, is yet to be seen. This has been due mainly to a low transfer of technical know-how and high cost of compound feed to the small scale farmers.

Consistent with Government's priorities, specific attention is given to expansion of the domestic dairy industry with the aim of achieving 30 percent self sufficiency by the year 2002. (Table 4.4-3)

4.4.2 Recent Production Trend

(1) Livestock Numbers in the Study Area

The study area has been traditionally popular for livestock and poultry farming. Livestock resources in the Study area according to Livestock Statistics 1991/92, are shown in Table 4.4-4. Exotic and improved breeds of the national cattle herd are mostly concentrated in the up-country areas of Kandy, Nuwara-eliya and Badulla Districts, where intensive farming systems are practiced. In the drier areas of the Study area, farmers practice extensive farming systems.

(2) Farming Systems

(i) Dairy Farming
In general, there are four major clearly identifiable dairy farming systems adopted in the Study Area as well as in other parts of the country, namely,

- The Estate Systems (Zero grazing)
- The Mid County Small Holder Systems (Home garden, zero grazing or free grazing)
- The Coconut Triangle Systems, and
- The Dry Zone Extensive Systems.

The details of the farming systems are given in Table 4.4-5.

Milk is produced in all the districts. The highest production in the Study area is recorded for Nuwara Eliya, followed by Badulla and Kandy. In the dairy industry, ninety per cent of the total national herd is comprised of the local indigenous breed (Lanka cattle or Sinhala), whilst ten per cent are exotic or improved breeds such as Holstein Friesian, Ayrshire, Shorthorn and Jersey, etc. The latter, estimated around 80,000-110,000, is mostly concentrated in the up-country regions of Nuwara Eliya, Kandy and Badulla districts.

Composition of Cattle Breeds shown by Agriculture Census, 1982.

Cattle	Number of Farmers	Small scale	State Farms
Local Breed	1,243,229	1,198,047	45,182
	(91.7%)	(96.4%)	(3.6%)
Improved Breed	113,065	65,567	47,498
	(8.3%)	(58.0%)	(42.0%)
Total	1,356,294	1,263,614	92,680
	(100.0%)	(93.0%)	(7.0%)

Source: 1982 Agriculture Census.

The dairy industry today has gathered momentum after a decade of stagnation. This growth apparently is due to the price incentives paid to the farmers for their milk and the privatization policy of the government. The producer price for raw milk payable at the collecting centers is currently set at Rs. 8.50 per letre (4.3% fat). The pricing is rather low compared to poultry products. The import of powdered milk, however, continues to increase annually to satisfy domestic consumption requirements.

Average body weight of local cattle is around 175-200 kg and the average milk production per day is estimated at 3 litres.

(ii) Buffalo Farming
Buffalo in Sri Lanka is primarily raised as a draught animal, but in recent years, its numbers has remained stagnant.

Murrah, Surti and Nili Ravi are good milk breeds of Indian and Pakistani origin, capable of producing 1,300 - 1,700 litres of milk per lactation. In the Study Area, Matale, Ratanapura and Moneragala Districts are the more popular areas for buffalo farming. The feeds are often supplemented with items of household refuse. In the dry zone areas, such as Moneragala, most buffalo herds are raised free grazing on natural pasture during daytime and paddocked at night.

The average body weight of the local buffalo is around 300 kg.,and
the milk is used for preparing the traditional products such as curd.

(iii) Beef Cattle Farming

The slaughtering of cattle and buffalo is somewhat constrained by the socio-cultural and dietary practices as well as Government regulations. There is no organized beef cattle farming systems in the Island and beef for consumption is predominantly obtained from surplus male stock in herds and culled stud bulls.

(iv) Goats

The most common goat species are Kottukachiya, Boer crosses, Jamnapari crosses, Saanan and Saanan crosses.

Goats is a favoured meat source in Sri Lanka Its popularity is mainly due to the minimal discrimination against mutton consumption based on religious as well as socio-cultural grounds. Goat farming is an important source of income, particularly to landless farmers, on account of the relative ease of rearing and the steady market. During the last decade, the price of mutton has increased substantially, though the producer prices have not kept the same pase. This is mainly due to constraints in the marketing system. Use of goat milk is not significant at present.

In most areas goats estrous all the year round. Average live weight is around 15 - 18 kg and the animals are marketed for slaughtering after 1 - 1.5 years. Disease control in goats is hardly practiced at present.

(v) Pigs
The intensive systems of pig farming are practiced in the Study area. The scale of operation is generally 2 - 5 sows and 1 boar. Pig farming is the most modernized of the livestock farming systems. Breeds kept in these herds are

Large White, Landrace and their crosses. Feed supply is mainly commercial feed obtained from local feed dealers which is often mixed with some agricultural by-products. Pig farming is not popular in the Study area due to religious constraints and marketing difficulties.

(vi) Poultry
There has been a steady and marked growth in poultry production. Kandy, with its high population density, offers the best access to the market. Further, ready availability of veterinary services, concentrated feed and day old chicks has made poultry farming in the district most extensive. The government continues to assist in providing support services to poultry production to meet the expected change in the consumption pattern from beef to chicken and eggs. Development of small scale poultry production operations in rural areas too are being encouraged.

To support the expanding poultry industry, large quantities of feed ingredients such as maize, soybean and fish meal are imported to the country. Around 60,000 tons of maize have been imported during 1991. Domestic production of the raw materials for the provender industry should be encouraged in order to ensure the long term viability of local poultry and pig industries.

(vii) Other animals
Rabbits, ducks and turkeys are raised by few small scale farmers, but it is not popular in the Sudy area.

(3) Marketing

(i) Milk
Milk collection operates through a number of systems. Some farmers located close to urban centers sell direct to retail outlets, but the typical system involves a group of farmers organizing a central collection center to deliver their milk either personally or through an agent or middleman. The milk is bulked into 40 litre cans, and delivered to a chilling centre or direct to the processor. The chilled milk from the centers is transported in insulated trucks by the processors to processing facilities.

In the Study area, there are two government owned liquid milk plants located at Kandy and Nuwara Eliya. Milk collection operates through a network of some 85 chilling centres established throughout the country of which 30 centres are currently operational in the Study area.

The Milk Industries of Lanka Ltd. (MILCO), a state owned company, provides the main market for fresh milk produced in the Study area. The extension service operated by MILCO assists the dairy farmers in the formation of village level producer societies to organize milk collecting centers. It also arranges the input supplies such as concentrate feed, drugs and minerals, pasture propagation material, etc.

(ii) Meat and Live Animals
Marketing channels for livestock and its products in the the Study area, like in the rest of the country, are not properly organized. The sales are usually through a middleman who is either a licensed livestock trader or the owner of a butchery. Middleman buy animals from farmers at the farm gate. Livestock sales transactions are made through price bargaining usually according to the external appearance with little or no regard to the weight of the animals.

One of the weaknesses of the livestock marketing systems has been the lack of objectives standards for grading animals and its products. Some medium and large scale poultry farms sell their products directly to the retail stores or food market.

In Sri Lanka there are special slaughter regulations. Controls on the slaughter of buffaloes and female cattle have been introduced to arrest the regional decline in cattle and buffalo population. However, illegal slaughtering is found in several rural private backyard abattoirs. At times of economic pressures and/or feed scarcities, the small farmers often resort to disposing of the unwanted animals even at very low market prices.

In the Study area, slaughtering of cattle and goats are generally managed by Islamic people.

(iii) Slaughterhouses

Every district except Badulla and Moneragala, has a public slaughterhouse for cattle and goats. However, a high percentage of livestock is slaughtered in un-registered small back-yard facilities. Because most meat is sold as warm carcasses within a few hours of slaughter, butchers preferred to slaughter livestock in their own low cost facilities located close to the market place and save on transportation and refrigerated storage cost. Further, many slaughterhouses are located on riversides and release the waste and drain water directly into the rivers without any treatment, thereby causing river contamination. Operations in the Kandy municipal slaughterhouse are supervised by municipal veterinarians with skills in antemorten inspection. However, in the other slaughterhouses, Public Health Inspectors carried out only meat inspection thereby increasing the health risks posed with the handling of carcasses infected with zoonoses such as brucellosis or tuberculosis etc.

(iv) Commercial Feed

In the Study area, animal feeds are mainly obtained from private commercial feed mills in Colombo. However, the small scale farmers find market prices of these feeds prohibitive. As stated before, Sri Lanka imports several feed ingredients for the provender industry. Frequent price fluctuations of the imported ingredients have led to unstable and high production costs resulting in high feed prices. Greater emphasis has to be placed on research and extension to achieve a breakthrough in the animal feed grain and fodder production. Unless a concentrated effort is made on this field, all optimistic livestock projections, particularly those for poultry and pig production, will not be realized.

Prior to 1984, the government owned Ceylon Oil and Fats Corporation (COFC) was the principal supplier of compound feeds in Sri Lanka. With the sale of 60 per cent of the issued share capital of COFC in 1991, the animal feed industry is now wholly vested within the private sector. The livestock feed industry, particularly the poultry feed sector, is expanding rapidly.

(4) Animal Health Status

Due to vaccination and veterinary inspection programmes, the animal herd has not suffered from heavy contagious diseases in the recent years. In the tropic zone, there exist various kinds of epidemics; some have been controlled while others have hindered the wholesome development of livestock industry. Among a variety of animal diseases, the more important ones are tick-bone disease, internal parasitism, epidemic diseases

such as Foot and Mouth Disease, Rinderpest, Swine Fever, Blackleg, Haemorrhagic Septicaemia, Brucellosis, Newcastle Disease and new exotic poultry diseases such as Marek's Disease and Gumboro Disease.

In the past, Sri Lanka experienced numerous outbreaks of exotic diseases that gained entry from abroad and caused tremendous economic losses to local farmers. Rinderpest outbreak first occurred in 1943 and again in 1987. Foot and Mouth Disease too has been introduced from foreign sources. A very virulent type of Marek's Disease was introduced in 1991 which affected the poultry industry very severely. It is also suspected that Infectious Bursal Disease (IBD) and Avian Encephalomylitis (AE) too have just been introduced to Sri Lanka. Further, poultry diseases like IB, CRD, etc., that were not present hitherto are now prevalent in Sri Lanka. Swine Fever, which was introduced in 1983, broke the back-bone of the swine industry. New diseases, like Parvo have also entered through imported animals. (Table 4.4-6)

(5) Price of Livestock Products

Table 4.4-7 shows the prices of several livestock products. As for meat, mutton (mainly goats meat) is more popular and was the most expensive in the Study area as well as in Colombo.

(6) Supporting Services

(i) Extension Services

The training and extension services on livestock are provided by the Department of Animal Production and Health (DAPH). The programmes provide technical advice and services to farmers for breeding stock improvement, disease control,etc., with its outreach down to the grass-root level. Despite the shortcomings that has arrisen from lack of facilities and equipment, a commendable effort is being made to maintain the services by those involved in extension work.

(ii) Animal Disease Control

The veterinary services is a state owned network in Sri Lanka, and is structured in a pyramidal organization system. Each province has a local veterinary service centre with small stations operating at the district level. The compulsory vaccination programs,which covers some livestock diseases, are subsidized by the Provincial veterinary service, but a major part of the cost has to be borne by farmers. Most of the Provincial veterinary offices require further investment to procure basic equipment and tools.

(iii) Central Artificial Insemination Centre (CAIC)

This CAIC is located at Kundsale, 8 km north of Kandy. The centre maintains about 32 bulls of both European and Indian breeds in addition to buffalo, sheep and goats as semen donors. Semen is available in two forms, namely, deep frozen semen in mini straw and chilled semen. Assisted by the Asian Development Bank, the center is well managed though the available facilities are under utilized due to shortage of some basic equipment. Provision of the required laboratory equipment is essential to up-grade the level of scientific work expected of the center.

The impact of the AI program has been minimal due to lack of interest by the AI technicians, shortage of skilled technicians, financial restrictions and constraints on communication and transport facilities. The highest AI coverage of the island is in the Central Province, whose performance is around 50 per cent of the

breeder cattle. In 1991, about 21,400 inseminations have been carried out in the province. (Table 4.4-8).

(iv) Research Institutions
Veterinary and animal husbandry research institutions are concentrated in Kandy. There are Veterinary Research Institute (basic livestock research institute), Vaccine Production Centre and Animal Virus Laboratory. These institutions too need basic equipment.

The Central Poultry Research Station, located in Kandy, was established with the assistance of the Canadian International Development Agency (CIDA). At present, this station under the control by NLDB. Small scale farmers are supplied with day-old chicks and month old pullets from this hatchery through the local field veterinary officers.

(v) State Farms
National Livestock Development Board (NLDB) plays an important role in livestock development. Import of new breeding stocks, reception of breeding animals or semen from overseas, absorption of new technology and the setting up of demonstration to train farmers are the main function of this organization. Due to shortage of government subsidies most of these state farms are in permanent cash flow and investment problems and their capital and labor efficiency are very low. The most important state farms under the direction of NLDB in the study area are shown in Table 4.4-9.

(vi) Institutional Credit Facilities
Institutional credit for livestock and poultry development could be obtained from any commercial bank after satisfying the bank management about the viability of the enterprise, and by providing the required collateral. Credit so obtained can be utilized for production of livestock and poultry, and/or for processing and marketing of livestock products. Livestock sector is regarded as a priority sector, and thus qualifies for concessionary interest rates, which is 21 per cent per annum at present.

In addition to the above commercial lending for agriculture, there are also special credit schemes. The current interest rate in these credit schemes is 18 per cent per annum. These credit facilities are available under the followings;

1. Credit Scheme for Dairy Development
2. ADB-Sri Lanka Livestock Development Credit Scheme
3. Credit Scheme to promote Self Employment
4. Small and Medium Industries Loan Scheme (SMI)

(vii) Franchise Breeders of Poultry
The 22 chick hatcheries in the country including Central Poultry Research Station, supplies day old chicks to poultry farmers throughout the island. In the Study area, these hybrid chicks are available through feed dealers or middlemen.

(7) Development Projects in the Study Area

Numerous projects have been initiated for promoting the development of the livestock sector in the Study area. On-going development projects are shown in Table 4.4-10.

4.4.3 Constraints and Prospects

(1) Major Constraints

a) Low Genetic Potential of Existing Breeds

b) Low Utilization of Existing Animal Resources
The traditional production system is one of the main constraints that hinders better utilization of farm animals. Farmers keep animal herds fast growing in numbers but pay little attention to the condition of the tanimals. The general feed shortage coupled with imbalanced ratios has led to low reproduction performance and high mortality rate for young animals.

c) Low Productivity of Feed Production Area
Inadequate forage and fodder supplies, particularly during the stressful dry months, are major factors behind low productivity and very low calving rates (60 to 70 per cent).

d) Low Yield on Natural Grassland

e) Inefficient Utilization of Crops Residues and By-Products.
Rice straw and bagasse are fed to animals without any treatment and the utilization of enriched feedstuffs are low. Approximately 50 per cent or more rice straw is not used as animal feed due to lack of know-how on storage and treatment of this type of feed.

f) Low Energy and Protein Intake, Ratio-Imbalance
Lush grasses in the rainy season are low in energy and due to the absence of legumes in the pasture, the protein content of the feed is always below the physiologically required level. Rice straw and other crop residues are deficient in protein. Rice milling by-products are poor in essential amino acids. Continual protein deficiency suppresses animal growth and reproduction.

g) Performance and Production Losses due to Diseases
Due to under nourishment farm animals are very susceptible for diseases. Despite the fact that the country employs an ambitious veterinary services programme, medicine supply, transport and communication are insufficient. Vaccines produced in the country are not very efficient and have a short shelf life. The production and commercial supply of veterinary medicines is not enough to cure animals. Preventive antibiotics are not available and medicated feeds cannot be produced in sufficient quantity and range.

h) Management and Productivity Problems in State Farms
Discontinuation of Government subsidies to state run enterprises including the livestock farms has caused a serious set-back in the production and supply of good quality breeding stocks to the farmers.

i) Increasing Processing and Marketing Problems
Common bottleneck of animal production is the absence of processing facilities except for milk production.

(2) Prospects

The livestock industry in the Study area is favoured by several conditions that are pre-requisites for future livestock development.

a) The Study area has a range of climates suitable for various livestock activities, including those of exotic or improved breeds.

b) Livestock products, in general, are easily distributed for marketing throughout the country since the Study area is located in the central part of the island.

c) Many people in the Study area are familiar with livestock farming gained through tradition, experience or through employment at the large scale private or state farms.

d) The Study area has a high yield potential in pasture grasses and agricultural products compared to other areas.

e) Most of the farmers are diligent and have an extraordinary strong drive to study new farming systems.

(3) Project Proposal

Ambitious targets have been established for livestock production as part of governments effort's to improve consumption patterns and increase milk production. As stated before, consistent with government's priorities, specific attention is given to expansion of the dairy industry. Government's aim is to reach a level of self sufficiency rate of 30 per cent by the year 2002.

An optimistic livestock production target is emphasized in the national plan, but the per capita livestock products and other animal protein consumption will tend to increase only slightly due to rapid population growth. On the demand side it is clear that animal production holds the key to increasing the food protein level of the country's growing population. Livestock production would thus be a profitable enterprise and will attract even greater investment from the private sector accelerating its growth. However, due to the the limitations in the land and feed resources, the policy objectives should move from those of expanding animal numbers to increasing the output of animal products per unit of land area. Long range forecast for livestock numbers should be replaced by new targets based on products output, i.e., kg of meat and litres of milk. Introduction of improved livestock can result in a major improvement of product without a significant increase in numbers. Achievement of targets will depend heavily on use of animals with higher genetic potential, better production and management systems, improved veterinary services and the availability of larger supplies of good quality animal feeds such as grass, feed grain and protein supplements.

From the above analysis of the present situation and national policies, number of possible projects have been identified and prioritized. Included among the top ranking projects are:

1. Strengthening of Central Artificial Insemination Centre.
   Introduction and development of appropriate technology for genetic improvement.
   Provide Frozen Semen Processing Equipment, Artificial Insemination Equipment, vehicles and others. About 20,000,000 yen.

2. Strengthening of District Level Veterinary Surgeon Station.
   Animal health services (prevention, eradication, control and treatment of animal diseases, veterinary public health, etc.)
   Supply basic diagnostic and treatment equipment and vehicles.

7 districts, 10,000,000 yen each station, Total cost 70,000,000 yen.

3. Strengthening of DAPH's Continuous Education Centre.
   Extension services.
   Educational equipment and vehicles. Total cost 10,000,000 yen.

Total estimated project cost: 100,000,000 yen.

4.5 Agricultural Infrastructure

4.5.1 Present Condition of Irrigation Scheme

Irrigation schemes are categorised as minor schemes (village works), medium schemes and major schemes depending on the size of the command area.

Minor scheme is defined as one that has a command area of less than 200 acres (80 ha) operational during any given season. Traditionally, under a minor tank scheme, delivery of water is made from the supply canal to a block of several holdings and not individually to each holding. Minor schemes are sometimes subdivided into two types. One is the Minor scheme with the command area ranging from 10 acres (4.047 ha) to 200 acres (80 ha). Others, having command areas of less than 10 acres, are defined as micro schemes.

Medium scheme is defined as one with a command area of more than 200 acres (80 ha) but less than about 1,500 acres (600 ha). Major schemes have command areas above 1,500 acres (600 ha). Medium and Major schemes are sometimes combined and defined as major schemes having command area of more than 200 acres (80 ha).

(1) Existing Major and Medium Schemes

There are 73 major and medium schemes covering 25,632.6 ha in the Study area. Though the gross area of Central, Uva and Sabaragamuwa provinces constitutes about 1/3 of Island, the extent under major and medium schemes represents only about 8 % of the total extent under the two categories in Sri Lanka. Table 4.5-1 shows the name and location of the schemes and Table 4.5-2 shows land extents under major and medium schemes in the three provinces.

In Matale district, there are 1,214 ha under 7 major and medium schemes. This is 1.57 % of total extent under irrigation schemes in the three provinces and 11.61 % of those in the district. Command area of respective schemes in this district varies from 81.3 ha to 206.5 ha except the largest scheme, Nalanda Reservoir, which has a command area 473.5 ha.

In Kandy district, there are 5,992.5 ha under 5 major and medium schemes. This represents 7.74 % of total extent under irrigation schemes in the three provinces and 33.98 % of those in the district. Command area of respective schemes in this district varies from 120 ha to 177.2 ha, except Murapola Anicut (666.6 ha) and Minipe Yoda Ela Anicut (4,908.5 ha) schemes.

In Nuwara Eliya district, there are 1,714.4 ha commanded by 9 major and medium schemes. This is 2.21 % of total extent area under irrigation schemes in the three provinces and 17.69 % of those in the district. Command area of respective schemes in this district varies from 81.3 ha to 195.1 ha except the largest scheme, Ma Ela Anicut, which commands an area of 473.5 ha

In Badulla district, there are 8,128.7 ha under 18 major and medium schemes. This represents 10.50 % of total extent under irrigation schemes in the three provinces and 58.40 % of those in the district. Command area of respective schemes in this district is larger than in the three districts mentioned above and varies from 81.3 ha to 1,626.0 ha

In Moneragala district, there are 6,175.6 ha under 27 major and medium schemes. This is 7.98 % of total extent of land area under irrigation schemes in the three provinces and 56.20 % of those in the district. Command area of respective schemes varies from 80.0 ha to 813.0 ha of which the majority ranges from 80.0 ha to 200 ha.

In Kegalle district, there are no major and medium schemes.

In Ratnapura district, there are 2,407.3 ha commanded by 7 major and medium schemes. This is 3.11 % of total extent under irrigation schemes in the three provinces and 23.17 % of those in the district. Command area of respective schemes in this district varies from 87.8 ha to 243.9 ha except Uggal Kaltota Anicut (1,100 ha) and Panamure Anicut (508.1 ha) schemes.

In the Study area, there are 9,701.6 ha under 11 large scale schemes each having a command area of over 600 ha. These are distributed as 2 schemes in the Central Province, 8 schemes in the Uva Province, and 1 scheme in the Sabaragamuwa Province. Command area of majority of schemes vary from 100 to 200 ha in the Central Province, 100 ha to 400 ha in the Uva Province, and 100 ha to 250 ha in the Sabaragamuwa Province.

Table 4.5-3 shows the present condition of the major and medium schemes. Except for a few, nearly all schemes required rehabilitation, especially to the intake facilities, irrigation canals and the related structures.

(2) Exiting Minor Scheme

There are 6,935 minor schemes extended over 51,772.7 ha in the Study area. These consist of 726 tank schemes with 10,526.8 ha, 6,029 anicut schemes with 41,245.9 ha and 19 spring water schemes with 67.1 ha. Extents of minor schemes in the Central, Uva and Sabaragamuwa share about 29 % of the total of Sri Lanka. Table 4.5-2 shows the division wise distribution of minor schemes classified according to scheme size.

In Matale district, there are 9,250.5 ha commanded by minor schemes consisting 3,482 ha under tank schemes and 5,768.5 ha under anicut schemes. This is 11.95 % of total extent in irrigation schemes in the three provinces and 88.39 % of those in the district.

In Kandy district, there are 11,636.9 ha under minor schemes consisting 2,419.0 ha under tank schemes and 9,217.9 ha under anicut schemes. This is 15.03 % of total extent in irrigation schemes in the three provinces and 66.02 % of those in the district.

In Nuwara Eliya district, there are 7,952.3 ha commanded by minor schemes consisting 845.4 ha under tank schemes and 7,106.9 ha under anicut schemes. This is 10.27 % of total extent in irrigation schemes in the three provinces and 82.31 % of those in the district.

In Badulla district, there are 5,786.5 ha commanded by minor schemes consisting 106.4 ha under tank schemes and 5,680.1 ha under anicut schemes. This is 7.48 % of total extent under irrigation schemes in the three provinces and 41.60 % of those in the district.

In Moneragala district, there are 4,812.4 ha under minor schemes consisting 2,972.0 ha in tank schemes and 1,840.4 ha in anicut schemes. This is 6.22 % of total extent under irrigation schemes in the three provinces and 43.80 % of those in the district.

In Kegalle district, there are 4,356.1 ha under minor schemes consisting 102.4 ha in tank schemes and 4,253.7 ha in anicut schemes. This is 5.63 % of total extent under irrigation schemes in the three provinces.

In Ratnapura district, there are 7,978.0 ha under minor schemes consisting 599.6 ha in tank schemes and 7,378.4 ha in anicut schemes. This is 10.31 % of total extent under irrigation schemes in the three provinces and 76.83 % of those in the district.

Table 4.5-4 shows the distribution of Tank and Anicut schemes. Tank schemes are dominant in Moneragala district, northern part of Badulla district and in northern part of Matale district. Except Kandy division in Kandy district, anicut schemes are the most dominant type in the Study area. Along the line separating the dry zone and intermediate zone, a distribution tendency of tanks and anicuts can be recognised. In divisions located in the agro-ecological region DL1, tank schemes dominate while in divisions located in agro-ecological regions WL1 to WL3, anicut scheme dominate.

Table 4.5-5 shows the condition of minor schemes in the respective divisions. The condition of the schemes are categorised as follows:

Category	Condition
A :	the condition of scheme is good
B :	the condition of scheme is fair
C :	the condition of scheme is poor
D :	the condition of scheme is poor, slightly damaged
E :	the condition of scheme is poor, severely damaged
F :	abandoned scheme

As seen in the Table 4.5-5, only 52.84 % of the command area and 36.45 % of the number of schemes fall in the category of A and B. On the contrary, schemes categorised in C, D and E are quite large representing 44.17 % in terms of the command area and 60.45 % in terms of numbers. There are some abandoned schemes in Matale, Badulla and Kandy districts. Matale district in particular has some 121 abandoned schemes extending over an area of 1,282 ha.

The following table shows summary of minor scheme conditions:

Scheme Size	in Area (ha)		in Numbers (nos)	
Condition A and B				
Overall	27,355.8	52.84 %	2,528	36.45 %
Over 30 ha	7,396.9	67.50 %	162	55.48 %
5 to 30 ha	16,526.2	55.36 %	1,373	50.33 %
Below 5 ha	3,445.6	31.44 %	993	25.36 %
Condition C				
Overall	12,723.4	24.58 %	1,858	26.79 %
Over 30 ha	1,854.1	16.92 %	74	25.34 %
5 to 30 ha	7,983.9	26.74 %	808	29.62 %
Below 5 ha	2,885.4	26.33 %	976	24.93 %
Condition D				
Overall	4,980.6	9.62 %	936	13.50 %
Over 30 ha	648.3	5.92 %	16	6.51 %
5 to 30 ha	2,526.3	8.46 %	260	9.53 %
Below 5 ha	1,806.0	16.48 %	657	16.78 %
Condition E				
Overall	5,163.5	9.97 %	1,398	20.16 %
Over 30 ha	371.4	3.39 %	22	7.53 %
5 to 30 ha	2,296.3	7.69 %	242	8.87 %
Below 5 ha	2,495.8	22.77 %	1,134	28.97 %

From this table, the following generalized tendencies in the relationship between the condition and the size of the schemes can be recognized.

- Condition of the schemes over 30 ha in extent are better than the smaller schemes
- Condition of the schemes below 5 ha in extent are poor compared to others.
- Average command area of tank schemes is larger than that of anicut schemes.
- Condition of tank schemes are better than anicut schemes.
- 3/4 of the anicut schemes below 5 ha in extent are in poor condition.

(3) Irrigation Facilities

Irrigation facilities in general are divided into head works and canal system. Head works of two kinds can be recognized in the Study area, namely, Anicut, which is a diversion weir, and Tank, which is a reservoir with a dam.

(i) Head Works

In the Study area, almost all anicuts are fixed type weirs constructed on hard rock, equipped with wooden or steal sluice gates. Tanks are built with earthfill dams equipped with a sluice and overflow or morning glory type spillways.

There are instances where more than one anicut or one tank or their combination used in the same scheme. Such schemes are found in Kandy, Nuwara Eliya, Ratnapura and Badulla districts. Tank capacity and anicut length vary from 46,101 m^3 to 30,380,000 m^3 and 7 m to 9 m, respectively, depending on the scheme size. In minor schemes, generally, there is only one intake facility . Among 6,935 schemes, 726 schemes are irrigated through tanks and 6,935 schemes are through anicuts.

(ii) Canal System

In the Study area, most canals are earth canals in principle while some canals running on hill side along the contour line are provided with stone masonry or concrete lining. Major and medium schemes have tributary canals, i.e. branch, distributory and feeder canals. However, there are no tributary canal in minor scheme, in general. Capacity of canals in minor schemes is almost same as the distributory or feeder canals of major and medium schemes. Canal density in major and medium schemes vary from 18 m/ha to 200 m/ha depending on the schemes.

Canal structures in minor schemes are only the field outlets. There are variety of canal structures in major and medium schemes. Number of structures per ha varies from 0.07 nos/ha to 2.25 nos/ha depending on the scheme.

(4) Cropping Intensity under Irrigation Schemes

Cropping intensities of major and medium schemes and minor schemes from cultivation season 1986/87 Maha to cultivation season 1990 Yala are shown in Tables 4.5-6. Cropping intensity in the Study area is higher than or almost same as the average of Sri Lanka under minor schemes and major/medium schemes. However, cropping intensity under minor schemes is lower than that of major scheme. Cropping intensity in Yala in both schemes are lower than that of in Maha. Fluctuation of cropping intensity is quite large in Yala. It is considered that the large fluctuations are not only caused by the weather pattern itself, but also due to problems of the irrigation facilities and water management etc., as well.

As for Matale district, the copping intensity is generally higher than that of Sri Lanka. The intensity in major scheme varies from about 82 % to 98 % in Maha and from 31 % to 55 % in Yala. The intensity in minor schemes varies from 75 % to 90 % in Maha and from 25 % to 41 % in Yala. The fluctuations of the intensity are large when the area is faced with adverse physical condition.

In the Kandy district, cropping intensity is higher than that of Sri Lanka. The intensity in major schemes is stable and varies around 99 % in Maha and around 93 % in Yala The intensity under minor scheme varies from 94 % to 96 % in Maha and from 67 % to 72 % in Yala.

As for Nuwara Eliya district, cropping intensity is almost same as or slightly lower than that of Sri Lanka. The intensity in major schemes varies from 87 % to 93 % in Maha and around 53 % in Yala. The intensity under minor schemes varies from 83 % to 88 % in Maha and around 50 % in Yala. Considering weather conditions experienced in the district, which belongs to the wet and intermediate zone, the intensity is rather low.

In the Badulla district, cropping intensity is higher than that of Sri Lanka. The intensity in major schemes is stable and varies around 98 % in Maha and 73 % to 84 % in Yala The intensity of minor schemes varies from 89 % to 95 % in Maha and 33 % to 35 % in Yala. Low cropping intensities under minor schemes in the Yala season reflects the natural conditions in the northern part of the district which belongs to the dry zone.

As for Moneragala district, cropping intensity is almost the same as that of Sri Lanka. However, in the central and eastern parts of the district that belong to intermediate zone, the intensity is slightly low. The intensity in major schemes is stable and varies between 78 % to 90 % in Maha and 18 % to 57 % in Yala The intensity under

minor schemes varies from 67 % to 81 % in Maha and 17 % to 30 % in Yala. Taking into account its natural condition that major part of the district belongs to the dry zone, cropping intensity in minor schemes in Yala is quite low and fluctuations of the intensity also quite large during both seasons.

In the Ratnapura district, cropping intensity is higher than that of Sri Lanka. The intensity in major schemes is stable and varies from 92 to 99 % in Maha and from 82 to 93 % in Yala The intensity of minor scheme varies from 90 % to 93 % in Maha and 68 % to 84 % in Yala.

In the Kegalle district, cropping intensity is higher than that of Sri Lanka and is rather stable. The intensity varies around 99 % in Maha and 85 % to 98 % in Yala.

(5) Irrigation Rate

Irrigation rate of paddy (total extent of irrigation scheme/total extent of paddy field) in the Study area is higher than that of national level except Kegalle district. The rate for respective district from cropping year 1987/88 to 1992/93 is shown in below.

Cropping Year	1987/88 Average	1988/89	1989/90	1990/91	1991/92	1992/93
Wet Zone	41.08% 44.60%	41.75%	42.67%	47.19%	47.29%	47.37%
Intermediate Zone	70.04%	68.99% 69.85%	69.30%	70.27%	70.16%	70.32%
Dry Zone	69.86% 69.33%	71.47%	71.69%	66.72%	67.55%	68.68%
Matale	76.76% 76.25%	77.61%	78.15%	75.33%	75.38%	74.38%
Kandy	64.10% 63.67%	64.09%	63.82%	63.47%	63.46%	63.10%
Nuwara Eliya	96.78% 97.66%	98.15%	97.79%	97.69%	97.83%	97.73%
Badulla	90.08% 88.28%	89.93%	88.97%	86.34%	86.68%	86.79%
Moneragala	69.20% 70.53%	69.58%	72.40%	70.37%	71.52%	70.14%
Ratnapura	63.19% 65.03%	64.07%	69.96%	64.24%	64.46%	63.40%
Kegalle	21.55% 23.49%	22.29%	22.69%	25.11%	25.11%	24.17%

Source : Statistical Abstract of the Democratic of Sri Lanka,

In the above table, irrigation rate of Kegalle district shows a very low value and the rates of Nuwara Eliya and Badulla district show very high values. The rates of Kandy and Ratnapura district show higher value than that of national average, and the rates of Matale and Moneragala districts show similar or slightly higher value than the national average.

As for irrigation rate of upland crops, there are no reliable data on Irrigated extents at district or national level. However, upland crops, particularly vegetables and potato, are cultivated under irrigation in Nuwara Eliya, and hill area of Kandy and Badulla districts. Further, cash crops such as onion and chilli are grown under irrigation in the drier parts of the Matale amd Ratnapura districts. In Moneragala district, irrigation for upland crops is restricted mainly to sugar cane.

(6) Drainage

In the up-country area, there are very few drainage canals. Since majority of schemes, except those located in flat lowlands, are constructed in valleys or beside hill slopes and irrigation of a paddy fields is done plot-to-plot method, drainage conditions are quite good and requirement of drainage canals is minimal.

In some cases, the natural stream is used as the drainage canal of the scheme and this stream is again used as the water resource for irrigation schemes located in down stream.

(7) Farm Road

Except few major and minor schemes in lowlands, there are no proper farm roads having necessary capacity to carry farm machinery, transport equipment and vehicles. Since major part of canals are constructed in the hill slope along the contour line, most roads remain as footpaths beside the canals with avarage width of about 50 cm. In some major and minor schemes, farm roads functioned as operation and maintenance road as well. Roads having a width of about 2 to 3 meters are provided along the main and branch canals. In general, the distributory canals are not provided with such roads, but with footpaths. These roads are sometimes not in proper condition. They are often covered with grasses and small trees blocking the passage of pedestrians. Condition of the roads are closely linked to the condition of canals. If the canals are well maintained, the condition of the roads is generally good.

(8) Operation and Maintenance

In accordance with the 13th Amendment of the constitution, the provincial councils in 1990, took over the responsibility for operation and maintenance of all minor schemes from the Department of Agrarian Services (DAS). Funds for these activities were accordingly transfered to the provincial councils. However, in 1991, the GOSL budget for minor schemes has again been brought under the DAS. Due to the frequently changing administration of minor schemes, the functional relationship between the central government and the provincial councils is yet to stabilize. The current situation has affected the operation and maintenance activities of minor schemes.

The performance of existing schemes in the Study area, especially the minor schemes below 5 ha, has been poor. As shown in the inventory results, existing minor schemes classified as in poor condition accounted for 44.17 % in term of command area and 60.45 % in term of the number. Maintenance work is not carried out regularly causing deterioration of facilities and wastage of water resulting in loss of production. In principle, operation and maintenance is expected to be done though farmers' effort. However, maintenance or repairing is rarely done due to poor farmer participation and insufficient budget allocations resulting in malfunction of the facilities. Water distribution practices often result in wastage at the head of the canals and shortages at the tail ends. In several schemes rehabilitated by Village Irrigation Rehabilitation Programme (VIRP), water management and maintenance are carried out effectively.

4.5.2 On-Going Rehabilitation Project

(1) National Irrigation Rehabilitation Project

National Irrigation Rehabilitation Project (NIRP) has commenced from 1992 to stabilise and increase agricultural production and incomes and to raise the standards of living through the rehabilitation and improved O&M of existing irrigation schemes.

Under NIRP, 19 major/medium schemes extending over 4,554 ha and minor schemes extending over 7,700 ha have been identified for rehabilitation and improvment.

Province	Nos of scheme	Area (ha)	Estimated Cost (Rs. Million)
Major/ Medium Scheme			
Central	4	1,412	26.6
Uva	11	2,516	61.9
Sabaragamuwa	4	581	12.4
Sub-total	19	21,905	409.8
Minor Scheme			
Central	n.a.	3,500	105.0*
Uva	n.a.	2,200	66.0*
Sabaragamuwa	n.a.	2,000	60.0*
Sub-total	n.a.	7,700	2,310.0*

Note : * Maximum cost

The major and medium schemes that will be rehabilitated under the project are identified in the NIRP appraisal report 1992. As for minor schemes, there is no identified list but the target area for rehabilitation at the provincial level is shown. Rehabilitation of minor schemes proposed by the agencies concerned will be caught up as projects in accordance with the following selection criteria:

- Command area of minor schemes to be rehabilitated would not be less than 4 ha.
- The cost of rehabilitation would not exceeded a base cost of Rs. 30,000 (US$ 750)

(2) Integrated Rural Development Projects

Under Integrated Rural Development Projects (IRDP), rehabilitation of major and medium schemes and minor schemes are being carried out. Method of identification of the schemes to be rehabilitated is the same as that of NIRP. From the respective IRDP offices in the districts, the following information were obtained.

In Matale district, rehabilitation of 9 major and medium schemes covering 2,900 ha and 92 monor schemes covering 2,446 ha have been carried out in the period of 1981 to 1991. At present, no further programmes are scheduled.

In Kandy district, rehabilitation of 11 minor schemes commanding 403 ha had been carried out in the period of 1987 to 1992. No new rehabilitation programmes are scheduled at present.

In Nuwara Eliya district, rehabilitation of 56 major and medium schemes covering 6,441 ha and 183 minor schemes covering 2,392 ha have been carried out in

the period from 1979 to 1992. No further programmes on rehabilitation of irrigation scheme is considered at present.

In Badulla district, rehabilitation of 10 major and medium schemes covering 5,650 ha of and 250 minor schemes covering 2,612 ha have been carried out in the phase I period from 1983 to 1992. In phase II period from 1993 to 1996, rehabilitation of 140 irrigation schemes covering 664 ha and rehabilitation of 14 tank irrigation projects with 140 ha are programmed.

In Moneragala district, rehabilitation of 28 minor schemes with 600 ha have been made in the phase I period from 1984 to 1991. In phase II period from 1992 to 1996, rehabilitation of 3 irrigation schemes are programmed for rehabilitation.

In Ratnapura district, rehabilitation of 83 minor schemes covering 668 ha have been carried out in the period from 1984 to 1992. In the 1993 programme, rehabilitation of 17 irrigation schemes are scheduled.

In Kegalle district, rehabilitation of 154 minor scemes with 1,300.8 ha have been carried out in the period from 1986 to 1992. In the 1993/94 programme, rehabilitation of 70 irrigation schemes covering 770 ha are scheduled. .

(3) Moneragala Irrigation and Community Development Project

The project is formulated to raise living standards and the quality of life of people in about half of the disadvantaged district of Moneragala through the rehabilitation of eight medium/major schemes and improvement of rural infrastructures. By rehabilitation of the eight schemes shown below, the projects envisages to enhance the productive capacity in one fifth of the irrigated paddy land in the district.

Name	Division	Command Area
1. Dehiattawela Anicut Scheme	Bibile	284 ha
2.Monerawana Anicut	Bibile	89 ha
3.Handapanagala Wewa	Wellawaya	392 ha
4.Yudaganawa Wewa	Wellawaya	164 ha
5.Kumbukkan Oya Anicut	Wellawaya	765 ha
6.Ethimole Wewa	Moneragala	396 ha
7.Kotiyuagala Wewa	Moneragala	183 ha
8.Dambe Wewa	Wellawaya	89 ha
Total		2,362 ha

4.6 Rural Infrastructure

4.6.1 Rural Roads

(1) Rural Roads in Sri Lanka

It is estimated that the total length of all type of roads in Sri Lanka is about 100,000 km. These include national roads, rural roads, estate roads as well as private roads. About 30% of such roads are paved with asphalt. The road condition have been improved since the middle of the 1980's through the rehabilitation projects financed by the World Bank. Rehabilitation of 468 km of road length has been completed by 1990, and work on further 1,200 km is on-going. However, in rural areas, maintenance of roads lags behind due to lack of budget allocations and construction machinery as well as the natural conditions, thereby increasing the road length requiring rehabilitation.

(2) Types of Road

Roads in Sri Lanka are classified into six classes from A to F. This classification is not based on the traffic volume, road width or the structure, but has been made conceptually according to the relative importance of the road. The concept, road width, standard structure and the organization responsible for maintenance and controls for each class of road are shown in the table below.

Class	A	B	C	D	E	F
Concept/ Function	Trunk roads between major cities (National roads)	Trunk roads linking with Class A roads & urban area (District roads)	Minor roads linking with Class B roads & local area (Local roads)	Minor roads linking with Class B roads & local area (Local roads)	Rural road; Private roads, in Estates	Lanes, Foot-path, Private roads
Road witdh	over 6.2m	3.7~6.2m	3.0~3.7m	3.0~3.7m	below 3.0m	-
Pavement	Bitumen	Bitumen	Tarred for the greater part	Gravel partial tarred	Gravel or not paved	not paved
Maintenance & control Road	RDA	RDA	Provincial Councils & Local Authorities	Provincial Councils & Local Authorities	Provincial Councils & Local Authorities, Estates,others	-

(3) Administering Organizations and Maintenance & Control System

Class A and B roads, called highways in Sri Lanka, are administered by the Road Development Authority (RDA) under the Ministry of Highway and Transport. The Authority stations a Chief Engineer's Office in each Province and district for the control, maintenance and repair of road surfaces, bridges and culverts. The minor roads below Class C were also maintained and controlled fully by RDA until 1989, when the Provincial Council were inaugurated. The road administration was then transferred to the Provincial Councils and Local Authorities. However, due to unsatisfactory administrative setup within the Provincial Councils, the lack of engineers and budget, maintenance and controls of roads by these authorities are not fully implemented.

The organization charts of the RDA and the Road Development Section in the Provincial Council (Central Province) are shown in Fig. 4.6-1.

(4) Present Condition of the Study Area

According to the inventory survey conducted through divisional secretariats and the statistics of the RDA, the present road condition in the Study area is summarized as follows.

	Road Length(km)					Density ofRoads	
	A	B	C	D	Total	km/km	Person/km
Kandy	205	466	808	633	2,112	1.12	589
Nuwara Eliya	144	354	381	225	1,104	0.65	631
Matale	112	193	339	237	880	0.44	496
Ratnapura	254	298	495	379	1,425	0.43	668
Kegalla	107	205	377	350	1,038	0.63	728
Badulla	208	354	570	480	1,612	0.57	469
Moneragala	219	161	395	459	1,235	0.22	325
Total	1,247	2,030	3,366	2,763	9,405	0.50	557
(Sri Lanka Total)					(25,953)	(0.40)	(665)

The density of roads in the Study area, though it varies depending on the district, is higher than the national average except in the Moneragala district. The reason for the high density of roads is the existence of many forests and other natural sources in the Study area. When the zones where cultivation and habitation are prohibited are excluded, the density of roads in the Study area jumps up to 0.80(km/km2), and in this case, even the density of roads in the Moneragala district (0.48) exceeds the national average.

As seen in the above table, the density of roads per unit area in the Kandy district, with the large city of Kandy, is the highest, implying high diffusion of the road network. Concerning the population per unit distance, the two districts in the Uva Province and the Matale district show low values since these districts are less populated.

The density of roads in the Ratnapura district, in comparison to other districts, is rather inferior. However, the road network in the Study area, in general, can be considered as well developed.

(5) Constraints

From the results of the inventory survey, it is recognized that the condition of the road network in the Study area better than the national level. However, the inventory survey also revealed that a considerable road length required rehabilitation as shown below.

	Distance of Roads Rehabilitation (km)				
Class of Road	A	B	C	D	E
Kandy District	10	20	549	293	220
Nuwara Eliya District	0	0	194	146	71
Matale District	10	10	177	197	146
Ratnapura District	0	0	233	198	283
Kegalla District	10	0	43	119	269
Badulla District	0	40	292	248	200
Moneragala District	70	30	71	98	219
Study Area Total	100	100	1,559	1,299	1,408
(Ratio to Total Distance)	(7%)	(4%)	(46%)	(47%)	(19%)

The rehabilitation projects on the Class A and B roads have been carried out with financial assistance from the World Bank, ADB and OECF. Accordingly, the ratios of rehabilitation of such roads to the total distance are low, implying the well-maintained roads. However, of the roads maintained by the Provincial Councils and Local Authorities, nearly 50% of the class C and D roads, and 20% of the class E roads are

facing the necessity of rehabilitation due to the poor maintenance and insufficiency of budget. Through the field survey, it was noticed that there are many sections that hamper smooth transportation in the Class C, D and E roads, (that play a important role in agricultural product transportation), especially in the rainy seasons.

4.6.2 Rural Water Supply

(1) Diffusion of Water Supply Systems in Sri Lanka

The sources of domestic water supply in Sri Lanka, in a broad classification, are as follows:

1. Piped water supply system
2. Tube well with hand pump
3. Dug well
4. Rivers, tanks and springs

The water-supply ratio in the following table shows the population using safe water, protected against contamination in some way or other, under the present water supply system of the National Water Supply & Drainage Board (NWS&DB):

	Urban area	Rural area	National
Waterworks	63%	8%	20%
Wells & Hand Pump	25%	57%	50%
Total	88%	65%	70%

Various international organizations from the developed countries have assisted Sri Lanka to modernize the water-supply system in accordance with the International Drinking Water Supply and Sanitation Programme proposed by the U.N. in 1980. Judging from the growth of water-supply ratio by 1990, and the investment programmes for water supply projects to be implemented hereafter, the NWS&DB expects that a 100% water supply ratio will be attained in 2005.

(2) Administering Organizations and Operation and Maintenance System

NWS&DB has eight Regional Offices under five Regional Support Centres executing all aspects of the water supply projects from planning, design through to construction.

No definite administering division is established for the operation and maintenance of the water-supply systems. However the water intake and distribution of the medium and large water supply facilities are directly maintained by the National Water Supply & Drainage Board.

Distribution facilities of small water supply schemes, tube wells with hand pump and dug wells are maintained by the Local Authorities (MC, UC and Pradeshya Sabha) with the support from NWS&DB.

The administering areas of the regional offices of NWS&DB in the Study area are as follows:

Regional Support Centre	Regional Office	Covering Districts
1. Central Range	Kandy	Kandy, N'Eliya, Matale Kegalla & Part of Ratnapura
	Bandarawela	Badulla, Monaragala
2. Western Range	Ratmkalana	A greater part of Ratnapura

The organization chart of NWS&DB is shown in Fig. 4.6-2.

(3) Existing & On-Going Water Supply Projects in the Study Area

In the Study area, several programmes or studies on water supply have been implemented or are under way with the assistance of various funding agencies. Table 4.6.-1 shows such activities by district.

In 5 of the 7 districts in the Study area, district scale water supply development plans have been established. In the Matale district, the water-supply project commenced in 1983 and was completed in 1991. Outlines of these projects are described below.

Kandy District

Finish International Development Agency (FINNIDA) provided assistance for development of water-supply and sanitation facilities to the Harispattuwa, Pujapitiya and Akurana Divisions from 1980 to 1987. Based on this achievement, FINNIDA established an entire district development plan in 1987. After completing Phase I of the study in 1992, it is presently being transfered to the Phase II study. An outline of their plan involving the water-supply facilities up to Phase II is shown below.

	Harispattuwa WSS	Phase I	Phase II (On-going)
Implementation period	1980 ~ 1987	1987 ~ 1992	1992 ~ 1995
Applicable Divisions	Harispattuwa, Akurana, Pujapitiya	Udanuwara, Yatinuwara, Tumpane, Pata Dumbara, Kundasale	Yatinuwara, Udanuwara, Meda Dumbara, Pata Hewaheta, Kundasale,Tumpane
Tube Wells with Hand Pump & Dug Wells	Approx. 1,000 units	Approx. 750 units	Approx. 370 units
Piped Water Supply System	11 systems	4 systems	1 system
Operating Costs	Approx.800M.Rs.		Approx.462M.Rs.
Beneficiaries		Approx. 280,000	Approx. 95,000

Moneragala and Kegalle Districts

In 1991, a development plan involving rutal water supply and sanitary facilities was established for Kegalla, Moneragala and Karutala districts under an ADB aid programme. This development plan aims to achieve 100% water-supply to farm villages by 2010. The scale and investment amount are as follows:

		Kegalle District		Moneragala District	
		No.of Units	Investment (M.RS)	No.of Units	Investment (M.RS)
Piped water-supply system(households)		9,410	86.8	17,530	235.8
Tube Wells with Hand Pump	(New)	350	25.4	570	41.6
	(Repair)	7	0.1	395	7.9
Dug Wells	(New)	2,320	20.1	7,040	63.3
	(Repair)	17,410	96.6	4,470	25.9
Spring water		4,190	51.1	540	3.8
Rain water		0	0	6,540	73.6
Total		-	280.1	-	451.9

Ratnapura and Badulla Districts

A development plan covering the period of 1993 ~ 2001 was established in 1991 for both districts with the aid from UNDP. The plan aims to achieve 100% water-supply. No concrete restored volume is shown in the development plan, but the plan established the number of water-supply beneficiaries and targeted water-supply rates as follows:

	Ratnapura District		Badulla District	
	Beneficiaries	Target rate	Beneficiaries	Target rate
Piped Water Supply				
Natural flow	96,287	21%	67,517	25%
Pumping up	14,003	10%	7,553	2%
Dug Wells w/Hand Pumps	7,516	2%	4,346	1%
Deep Wells w/Hand Pumps	109,787	14%	134,654	31%
Dug Wells only	254,618	48%	202,138	41%
Total	482,211	95%	416,201	100%

The development plan above has been prepared in compliance with the priority order established in 1992, and is to be implemented from 1993.

Matale District

DANIDA (Danish International Development Agency), during the period from 1981 to 1982, established the development plan involving farm village water-supply and sanitary facilities for Matale and Polonaruwa districts. The plan was implemented from 1983 and the following water supply facilities were either constructed or repaired by 1991. The water supply rate is presently 75%.

Hand Pump Facilities		Hand Pump Facilities	Piped Water Supply
Deep Wells	Dug Wells	Repairs	Systems(Constructed)
971 units	106 units	513 units	18 facilities

In the remaining Nuwara Eliya district, a water supply development plan has not been established as yet. Rehabilitation of the pipe water supply systems and construction of dug wells are conducted under the IRDP project.

(4) Status Quo of the Study Area

The diffusion of water-supply and the status quo of its facilities by district, based on the inventory survey carried out for each Division and the statistics of NWS&DB, are shown below:

District	Diffution Rate	Piped Water	Hand Pumps	Dug Wells
Kandy	69.3%	17.8%	22.3%	59.9%
Nuwara Eliya	39.0%	24.3%	0%	75.7%
Matale	75.0%	15.3%	34.1%	50.6%
Ratnapura	67.0%	20.3%	6.1%	73.6%
Kegalla	70.3%	11.4%	2.8%	85.8%
Badulla	55.2%	34.9%	10.1%	55.0%
Moneragala	57.7%	9.8%	21.1%	69.1%
Study Area Total	62.8%	19.0%	13.6%	67.4%
(Rural Area in Sri Lanka)	(65%)	(12%)	(88%)	
(Sri Lanka)	(70%)	(28%)	(72%)	

The table above shows that the diffusion rate for the Nuwara Eliya district is extremely low. The reason is that Nuwara Eliya, being the most mountainous district in the Study area, has many torrents and abundant spring water and as a result the demand for water-supply facilities has not been so strong. The same holds for the Badulla district. In the mountainous areas of both the Nuwara Eliya and Badulla, gravity-system piped water supply from rivers is frequently employed. The figures in the table above suggest this clearly.

On the other hand, the table shows that the Moneragala, Kegalla and Matale districts, which have much flat-land, are dependent on underground water. In the Matale district, a water-supply project with hand pumps as the core was implemented from the early 1980's with the aid of DANIDA. This project was completed in 1991. This is the reason for the high diffusion rate of water supply and hand pumps in Matale.

(5) Constraints

The water supply development plans are decided by cooperating agencies, which aim to achieve 100% water supply in the targeted years of 2001 or 2010 for 5 districts out of 7 districts. Concerning the Matale and Nuwara Eliya districts, where some of the water supply projects have already been completed and which have an abundant water supply, it is still necessary to raise the diffusion rate of domestic water in order to improve health and sanitation.

4.6.3 Rural Electrification

(1) Electric Power Supply in Sri Lanka

Presently, 14 hydro-electric power plants and 3 thermoelectric power plants are operating in Sri Lanka. The total maximum power generation capacities are 1,017MW and 272MW, respectively. According to the statistics for 1991, the Ceylon Electricity Board (CEB) supplies power to 882,373 households.

(2) Outline of Rural Area Electrification Projects

The electrifiation projects for rural areas are mainly managed by the following funds:

1) DCB : Government funds allocated to the members of the National Assembly for local districts
2) ADB : Electrification plan by ADB loan
3) IRDP : Budget for the farm village over-all development plan Investments for farm village electrification became active from the middle of the 1970's

Some 10,000 plans were implemented by 1991, including the1981-1990 farm village electrification plans using ADB loans (1065 plans). The scope of implementation of these plans is classified into the following two types:

1) RESS Plan : Extension of high-voltage transmission lines to the beneficiaries' area; installation of power distribution equipment (transformers); and construction of low-voltage power distribution network (New Scheme)
2) REES Plan : Extension of low-voltage power distribution network (Extension Scheme)

At present the RESS plans are mainly implemented under the ADB and IRDP programmes while the RESS plans are implemented under the DCB. Originally, distinction between the RESS and REES plans in terms of scope of implementation was not clearly established, but the total of plans implemented by 1990 breaks down as follows:

DCB (RESS & REES)	ADB (RESS)	IRDP (RESS)
7,800 items	1,065 items	115 items

According to CEB, over 80% of the plans implemented by DCB are REES plan.

(3) Diffusion of Rural Electrification

According to CEB, the accurate electrification rate of farming areas is not available since no reliable data on the number of farm villages and households have been established. The national electrification rate, according to the 1991 statistics digest of CEB, is 33%, which is estimated to have grown to 37% presently. Looking at the ADB reports and other data, the electrification rate in farming areas may reasonablybe estimated at 15-20%.

One reason for the low electrification rate in the farming areas is the low density of the low-voltage power distribution network. Another reason is that the costs required for the exterior and interior wiring must be borne by the beneficiaries. It is estimated that a considerable number of households refrain from having electricity for this reason. The Government of Sri Lanka tries to promote the exterior and interior wiring of private houses though low interest loan granted by the People's Bank. However, according to the estimates in the ADB report, about 50% of houses in the farming areas, to which the distribution wiring is possible, remains unelectrified. Taken as a whole, it is presumed that the electrification rate for the whole country at present moment would be between 43-45%.

(4) On-Going Projects for Rural Electrification

Following the conclusion of rural electrification plan under the ADB loan, which was implemented from 1981 through to 1990 (RE-1), the second phase of the plan (RE-2) is being implemented for completion in 1993. This project treats 611 RESS plan

items and 817 REES plan items and envisages over 12% EIRP (electricity internal revenue rate) for 20 years.

Further, based on the ADB's master plan for farm village electrification (March, 1992) which is divided into phases RE-3 - 6, the government aims to implement 3,750 rural electrification programmes by the year 2000, thereby raising the national average rate of rural electrification to 70%, subject to the following conditions:

1) RE-3 to be started in the latter half of 1993.
2) To implement 500 RESS programmes per year.
3) To make public investment of US$30 million annually for the above RESS programmes.
4) To raise the electricity charges of the low power consumption households by 25-30% by 1994.
5) To reduce power loss and maintenance costs by improving existing power distribution facilities.
6) To provide a full low-voltage distribution network for each district and assess the state of power distribution facilities (transformers) and the electrification rate of each district.
7) To reduce the illegal power consumption

(5) Administering Organizations and Maintenance & Control Systems

Power production and supply in Sri Lanka are managed by CEB under the control of the Ministry of Power and Energy. The Board, through a Provincial Office established in each Province (2 offices in the western Province), implements the electrification programmes nationwide. The Area Engineer Offices, subordinate to each Provicial Office, implement the electrification programmes, maintainance and controls and collection of the electric charges for each district.

In urban areas, maintenance, controls and collection of electric charges have been transferred to the Lanka Electric Corporation (LECO) capitalized by the Ceylon Electricity Board. The organization chart of the Ceylon Electricity Board, Central Province,is shown in Fig. 4.6-3.

A greater part of the rural electrification project in the past was implemented with DCB funds inaugurated in 1974. The DCB funds ran low as the rural electrification programme progressed, and additional funds through the ADB loan and IRDP budget were introduced. Electrification has tended to be implemented on the basis of requests from local authorities. In some cases, low-voltage distribution wires have been extended excessively (RESS Plan) and programmes with large power loss have been implemented, resulting in inferior power supply.

(6) Status Quo of the Area Studied

The status quo of the area studied, based on the inventory survey on the division level and the statistics of CEB, is summarized below:

	No. of Rate Contracts/ of contracts	Electrification	High-voltage wire density	Low-voltage wire density	(transformer)
Kandy	85,327	34.9%	0.38	1.65	177
Nuwara Eliya	22,176	15.9%	0.34	0.69	65
Matale	18,555	19.2%	0.21	0.66	102
Ratnapura	40,926	21.3%	0.20	0.49	163
Kegalle	31,083	18.1%	0.31	0.86	123
Badulla	44,311	28.4%	0.20	0.78	123
Moneragala	8,252	10.9%	0.08	0.17	84
Study Area Total	250,630	23.3%	0.20	0.68	127
(Whole Country)	(882,373)	(37%)	(0.20)	(0.60)	(118)

The electrification rate and the high wire densities of the Kandy district, though it varies depending on the division, is at the national level.

The number of contracts/transformer is small in the Nuwara Eliya district. This reflects the low efficiency of electrification in mountainous areas.

The Kegalle district has a comparatively low electrification rate for a high distribution wire density. This suggests that there is still room to raise the electrification rate when the power distribution facilities are restored.

The Moneragala district is an extremely depopulated area with no satisfactory power distribution wire network. It is feared that excessive investment would be needed to raise the electrification rate.

(7) Constraints

The farm village electrification project represents one of the important national policies for the Government of Sri Lanka in view of stimulating economic growth, saving fuel imports, reducing the collection of firewood and charcoal and promoting employment. However, one major problem that hampers further electrification in the farming areas is that the cost of external and internal wiring must be borne by the beneficiary household. This investment in wiring costs is too large a burden on the farmers, so they tend to rely on kerosene inspite of its costing more than electricity. It is considered that an appreciable increase in the electrification rate will not be possible unless the social and economic conditions of the farming villages undergo a substancial improvement.

4.7 Environment and Farm Land Conservation

4.7.1 Current Environmental Conditions

(1) Socio-economic Environment

a) Administrative boundary and demography

The Study area is situated in the central hill country of Sri Lanka, which consists of Central province, Uva province and Sabaragamuwa province with land locked conditions administratively. Its total area is about 19,000 km2 or 29 % of the total national land area. The total population in the Study area is about 4.1 million in 1981, and it corresponds to the population density of 215 persons/km2 little lower

than the national average of 241 person/km2. The ethnic groups in the area is summarized in Table 4.7-1, and there are no serious confliction among them at present.

b) Socio-economy

The Study area is one of the regions which have suffered from chronic problems such as unemployment, low economic growth, shortage of cultivation land and a lot of landless people. By the end of 1950's, the area had been utilized for the commercial agricultural sector leaving behind very little room for the expansion of the traditional agricultural sector except for only Moneragala province. Although the area covers more than 35 % of the total agricultural lands in Sri Lanka, the lands for small holder cultivation is very few because the most of these lands are under large estates. Besides the tea and rubber processing industries, the industrial sector in the area is quite small, and had very little investment during the past two decades. Thus, it can be said that the most problems on regional socio-economy confronted to the area are originating in its historical background of regional development.

GDP in the Study area is about Rs.11.4 million or 21 % of the total GDP in Sri Lanka in 1990, and the average per capita GDP in the area about Rs. 2,790 is fairly lower than that of the national level of Rs. 3,597. The most important sector is agriculture and its sectoral GDP is about Rs.3.4 million occupying 30 % of the total GDP in the Study area in 1990. It should be noted that the area has large share of production of two major plantation crops, tea and rubber, contributing to the national economy.

c) Land use

Agricultural land is the most predominant land use, and its area is about 1,175,000 ha in total which occupies about 62 % of the total Study area. Second is the forest land occupying about 517,000 ha or 27 % of the total area. Other land use categories such as urban land, scrub and grass land, and barren land occupy only 10 % of the total area. Large portion of the land areas for plantation especially tea and rubber is one of the characteristics in the Study area. Tea plantation estates are mostly located in Kandy, Nuwara Eliya, Badulla and Ratnapura districts, and rubber estates are in Kegalla and Ratnapura districts. The Study area covers about 73 % of the tea plantation area and about 48 % of rubber plantation area in Sri Lanka. It means that the Study area accounts for large share of the national economy and the foreign export earnings of the country.

One of the most important characteristics on land in the Study area is the fragmentation of lands due to i) increasing population, ii) lack of alternative employment opportunities out side agriculture, and iii) the existence of laws and customs of succession which prescribed the fragmentation of properties amongst heirs on a fair division basis. Pressure on lands is such, that holdings are getting smaller from generation to generation due to increase of population. According to the census of Agriculture in 1982, about 13.2 % of farmers do not own any lands, and this is 2.2 % higher than that of the national average. This figure is much higher in Ratnapura, Matale and Moneragala districts as shown below. Since the last census of 1982, ever-increasing population pressures on the land and the growing number of landless farmers have escalated, and this is reflected in extensive cultivation of steep slopes and destructive slush and burn practices high up the mountain crests.

Item Province/District	Agricultural Operators (1982) Total No. of Operators	No. of Not Owing any Land	%
I.Central P.	196,059	24,981	12.7
Matale D.	50,400	8,267	16.4
Kandy D.	107,151	11,965	11.2
Nuwara Eliya D.	38,508	4,749	12.3
II.Uva P.	115,987	16,301	14.1
Badulla D.	69,813	9,343	13.4
Moneragala D.	46,174	6,958	15.1
III.Savaragamuwa P.	204,745	26,905	13.1
Kegalla D.	98,080	7,508	7.7
Ratnapura D.	106,665	19,397	18.2
Total	516,791	68,187	13.2
Sri Lanka Total	1,794,703	197,591	11.0

source: Census of Agriculture, 1982, M. of Policy Planning and Implementation

(2) Natural Environment

a) Topography

The Study area, which has a total land area of about 19,000 km2, mostly lies in the central highlands and shows complex topographical conditions with very wide vertical ranges from below 50 m to more than 2,500 m above sea level. From its elevation and slope characteristics, the Study area can be divided into the following three topographical regions.

i) Low Land Area: gently undulating and flat lowland terrain of elevation below 100 m, consisting foothills and lowland plains,
ii) Upland Area: hilly, steep and rolling upland terrain of elevation from 100 to 1,500 m, consisting ridges, hills and valleys, and
iii) Highland Area: mountainous highland terrain of elevation above 1,500 m, consisting of plains, plateaus, mountain peaks and ridges.

The most predominant topographic region is the upland area. It can be found broadly only except for Nuwara Eliya district, and occupies about 66 % of the total Study area. The low land which occupies about 20 % of the total area, can be mostly found in Moneragala and Ratnapura districts. While, the highland area consisting about 14 % of the total area is mostly situated in Nuwara Eliya district.

b) Soil conditions

Soils in the Study area broadly fall into 8 major soil groups and associations as shown below. Major soil groups in the wet zone consisting of Nuwara Eliya district, Ratnapura district, and the southern part of Badulla and Kegalla districts, are Red Yellow Podzolic Soils and Mountain Regosols, and Red Yellow Podzolic Soils. The semi-wet and intermediate zone consisting Kandy district and the southern part of Matale district, is widely occupied by Red Yellow Podzolic Soils and Mountain Regosols, Reddish Brown Latosolic Soils, and Immature Brown Loams. While Reddish Brown Earths and Low Humid Gley Soils, Reddish Brown Earths and Solodized Solonetz, and Reddish Brown Earths and Immature Brown Loams are predominantly distributed in the semi-dry and intermediate zone

consisting of Moneragala district, and the northern part of Matale and Badulla districts.

District	Soil Group* (unit: %)								
	a)	b)	c)	d)	e)	f)	g)	h)	Total
a) Matale	50	0	20	10	nil	5	0	15	100
b) Kandy	0	0	0	40	10	15	20	5	100
c) Nuwara Eliya	0	0	0	50	40	nil	0	10	100
d) Badulla	30	0	10	30	20	0	0	10	100
e) Moneragala	50	15	20	0	0	0	0	15	100
f) Kegalla	0	0	0	15	75	5	5	nil	100
g) Ratnapura	5	0	10	0	80	0	0	5	100

note: a) Reddish Brown Earths and Low Humid Gley Soils (RBEs/LHG),
b) Reddish Brown Earths and Solodized Solonetz (RBEs/SS),
c) Reddish Brown Earths and Immature Brown Loams (RBEs/IBL),
d) Red Yellow Podzolic Soils and Mountain Regosols (RYP/MR),
e) Red Yellow Podzolic Soils (RYP),
f) Reddish Brown Latosolic Soils (RBL),
g) Immature Brown Loams (IBL),
h) Others (Erosional Remnant, and Steep Rockland and Lithosols).
source: The National Atlas of Sri Lanka, 1988, Survey Department

Among the soil groups in the area, Immature Brown Loams and Reddish Brown Earths are highly erodible and need special soil conservation measures. Although Red Yellow Podzolic Soils and Reddish Brown Latosolic Soils are considered rather stable soils, these are also prone to high erosion because of the distribution in steep slopes. In general, these soil groups are suitable for a wide range of plant growth with proper water management both irrigated and rainfed types of cultivation.

c) Climate and agro-ecological zones

The wide variation of altitude from 20 m to more than 2,500 m above sea level and the presence of both wet and dry climatic zones result in the complexity of environment in the Study area. The wet zone which consists of mountainous and hilly regions in the middle and western parts of the area receives high annual rainfall more than 3,000 mm. Northern and eastern parts of the are fall in the intermediate zone receiving annual rainfall 2,000 - 3,000 mm. While, the southeastern part is included in the dry zone which has annual rainfall less than 2,000 mm.

The area enjoys high rainfall by northeast and southwest monsoonal rains. The major cultivation season, the Maha, occurs during the northeast monsoonal period and extends from October to March. The minor cultivation season, the Yala, corresponds to the southwest monsoonal period from April to September. The highest rainfall normally occurs during the Maha season. However, there is a water deficit for much of the district for cultivation during the Yala season due to the imbalance between monthly rainfall distribution and rate of evapotranspiration.

Annual mean temperature in the area mostly depends on the elevation. It is 24.4 ^{o}C in Kandy (El 477 m), 15.4 ^{o}C in Nuwara Eliya (El 1,832 m), 23.2 ^{o}C in Badulla (El 670 m), and 27.1 ^{o}C in Ratnapura (El 34 m), for example. Mean daily temperature, however, varies little throughout a year. There is also a high regional variation in number of humid, and the highest and least diurnal variation of humid

occur during the dry months (normally February) and the wet months (normally May or June).

d) National parks and forest reserves
As shown in Table 4.7-2, the total extent of lands under protection is about 3,347 km2 or 17.6 % of the total Study area excluding proposed parks and reserves. These protected areas are mainly distributed in the surrounding areas of district border. Major national parks and reserves in the area are Yala national park, Uda Walawe national park, Lunugamwehera national park, Maduru national park, Wasgomuwa national park, Peak Wilderness sanctuary and Sinharaja forest reserve.

In the Study area, dense forests are largely limited to the protected and remote areas in the mountain terrain and reserves. These forest areas are characterized by dry and mixed evergreen of semi-deciduous trees. The dominant canopy is composed of valuable timber and firewood trees, such as Weera (Drypetessepiaria), Palu (Manilkara hexandra), Velang (Pterospermum canescens), Kanumella (Disospyrous ovalifolia), Halmilla (Berrya cordifolia) and Kaluwara (Diospyous ebenum). Much of these forest trees have been seriously degraded by shifting cultivation around the settled areas. Other large trees such as jak, banyan, tamarind, kumbuk and capok are also found along river banks, tanks and canals, roadsides, and settlement areas where they provide shade, water protection and local fuel and food consumption.

Outside of the forest cover areas, there are a large extent of natural vegetation areas such as scrub woodlands, grasslands and savannas. Thickets occur around abandoned lands or in areas earlier cultivated but where the soil has become debilitated, and savannas are in areas where successive fires for shifting cultivation have prevented formulation of woody growth. The major grasses are illuk (Imperata cylindrica), mana (Cymbopogon confertiflorus) and guinea grass (Panicum maximum), which grow up to 2 m in height.

There is a wide range of fauna inhabiting the national reserves including endangered and threatened animal species, such as elephant, leopard, Bengal monitor, python, purple-faced langur and tongue macaque. Elephants have seasonal movements related to their grazing pattern and water requirements. An estimation of 1982 puts the number of elephants in Sri Lanka at around 2,000 of which 400-600 are in Yala and adjacent areas. Due to increased human activities around the elephants' habitats, migratory movements have been hampered, causing overgrazing in protected areas and conflicts with new settlement areas. This has also effected other ecological balances and the foraging patterns of other animals.

4.7.2 Environmental Problems in the Study Area

Although some variations are found among the districts, the following seven (7) issues can be pointed out as the major causes of environmental degradation in the Study area;

(1) Soil erosion, (2) Deforestation, (3) Shifting cultivation,
(4) Encroachment of reserves, (5) Mono-cropping of tobacco and sugar cane,
(6) Gem mining, and (7) Landslides.

These environmental problems originate a broad socio-economic activities for livelihood of the people living in rural areas, and they are firmly linked each other as

shown in Fig. 4.7-1. This fact suggests that the environmental problems eventually result in the degradation of land resources, forest resources and bio-diversity, and there would be great difficulties to solve environmental degradation in the area without any consideration of socio-economic aspects of the local people and participation of them. The environmental issues by each district with relative significance are summarized below based on the results of inquiry survey in this Study. A specific, but common conditions of the environmental issues in the Study area mentioned above, is briefly described hereafter.

District	Central P.			Uva P.		Sabaragamuwa P.	
Env'tal Issue	Matale	Kandy	N.E.	Badulla	Mon'la	Kegalla	Rat'ra
(1) Soil erosion	A	A	A	A	B	A	A
(2) Deforestation	A	A	A	A	B	A	A
(3) Shifting cultivation	A	B	C	A	A	B	A
(4) Encroach't of reserve	B	B	B	B	A	C	A
(5) Mono-cropping	B	A	B	B	B	C	B
(6) Gem mining	C	B	C	B	C	B	A
(7) Landslides	B	C	A	A	C	B	B

note: A: Issues which have relatively high significance.
B: Issues which have relatively medium significance.
C: Issues which have relatively low significance.
source: JICA Study Team

(1) Soil Erosion

Soil erosion is identified as a very widespread and serious problem in the Study area. It is a combined effect of other environmental problems such as shifting cultivation, encroachment of reserves, deforestation, removal of surface cover vegetation, and inadequate agricultural practices. In general, mass movement, gully, rill erosion can be mostly found in the mountainous, highland and upland regions, and sheet and wide spread type of erosion are in gentle, undulating and flat regions. Soil erosion is not only reducing the quantity of soil but also depleting its nutrients, and this accelerates detrimental effects to the farmers in reducing productivity of their lands.

Soil conservation activities have been generally given much attention in the larger estates in the area. Thus, the small holders whose earnings are often inadequate for investment on soil conservation and the encroachers on state lands who tend to show little interests on soil conservation due to insecurity of land tenure should be put high priority of soil conservation practices in the Study area.

Intensity of erosion hazard is chiefly determined by slope gradient and land use. According to the previous study reports, estimates of soil erosion in common agricultural lands range from 18 to 70 ton/ha/y in the intermediate zone. In case of shifting cultivation and tobacco cultivation, it is estimated from 100 to 200 ton/ha/y clearly accelerated by utilization of steep slopes. Most tea small holding are poorly managed and consequently show a considerable soil loss of an estimated 75 to 150 ton/ha/y. While, it is estimated only 0.3 ton/ha/y in the well managed tea plantation mainly thanks to mechanical soil conservation measures, contour planting and thatching, usage of cover crops and shade trees, and preparation of a protective band of grasses on drain lips.

(2) Deforestation

A steady increase of population in the Study area has caused more needs for cultivation lands, and a pressure on lands has further aggravated virgin forests and physical characteristics of lands. Principal causes of deforestation in the area are a)

extraction of firewood, b) sifting cultivation, c) encroachment of forest reservations and d) illicit timber extraction, and these are inextricably tied up with poverty and livelihood of the local people.

For the local people, utilization of firewood is the most economical way for both domestic use and tobacco production. Shifting cultivation is a traditional activity which has the supplemented paddy cultivation, but today it is mostly undertaken by the people who have little or no lands. Encroachment of forest reservations and illicit forest felling can be commonly found in the area. A rapid increase of demand for building timber accelerates an illicit extraction of valuable timber from natural forest reserves and forest plantation areas. The locations of significant illicit felling are located in the remote areas, so that the vigilance of law enforcement authorities is to be less intensive conditions. The forest area by each district is shown below:

Item	Forest	% of the	ForestArea(m2/person)	
District	Area (ha)	Total Area	1981	2003
a) Matale D.	59,870	30.0	1,675	1,250
b) Kandy D.	31,730	16.8	282	221
c) Nuwara Eliya D.	48,570	28.5	930	629
d) Badulla D.	68,340	24.2	1,063	876
e) Moneragala D.	231,710	40.9	8,284	5,822
f) Kegalla D.	11,660	7.1	171	136
) Ratnapura D.	64,820	19.8	814	609
Total	516,700	27.2	1,172	888

source: JICA Study Team based on the Data from Forest Department

(3) Shifting Cultivation

A shifting cultivation which is one of major factors in deforestation and soil erosion, is quite widespread and more harmful to the environment in the Study area. A traditional form of shifting cultivation has almost disappeared in the area, because the increased pressure on lands does not allow farmers to put a long fallow period about 15 years. This has made the shifting cultivation no longer a sound system and in turn it becomes a negative factor concerning to the environmental degradation. At present, it is primarily concentrated in the dry zone segments, and the large extent of lands could be under some forms of the shifting cultivation in the area.

The average farm land size of a small holder is approximately 1.2 ha, of which over 1 ha is under rainfed farming or upland crops. In addition, many households, however, have a plot of shifting cultivation though it is not obviously reported to the authorities because of the existence of a ban. Those who conduct only shifting cultivation are considered the poorest section of the community.

To cut forest patches and burn out them for preparation of a seed-bed of annual crops such as finger millets, sweet corns, mustards and vegetables before the Maha season, and to plant ginger and tobacco after harvesting Maha season's crops before the Yala season in some extents is a normal practice of the shifting cultivation in the Study area. Unlike during the Maha season, crops for more commercial purposes are usually planted during the Yala season. Tobacco cultivation has gained an important status as a cash crop for farmers, and its area is widely spread in the district mainly through the activities of shifting cultivation and encroachment of reserved areas because of its economic attraction often surpassing environmental concerns. Conclusively, the very nature of shifting cultivation does not encourage any soil conservation activities owing mainly to i) most farmers of shifting cultivation not possessing a title to land, and ii) lack of extension facilities to educate farmers in conservation practices.

(4) Encroachment of Reserves

In the Study area, different types of reservations have been set up with the objectives of protecting environmentally critical areas such as forests, streams and irrigation canals. These reserves which account for about 18 % of the total Study area have been encroached threatened by the local people due to the increasing demand on cultivation lands though the exact figures are not available.

It is evident from the field investigation and inquiry survey that the large number of forest and stream reserves have been encroached mainly by shifting cultivation even in highland and hill top areas with steep slope. In some instances, encroachment could be simply a response to poverty and landlessness because the local people encroach reserves to find jobs and to live in. In this context, the stream and canal reserves in particular, are considered highly vulnerable because the reserves could provide choice of lands with access of water. Encroachment of forest reserves is usually found by felling trees in two different levels, namely a poor resort with unorganized felling and sawing of timber primarily for eking out a livelihood, and an operation with highly organized and carried out on a large scale. Besides, illicit gem mining is another activity which leads to the violation of reserves. As timber felling, this is also undertaken both on an organized and unorganized scale.

Encroachment on reserves brings about detrimental environmental consequences such as heavy soil erosion, rapid silting of irrigation canals, permanent drying up of springs, and slope instability conducive to different kinds of mass movement. Opening up of forest reserves has not only caused damage to flora but also resulted in the loss of fauna. Hence, the violation of reserves through encroachment has to be viewed with serious concerns.

(5) Mono-cropping of Tobacco and Sugar Cane

Cultivation of tobacco still goes on in the up-country area being met the required a cool climate, in spite of a lot of recommendations regarding the environmental hazards of tobacco cultivation on steep hill sides and river banks. At present, tobacco cultivation is mainly practiced particularly in the dry and intermediate regions of the district such as Kandy, Badulla, Matale and Moneragala districts. Due to its economic attraction and its capacity to thrive under marginal climate and soil conditions, tobacco has become a popular crop.

The negative environmental effects of tobacco cultivation are related to soil erosion, declining fertility and deforestation. Declining fertility is mostly reported from paddy lands which are cultivated tobacco during the Yala season. Although it brings an additional income to farmers, its yield tends to decline in the following season, and requires a heavy use of fertilizers and agrochemicals which causes in turn another environmental issues. Tobacco cultivation also causes forest destruction, because of the heavy dependence of tobacco barns on fuelwood to cure green leaves besides the removal of forest covers to cultivation. Operation of inadequate barns in tobacco growing areas complicates the issue and vitiates any easy solution of the problems.

As for sugar cane cultivation, the plantations so far have been wrecked by open conflict with wildlife particularly elephants and wild pigs because it has brought about forceful exclusion of the local wildlife from the cleared areas. Thus, the plantations and surrounding farm lands suffer heavy losses by the depredations of elephants, and both elephants and men are killed in regular confrontations especially in Moneragala district.

(6) Gem Mining

Gem mining conducted by licensed and unlicensed operators is very common economic activities in the Study area. Licensed gem mining operators are required to adhere to certain regulations which have a bearing on environmental conservation. For instance, removal of forest cover and use of explosives are prohibited, and dug up earths, sands and rocks are not permitted to be removed from the sites. Further, it is required to fill up pits after ceasing the mining activities. In practice, however, these requirements are sometimes observed in a breach due to weak enforcing capability of the regulations. The grater damage is mostly caused by the unlicensed operators who resort to illicit gem-mining with least attention to environmental damages.

The most frequent form of gem mining is a stream bed dredging at the upstream reach of rivers with a temporarily built wooden structure. This is followed by raking up the earth and pilling up it in a low ridge. The stream flow removes the lighter materials from the heap leaving gems and more dense materials behind.

There are many environmental damages that could be attributed to gem mining. Land subsidence is one of serious hazards mainly caused by excessive concentration of pits and horizontal tunnels in particular localities. Landslides could be triggered off in the areas where gem mining has contributed to slope instability. Regular dewatering from gem pits leads to the lowering of water table with its attendant consequences. Moreover, sedimentation of clay and other solute minerals resulting from sinking gem pits, and reduction of yield of paddy fields are commonly reported in the Study area. Besides, the unclosed pits with stagnant water provide breeding habitats for malaria mosquitoes.

(7) Landslides

The Study area has been experiencing a huge number of landslide incidents mainly due to its landslide prone topographic and climate conditions. Especially, Nuwara Eliya, Badulla, Kegalla and Matale districts have been seriously damaged by landslides among the 7 districts. The damages caused by landslides are normally greater in more intensively used hilly lands and densely populated areas. Besides, it has also played havoc with the economic infrastructure in the affected districts. Disruptions have been caused to water supply, power generation and distribution, telecommunications, arterial roads and educational facilities. Many reports suggested to pay early attentions on landslide prone areas for protection of human lives and properties, and to deal with causes of landslides and preventive actions.

According to the previous studies, the most important factor which are responsible for the occurrence of severe landslides is the rapid pace development activities on steep slopes and unstable grounds. Another cause is the growing trend towards intensive cultivation, involving double cropping, denudation of watershed areas, and the variety of de-stabilizing land use. More directly, the heavy and continuous rainfall exceeding certain threshold limits, a mass movement of earth on a slope surface with saturated soils and lubricated rocks, and man-made activities such as cutting hills and thereby making hill slopes unstable are considered major causes of landslides in the area. It is therefore, possible to some extent to anticipate the occurrence of these hazards in most geologically vulnerable areas.

4.7.3 State Policy on Environment and Farm Land Conservation

(1) State Policy

In modern times, a rapid growing population has exerted considerable pressure on the resources and environment in Sri Lanka. The provision of the basic needs of the people received the foremost attention of the Government, and environmental protection tended to get neglected. There were several enactment passed by the Government incorporating different aspects of the protection of natural resources and environment. However, the implementation of laws was very weak, particularly when there appeared to be a conflict between the poor and disadvantaged obtaining their basic needs on the one hand and the enforcement of the law on the other.

Following the 1972 Conference on the Human Environment organized by the United Nations, there was increased awareness in Sri Lanka for coordinated action on environmental conservation. However, the national responses remained sporadic and ad hoc for some years. Affirm political commitment on the environment was made in 1978 when aspects of safeguarding the environment were embodied in the constitution of the Republic, Article 24 explicitly stated that " The State shall protect, preserve and improve the environment for the benefit of the community."

In 1980, the National Environmental Act (NEA) was passed by the Parliament and became in operation. It paved the way for the creation of the Central Environment Authority (CEA) as the policy making and coordinating agency for environmental management. The CEA functioned directly under the Prime Minister who issued the following basic policy guidelines.

a) With a rapidly growing population and with the consequent income and resource requirements, Sri Lanka's development efforts have significantly affected the ecosystems and resource base of the country.

b) The process of population growth, accelerated agricultural development, industrialization and rapid urbanization have disturbed the harmony between nature and human beings.

c) Serious pre-occupation with environmental problems is a relatively new phenomenon in Sri Lanka, although there have always been concern for issues relating to the environment, it was only during the last few years that new problems emerged that gave environment an entirely new dimension.

d) Most of these problems have resulted from the efforts made to accelerate development itself, such as the growth and extension of primary export activities, the process of modernization of agriculture, industry, transportation, life styles, the growth of cities devoid of urban infrastructure, and the pressure of growing numbers on increasingly scarce resources.

e) Poverty itself brings about environmental degradation. Therefore, there is urgent need for development. It is no longer possible to separate the preservation of the environment with the necessity for development. Both are related and inseparable expressions of our capacity to improve our lives as well as to provide for the well being of future generations.

f) Sri Lanka already has a number of laws and regulations related to environment ranging from the preservation of forests to prevention of pollution. But these are scattered and administered by a variety of agencies at different levels of

authority without overall coordination and policy directions. Therefore, the CEA shall serve as a policy-making and coordinating body for environmental protection and management.

In 1984, the Cabinet Ministers made an important decision related to the environment conservation, namely to introduce a procedure of Environmental Impact Assessment (EIA) to all development projects. Besides, the CEA prepared a draft Environmental Action Plan in 1990 identifying specific projects and institutions that would be responsible for implementation based on the National Conservation Strategy completed in 1988. With renewed expression on the environment by the Government, the Act was comprehensively revised in 1988. Regulations were passed under the revised Act making it mandatory for all industries to obtain a license from CEA to ensure that environmental pollution will be kept down to acceptable levels.

In the 13th Amendment to the Constitution of Sri Lanka passed in 1987, which created Provincial Councils for devolving many of the Central Government's functions to the regions, the subject of environmental management was made a concurrent subject. This means that laws pertaining to the environment can be enacted by Parliament and they could also be enacted by a Provincial Council in respect of the area falling within its control and subject to the concurrence of Parliament. In other words, provincial laws cannot supersede or conflict with the National Environment Act or other laws passed by Parliament. The devolution of powers in relation to environmental management would confer on the Provincial Councils and the District Environmental Agencies (formed under the provisions of the National Environment Act) an important role in the environmental management in the regions.

In 1990, a separate Ministry of Cabinet rank was created for environmental affairs. This is the Ministry of Environment and Parliament Affairs (M/E&PA). This Ministry is responsible for all policy matters relating to environmental protection and management. The CEA functions under this Ministry. During the past few years, the Government has included in its development program several projects on the environment funded by foreign donor agencies, indicating a recognition of the importance of environmental and natural resources conservation in economic development.

(2) Institutional and Legal Structure

a) National Level

Management and implementation of environment and farm land conservation has depended on national administrative and legal structures unitary stated in the Constitution of the Democratic Socialist Republic of Sri Lanka in 1978. The establishment of the Central Environmental Authority (CEA) in 1981 under the National Environment Act of 1980, the Environmental Council in 1982, the District Environmental Agencies in 1984, and the Ministry of Environment and Parliamentary Affairs in 1990 are important national level landmarks in the progress towards legislative and institutional development in the field of environment.

While, the hierarchy of regional administrative divisions that supports the central government consists of Province, District, Divisions and Grama Niladhari units, in descending administrative order and area. The 13th Amendment to the Constitution in 1987 provided for devolution of power to the provinces, and this very important process for environmental management is still underway. Provinces are the fundamental administrative units of regional governance, and they have concurrent

jurisdiction with the central government over the protection of the environment, soils, coastal fisheries and wildlife among other resources.

Article 28 of the Constitution of Sri Lanka explicitly states that " it is the duty of every person in Sri Lanka to protect nature and conserve its riches." To help implement this goal, Sri Lanka has over 100 statutes directly or indirectly important to natural resources management and environmental protection. Some of the statutes date back to the middle of the last century. Among the more prominent pieces of legislation related to natural resources and environment are the Forest Ordinance of 1907, the Land Development Ordinance of 1935, Fauna and Flora Protection Ordinance of 1937, and the Soil Conservation Act of 1951. More recently, Parliament enacted the Coast Conservation Act of 1981, the National Aquatic Resources Act of 1981, the National Heritage and Wilderness Act of 1987, and the National Environmental Act of 1980, which was amended in 1988 to require environmental impact assessments (EIA) and licenses for industries potentially producing air, water, and land pollution. However, the large number of government entities responsible for implementing environmental laws might make this task difficulty due to gaps, overlaps and needs for inter and inner cooperation and coordination of the concerned agencies.

b) Provincial and District Level

From 1989, many powers and functions of the central government including environmental management were devolved on 7 newly created Provincial Councils (PCs). Unfortunately, most PCs do not have enough capacities to execute devolved functions at present. It might take more time that PCs possess actual capabilities to initiate regional level environmental planning and management activities.

While, the District Environment Agency (DEA) has been established in each district under the chairmanship of the governmental agent consisted by several district members from environmentally related departments. Major functions of the DEA specified in section 9 of the National Environment Act No. 47 of 1980 are as follows;

i) Collection of data and information at district level related to the environment and natural resources,
ii) Implementation of the district level environmental programs with approval of CEA,
iii) Preparation of district level environmental protection and management plans and programs, and
iv) Coordination of environmental matters between CEA and local government.

(3) National Strategy for Conservation

a) Identification of Constraints to Conservation

In spite of great efforts for natural resources conservation in Sri Lanka, many evidences indicate that the present rate of exploitation is rapidly out-stripping and degrading these resources. Inevitably, this will lead to irreversible changes in the environment which will in turn seriously impede socio-economic development. The following reasons are identified as major constraints to conservation:

- Population pressure which forces to spread of agriculture into cultivation of marginal lands,

- Lack of environmental planning and of rational allocation and use of resources,
- Lack of adequate baseline information,
- Weakness of institutional framework and infrastructure,
- Lack of trained personnel and of training facilities, and
- Lack of public participation in environmental conservation activities.

b) National Conservation Strategy

In order to tackle the constraints mentioned above, the following strategies are taken for environment and natural resources conservation in the national level:

Environmental consideration in socio-economic development

For the solution of environmental degradation, it is essential to apply the environmental consideration into the long-range socio-economic development planning. The idea must be imprinted in the people's minds that conservation only aims at ensuring continuous development at an optimum level. Without conservation, development tends to cause ecological damage which invariably leads to economic losses and social stresses. It is therefore, imperative that conservation should be integrated into the development process at every stage from policy formulation to planning and project implementation. A strong political commitment is very important to forge such links between environment and development.

Firm political commitment to sustainable development

Utilization of natural resources without any increase of productivity can not meet the demands of a rapidly growing population. Also, development without any conservation of resources can neither sustain populations nor improve the quality of living standards. Thus, the following principles must be taken:

i) Only ecological processes can assure the ability of a natural resource to produce harvestable amounts of food and other basic necessities of life.
ii) Over-exploitation upsets the balance of ecosystem and thereby endangers its productivity.
iii) The needs of an increased population can be met by making the country's natural resources more productive by recourse to science and technology.

Reinforcement of coordination and cross-linkages

Activities in one sector often adversely affect productivity in another sector. Suitable mechanisms should be devised to ensure sufficiently strong linkages between the organizations in charge of different sectors. Particular attention has been drawn to the need for the optimum use of land, with allocation for different purposes being determined on the basis of suitability.

Consolidation of baseline data

Lack and fragmentation of data is a severe constraint to proper environmental planning in many sectors. The compilation of "Baseline Data Handbook" including basic information on the natural resources, consumption patterns, population growth and development projections should be prepared for environmental planners. Another recommendation is the establishment of a national environment

reference center for disseminating information between government agencies and departments, NGOs, international organizations and individuals.

Enhancement of legislation, infrastructure and trained staff

The legislation relating to the environment presently found scattered in a number of different statutes should be reviewed and revised in order to ensure that:

- the legislation is adequate to effectively meet present day needs of resource management,
- the laws are applicable in all areas where they are needed,
- the authority and responsibilities of CEA are considerably enhanced, and provision made for delegation of such powers,
- the Environmental Quality Standard and the Environmental Impact Assessment (EIA) of development projects can be enforced, and
- penalties are adequate for breaking environmental laws.

The infrastructure for implementation of environmental laws, such as testing laboratories and logistics in form of transport should be provided. Lack of technically trained personnel is a problem with almost all institutions. Thus, the adequate trained staff should be provided to enforce the laws and provide back-up services.

Promotion of public participation

Healthy signs are already appearing of governmental and non-governmental organizations seeking and obtaining public support for conservation activities. There is now greater appreciation of the pressures that force people towards clearing of forests for shifting cultivation and mining. The non-governmental organizations have played a valuable role in conservation activities, both in training programs and in studies on environmental aspects of different activities. Closer cooperation between them and government organizations are mutually beneficial.

(4) National Environmental Action Plan

The National Environmental Action Plan (NEAP), 1992-1996 is the first comprehensive time phased environmental planning document of Sri Lanka prepared by the Ministry of Environment and Parliamentary Affairs, the CEA and other allied agencies based on national priorities and on an assessment of resources availability. Its objective is to establish an environmental agenda within the development context identifying national and local environmental issues and making efforts for providing solutions to such issues.

The NEAP includes both preventive and corrective measures in areas such as water and land resources, bio-diversity and wildlife, forestry, urban pollution, industrial pollution, coastal resources, energy, education and culture. Institutional enhancement required to implement the different actions have also been comprehensively reviewed. Financing of the different actions is to be met from both internal and external funds. Implementation stage of the NEAP involves a multitude of agencies, and coordination is effected through the National Environment Steering Committee (NESC).

The NEAP envisages an investment requirement of around Rs.4 billion (or US$ 100 million). The investments in the environmental field are intended to improve the quality of the overall development process and its long term sustainability. Actions recommended for each area indicate a certain degree prioritization in terms of timing. The process of priolitization was generally guided by the following criteria:

a) Degree of public concerns as reflected in public discussions,
b) Need to preserve certain non-renewable resources and to preventirreversible damages,
c) Likely economic and social impacts,
d) Degree of coverage by existing programs, and
e) Practical feasibility in terms of resources, personal and other constraints.

4.7.4 Conditions of On-going Projects and Programs

(1) Environment Conservation on the Mahaweli Development Project

The upper Mahaweli catchment area about 3,100 km2 is actually included in the Study area. Studies have revealed that considerable areas of arable land in this area are affected by non-protective use of natural resources leading to degradation of soil. Further, due to increase of population pressure and lack of new settlement alternatives and non-agricultural employment opportunities, a severe constraint has been placed on marginal and fragile areas exposing ecological systems' irrevocable hazards. In this connection, the Ministry of Lands, Irrigation and Mahaweli Development (M/LI&MD) drafted a National Wild Life Policy in 1988, and has started various kinds of programs and projects related to environmental conservation in the catchment area. Major environmental programs are shown below.

a) Mahaweli Environment Conservation Program (1983-1987)

This 5-year program being started in 1983 aimed at the establishment of protected areas so as to promote effectiveness of environmental conservation, to enhance capabilities of the Department of Wildlife Conservation and to enrich the wildlife habitats in the Mahaweli catchment area. Already 240,000 ha of wildlife areas have been gazetted, and the related infrastructures such as buffer zones, roads, buildings and sign boards are completed up to 75 to 80 % in 1990. Besides, the Park System Plan and Man/Elephant conflict studies have been completed, and the programs of enrichment of wildlife is being implemented.

b) Forest Conservation and Fuel Wood Production Program

The principal objective of this program is to manage and expand forest cover for the overall sustainability of the Mahaweli Development Project considering the critical role played by the forest cover in preservation of watershed, water resources and soil coverage, and the need to evolve fuel wood forest in the long term. Thus, the M/LI&MD has an on-going reafforestation program being taken various steps to restrict unnecessary elimination of forest resources. Certain areas such as riverine reservation, reservoir catchment and other critical areas have been reserved in perpetuity, and about 4,300 ha of fuel wood plantation has been conducted to ensure supply of energy for daily life of the local people.

c) Water Quality Monitoring Program

Testing of water quality in the Kotmale, Victoria and Randenigara reservoirs is carried out by the M/LI&MD in accordance with the water quality monitoring program in the Project area.

d) Watershed Management and Environmental Protection Program in Upper Mahaweli

With the creation of three major reservoirs in the upper Mahaweli catchment areas, attention was concentrated towards the vulnerability of the ecological systems in the area and the need to address the relevant issues within a rational framework of conservation. First action was taken to create a sanctuary in Victoria-Randenigara-Rantembe reservoir areas so as to protect them activities in the catchments that would lead siltation and sedimentation. Further, the Forest and Land Use Mapping Project (FORLUMP) is geared to formulate appropriate land use plan, to manage the watershed and to monitor sediment load in the Mahaweli river under the technical assistance of the United Kingdom. While, another watershed management project assisted by German was commenced in 1987 aiming to maintain sustainability of the upper catchment areas through balanced development of water, land and human resources. For this purpose, the project will identify replicable land use systems in pilot areas, develop environmental monitoring systems, create programs for environmental awareness.

e) Upper Mahaweli Environment Rehabilitation Project

This project aims at improvement of the catchment area of the Kotmale dam through the rehabilitation of the environment and upgrading the living standards of the local people. It has selected 18 environmentally degraded sub-catchments, and implemented better land use programs through a series of land use alternatives based on soils, slopes, rocks and socio-economic criteria.

(2) Integrated Rural Development Program

Integrated Rural Development Program (IRDP) is a Government program to maintain high economic growth with due consideration of i) external balance, ii) internal balance and iii) adverse short term effects of structural transformation on social welfare. The objective of IRDP is to mitigate inter and inner district disparities by improving socio-economic conditions of disadvantaged areas and social groups. Actually, the IRDP has been conducted in all districts of the Study area by introducing bi/multi-lateral foreign assistance.

Although to maintain and improve the environmental conditions in the rural area is one of the strategies of IRDP, a very few environment oriented projects, such as a soil conservation project in Ratnapura district and a reforestation project in Kandy district, have been conducted in this program. It means that the IRDP is likely to contribute indirectly to the improvement of environment as a result of the execution of various kinds of rural development projects.

(3) Landslide Hazard Mapping Project

Landslide Hazard Mapping Project (LHMP) is jointly funded by the GOSL, the United Nations Development Programme (UNEP) and the United Nations Center for Human Settlements (Habitat) being started from 1992. The LHMP aims to help resolve the diverse socio-economic problems faced by the inhabitants under constant threat or affected by landslides through appropriate land use planning coupled with mitigatory measures or planned settlement. To attain the objective mentioned above, the following basic maps are now under preparation:

a) Landform maps, Land use and Management maps, and Human Settlement Categorization maps based on the systematic interpretation of aerophotographs,
b) Slope Category maps derived from the delineated slope ranges, and

c) Landslide Hazard Zonation maps based on the overlay analysis of a) and b) above.

Its responsible agency in Sri Lanka is the National Building Research Organization (NBRO) belonging to the Ministry of Housing, and the project has been carried out in Nuwara Eliya and Badulla districts. The output of this project is still underway.

TABLES

Table 4.1-1

CLIMATOLOGICAL TABLE IN THE STUDY AREA (1/3)

KANDY Lat 7-20'N Lon 80-38'E Barometer 477.0 meter

		Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Station Level Pressure	day time	mb	959.2	958.5	958.5	957.5	956.2	956.6	956.5	956.8	957.4	958.0	958.6	958.9	957.7
	night time	mb	956.3	955.7	955.2	954.4	953.7	954.4	954.3	954.3	954.6	955.2	955.9	956.1	955.0
Relative Humidity	day time	%	85.0	84.0	85.0	87.0	81.0	79.0	79.0	80.0	80.0	83.0	86.0	79.0	82.0
	night time	%	67.0	57.0	59.0	73.0	74.0	73.0	72.0	72.0	72.0	77.0	72.0	75.0	70.0
Mean Daily Max. Temperature		deg C	27.9	29.6	31.1	30.9	29.8	27.8	27.2	27.8	27.8	28.4	28.2	27.6	28.8
Mean Daily Min. Temperature		deg C	18.3	17.9	19.4	21.1	21.4	21.4	21.0	21.0	19.7	20.0	19.7	18.8	20.0
Mean Wind Velocity	day time	km/hr													
	night time	km/hr													
Monthly Rainfall		mm	115.8	84.8	121.7	180.6	170.9	153.2	136.1	128.3	110.2	264.2	253.2	233.9	1,952.9
Numbers of Rainy Day		Day	7.0	5.0	7.0	11.0	9.0	15.0	13.0	11.0	11.0	16.0	16.0	12.0	133.0
Sunshine Hour		Hour	6.2	7.4	7.9	7.0	6.6	5.6	5.5	5.8	6.2	5.8	5.6	5.3	6.2

NUWARA ELIYA Lat 6-58' N Lon 80-46'E Barometer 1,894.6 meter

		Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Station Level Pressure	day time	mb	814.7	814.8	814.9	814.5	813.5	813.2	813.0	813.2	813.9	814.3	814.7	814.4	814.0
	night time	mb	812.8	812.8	813.1	812.4	811.7	811.6	811.4	811.4	811.8	812.2	812.7	812.5	812.2
Relative Humidity	day time	%	83.0	76.0	72.0	82.0	83.0	86.0	87.0	87.0	85.0	85.0	85.0	87.0	83.0
	night time	%	80.0	74.0	72.0	82.0	82.0	85.0	84.0	85.0	84.0	87.0	85.0	85.0	82.0
Mean Daily Max. Temperature		deg C	19.9	20.9	21.8	21.9	21.3	18.7	18.5	19.0	19.4	19.8	19.9	19.8	20.1
Mean Daily Min. Temperature		deg C	8.7	7.7	7.9	10.0	12.1	13.3	12.8	12.6	11.9	11.3	10.8	9.7	10.7
Mean Wind Velocity	day time	km/hr	7.4	9.0	8.7	6.3	7.6	13.4	12.7	10.9	10.1	7.1	7.1	7.9	9.0
	night time	km/hr	6.8	8.2	6.9	5.3	7.1	12.1	11.3	9.5	8.2	5.8	5.3	6.9	7.8
Monthly Rainfall		mm	145.0	75.9	96.5	153.7	236.7	266.2	222.5	179.6	165.1	222.2	208.5	190.0	2,161.9
Numbers of Rainy Day		Day	13.0	9.0	11.0	16.0	17.0	24.0	22.0	22.0	20.0	21.0	21.0	17.0	213.0
Sunshine Hour		Hour	5.4	5.8	6.4	5.2	3.3	2.8	2.2	2.4	2.9	3.8	4.1	4.6	4.1

Table 4.1-1

CLIMATOLOGICAL TABLE IN THE STUDY AREA (2/3)

RATNAPURA Lat 6-41' N Lon 80-24'E Barometer 34.4 meter

		Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Station Level Pressure	day time	mb	1,013.1	1,012.9	1,012.3	1,011.4	1,011.2	1,010.5	1,010.7	1,010.9	1,011.7	1,012.1	1,012.2	1,012.7	1,011.8
	night time	mb	1,008.9	1,008.4	1,008.1	1,007.7	1,007.1	1,007.9	1,008.0	1,008.0	1,008.2	1,008.6	1,008.6	1,008.8	1,008.2
Relative Humidity	day time	%	89.0	88.0	88.0	88.0	88.0	88.0	87.0	87.0	87.0	89.0	90.0	91.0	88.0
	night time	%	67.0	64.0	80.0	80.0	76.0	75.0	73.0	73.0	74.0	78.0	78.0	75.0	74.0
Mean Daily Max. Temperature		deg C	31.9	33.1	32.9	32.9	31.7	30.4	30.3	30.4	30.7	30.7	31.0	31.2	31.5
Mean Daily Min. Temperature		deg C	21.8	21.8	23.2	23.2	23.8	23.8	23.5	23.4	23.1	22.7	22.3	22.1	22.8
Mean Wind Velocity	day time	km/hr													
	night time	km/hr													
Monthly Rainfall		mm	151.4	180.6	340.6	340.6	494.3	462.5	306.6	327.7	315.0	498.3	353.6	213.6	3,387.8
Numbers of Rainy Day		Day	13.0	12.0	21.0	21.0	24.0	26.0	24.0	24.0	22.0	23.0	21.0	16.0	244.0
Sunshine Hour		Hour	4.9	5.7	5.4	5.4	3.5	3.0	3.1	2.6	3.5	3.8	4.2	5.2	4.3

BADULLA Lat 6-59' N Lon 81-03'E Barometer 669.6 meter

		Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Station Level Pressure	day time	mb	939.0	938.5	938.1	936.9	935.0	934.3	934.9	935.2	935.9	936.8	937.9	938.4	936.8
	night time	mb	936.2	935.6	935.2	934.1	932.6	932.8	932.8	932.8	923.2	934.2	935.3	935.8	934.2
Relative Humidity	day time	%	91.0	89.0	87.0	86.0	82.0	79.0	84.0	81.0	81.0	84.0	87.0	92.0	85.0
	night time	%	81.0	74.0	69.0	77.0	70.0	62.0	61.0	62.0	64.0	74.0	81.0	84.0	72.0
Mean Daily Max. Temperature		deg C	24.6	26.1	20.1	29.1	29.8	29.8	30.2	30.1	29.9	28.4	26.3	24.8	28.1
Mean Daily Min. Temperature		deg C	17.8	17.4	17.9	19.1	19.2	18.6	18.0	18.2	18.0	18.7	18.6	18.2	18.3
Mean Wind Velocity	day time	km/hr													
	night time	km/hr													
Monthly Rainfall		mm	229.1	120.6	110.0	196.6	114.3	24.1	49.3	96.0	92.7	216.2	267.2	274.8	1,790.9
Numbers of Rainy Day		Day	17.0	10.0	11.0	17.0	11.0	6.0	7.0	9.0	9.0	17.0	20.0	20.0	154.0
Sunshine Hour		Hour													

Table 4.1-1

CLIMATOLOGICAL TABLE IN THE STUDY AREA (3/3)

DIYATALAWA Lat 6-49' N Lon 80-458'E Barometer 1,247.5 meter

		Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Station Level Pressure	day time	mb	878.3	877.9	877.8	877.1	875.4	875.0	875.1	875.3	876.0	876.8	877.6	878.1	876.7
	night time	mb	875.8	875.6	875.5	874.7	873.4	873.5	873.5	873.5	873.9	874.6	875.4	875.7	874.6
Relative Humidity	day time	%	90.0	83.0	81.0	82.0	75.0	69.0	69.0	70.0	71.0	78.0	86.0	90.0	79.0
	night time	%	85.0	78.0	75.0	84.0	77.0	69.0	68.0	69.0	74.0	82.0	88.0	88.0	78.0
Mean Daily Max. Temperature		deg C	22.1	23.9	25.5	25.7	25.9	25.3	25.5	25.5	25.4	24.7	23.6	22.3	24.6
Mean Daily Min. Temperature		deg C	14.2	14.0	14.6	15.9	16.9	17.4	17.0	16.6	16.1	15.9	15.4	14.9	15.8
Mean Wind Velocity	day time	km/hr	3.1	2.9	2.7	2.7	4.3	7.1	6.8	6.1	5.2	3.9	2.9	3.2	4.2
	night time	km/hr	4.7	5.3	5.0	4.0	5.6	9.3	9.2	8.7	6.6	4.5	3.5	4.2	5.9
Monthly Rainfall		mm	152.4	85.6	121.4	210.1	143.0	46.2	58.7	89.4	94.5	246.2	277.9	203.5	1,730.9
Numbers of Rainy Day		Day	17.0	10.0	12.0	18.0	14.0	8.0	9.0	10.0	11.0	19.0	22.0	20.0	170.0
Sunshine Hour		Hour	5.0	5.3	5.2	3.8	4.2	4.3	4.7	5.2	5.6	4.3	3.2	3.9	4.6

Data Source : Department of Meteorology

Table 4.1-2 MONTHLY 75% PROBABILITY RAINFALL

in mm

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum in Maha	Sum in Yala
WU1	64.0	51.0	127.0	229.0	318.0	533.0	432.0	381.0	330.0	406.0	279.0	127.0	1,054.0	2,223.0
WU2	89.0	51.0	89.0	165.0	140.0	279.0	229.0	203.0	178.0	279.0	203.0	127.0	838.0	1,194.0
WU3	89.0	51.0	76.0	140.0	102.0	127.0	127.0	102.0	102.0	203.0	152.0	114.0	685.0	700.0
WM1	76.0	64.0	152.0	279.0	381.0	432.0	305.0	292.0	305.0	432.0	254.0	127.0	1,105.0	1,994.0
WM2	25.0	13.0	76.0	152.0	102.0	152.0	102.0	89.0	114.0	267.0	178.0	102.0	661.0	711.0
WM3	89.0	38.0	51.0	127.0	76.0	127.0	102.0	76.0	102.0	229.0	203.0	152.0	762.0	610.0
WL1	76.0	64.0	152.0	254.0	330.0	254.0	152.0	127.0	178.0	381.0	267.0	127.0	1,067.0	1,295.0
WL2	38.0	51.0	102.0	178.0	152.0	178.0	102.0	89.0	102.0	292.0	203.0	76.0	762.0	801.0
WL3	51.0	38.0	64.0	152.0	203.0	152.0	76.0	64.0	76.0	241.0	165.0	64.0	623.0	723.0
WL4	51.0	38.0	64.0	152.0	203.0	152.0	76.0	64.0	76.0	241.0	165.0	64.0	623.0	723.0
IU1	356.0	140.0	102.0	191.0	102.0	127.0	102.0	89.0	102.0	305.0	356.0	432.0	1,691.0	713.0
IU2	279.0	102.0	102.0	152.0	64.0	38.0	38.0	51.0	64.0	178.0	229.0	305.0	1,195.0	407.0
IU3	102.0	51.0	76.0	152.0	76.0	38.0	38.0	51.0	76.0	178.0	203.0	152.0	762.0	431.0
IM1	305.0	114.0	89.0	114.0	38.0	13.0	13.0	13.0	51.0	152.0	229.0	330.0	1,219.0	242.0
IM2	51.0	25.0	127.0	178.0	76.0	25.0	13.0	13.0	25.0	152.0	254.0	127.0	736.0	330.0
IM3	127.0	38.0	51.0	102.0	51.0	51.0	38.0	25.0	38.0	152.0	178.0	165.0	711.0	305.0
IL1	38.0	25.0	76.0	127.0	102.0	89.0	51.0	25.0	51.0	114.0	152.0	76.0	481.0	445.0
IL2	254.0	89.0	64.0	89.0	25.0	0.0	13.0	13.0	51.0	127.0	203.0	279.0	1,016.0	191.0
IL3	51.0	38.0	51.0	102.0	51.0	38.0	25.0	13.0	38.0	191.0	165.0	89.0	585.0	267.0
DL1	76.0	25.0	51.0	127.0	51.0	13.0	0.0	13.0	25.0	127.0	152.0	127.0	558.0	229.0
DL2	178.0	64.0	38.0	64.0	13.0	0.0	0.0	13.0	13.0	127.0	191.0	216.0	814.0	103.0
DL3	38.0	25.0	25.0	51.0	25.0	0.0	0.0	0.0	25.0	127.0	178.0	114.0	507.0	101.0
DL4	38.0	25.0	25.0	51.0	25.0	0.0	0.0	0.0	25.0	127.0	178.0	114.0	507.0	101.0
DL5	51.0	13.0	25.0	76.0	51.0	25.0	13.0	13.0	25.0	51.0	127.0	102.0	369.0	203.0

Table 4.1-3 ANNUAL AVERAGE RUN-OFF AT THE GAUSING SATATIONS (1/2)

Code	River Basin	River	Hydrometric Station	Station No.	Precipitation	Catchment Area	Averege Discharge		Run-off	Specific Discharge	Max. Discharge
					mm	km2	m3/s	mm	coefficient	m3/sec/km2	m3/sec
01	Kelani Ganaga	Kelani Ganaga	Nagalam Street	0101	4,050	2,085	176.1	2,664	66%	0.084	6,287
		Kelani Ganaga	Glencourse	0102	4,060	1,463	146.0	3,146	77%	0.100	4,286
		Kelani Ganaga	Metiyadola	0103	4,100	606	57.8	3,006	73%	0.095	2,344
		Sitawaka Ganaga	Algoda Bridge	0104	4,210	345	39.2	3,584	85%	0.114	1,048
		Sitawaka Ganaga	Deraniyagala	0105	5,000	152	21.4	4,445	89%	0.141	2,313
		Kelani Ganaga	Kitugala	0106	3,620	388	38.4	3,118	86%	0.099	2,259
		Naskeli Oya	Mousskelle	0107	3,500	122	12.6	3,264	93%	0.103	565
		Grugoda Oya	Imbulana	0108	3,525	329	21.4	2,054	58%	0.065	991
		Kehelgamu Oya	Norwood	0109	2,550	95	6.0	1,990	78%	0.063	133
		Kehelgamu Oya	Castlereigh	0109A		114	8.7	2,405		0.076	na
		Naskeli Oya	Laxapana	0110	3,775	168	14.2	2,667	71%	0.085	326
		Kelani Ganaga	Kaduwela	0111		1,884	149.4	2,501		0.079	na
		Grugoda Oya	Holambuwa	0112	3,150	155	7.5	1,517	48%	0.048	447
		Kelani Ganaga	Hanwella	0114	3,875	1,782	184.0	3,256	84%	0.103	2,620
		Kehelgamu Oya	Norton Bridge	0115	2,825	131	na	na			34
03	Kalu Ganga	Kalu Ganga	Patupaula	0301	3,970	2,598	235.2	2,885	73%	0.091	2,549
		Kalu Ganga	Millakanda	0302	4,110	769	72.5	2,972	72%	0.094	773
		Kalu Ganga	Malwala	0303	4,100	329	31.6	3,032	74%	0.096	1,403
		Kalu Ganga	Nambapana	0304	3,745	629	55.3	2,070	55%	0.088	841
		Kalu Ganga	Ellegawa	0305	3,910	1,393	120.0	2,717	69%	0.086	1,337
		Wey Ganga	Della	0306	2,610	220	12.3	1,758	67%	0.056	190
		Denawaka Ganga	Lellopitiya	0307	3,660	76	4.7	1,938	53%	0.062	74
		Naguru Ganaga	Kukulegama	0308	3,775	334	29.8	2,812	74%	0.089	845
		Kalu Ganaga	Magura	0309	4,700	136	13.1	3,033	65%	0.096	170
		Kalu Ganaga	Ratnapura	0310	3,445	604	48.3	2,521	73%	0.080	520
18	Walawe Ganaga	Walawe Ganaga	Embilipitiya	1801	2,590	1,580	44.9	897	35%	0.028	2,251
		Walawe Ganaga	Liyagahatota	1802		2,284	85.6	1,181		0.037	2,700
		Hulanda Oya	halmillaketiya	1803	1,815	166	1.3	247	14%	0.008	133
		Belihul Oya	Belihul Oya	1804	2,590	49	2.9	1,838	71%	0.059	62
		Belihul Oya	Belihul Oya	1804A		42	na	na	na		na
		Walawe Ganaga	Uda Walawe	1805	2,585	1,155	32.3	881	34%	0.028	1,175
		Walawe Ganaga	Samanala wewa	1806	2,950	353	18.8	1,675	57%	0.053	913
		Rakwana Ganga	Timbolketiya	1807	2,125	269	5.3	581	27%	0.020	3,271
		Weli Oya	Weragala	1808	2,250	261	6.7	812	36%	0.026	613
		Nau Ara	Mahagama	1809	1,530	366	1.7	148	10%	0.005	153
		Diywini Oya	Nawilgala	1810	2,140	23	0.4	609	28%	0.017	23
		Katupath Oya	Wagerugama	1811		99	na	na			na
		Hulanda Oya	Medaragama	1812	2,200	109	1.1	320	15%	0.010	101
22	Kirindi Oya	Kirindi Oya	Hunugamvehera	2201	1,725	913	12.3	424	25%	0.013	1,353
		Poonagal Oya	Poonagala	2202	2,475	6	0.2	1,027	41%	0.036	na
		Kirindi Oya	Wellawaya	2203	1,980	160	4.6	912	46%	0.029	290
		Kuda Oya	Kuda Oya	2204	1,890	290	3.9	419	22%	0.013	1,852
26	Menik Ganga	Menik Ganga	Kataragama	2601	1,560	787	7.0	281	18%	0.009	1,365
31	Kumbukkan Oya	Kumbukkan Oya	Kumbukkan	3101	na	259	2.1	257		0.008	na
		Kumbukkan Oya	Nakkala	3102	1,280	216	5.5	797	62%	0.025	190
		Kumbukkan Oya	Naligawila	3103	1,360	375	5.1	425	31%	0.014	238
		Hulanda Oya	Naligawila	3104	1,425	302	3.8	392	28%	0.013	60
35	Wila Oya	Wila Oya	Wedagama	3501	1,600	404	3.1	238	15%	0.008	453
36	Heda Oya	Heda Oya	Siyambalanduwa	3601	2,060	295	6.2	667	32%	0.021	906
		Heda Oya	Heda Oya Damsite	3602	1,800	409	8.8	677	38%	0.022	694
		Heda Oya	Luhugala	3603	na	471	na	na			na
44	Gal Oya	Gal Oya	Inginiyagala	4401	2,200	995	34.6	1,097	50%	0.035	2,452
		Gal Oya	Pitakumburu	4402	na	188	4.2	708		0.022	na
51	Unnichchai	Magalwatawan Aru	Periya Aru	5101	1,920	119	3.1	829	43%	0.026	1,812
52	Mudeni Aru	Gallodai Aru	Weragoda	5201	2,030	225	5.0	700	34%	0.022	565
		Rabukkan Oya	Nilobe	5202	2,115	159	5.9	1,169	55%	0.037	244
		Maha Oya	Maha Oya	5203	1,950	300	7.3	766	39%	0.024	566
		Mundeni Aru	Rugama	5204	na	1,295	19.5	475		0.015	na
		Rabukkan Oya	Polllebodda	5205	1,615	137	2.2	505	31%	0.016	121
54	Maduru Oya	Maduru Oya	Welikanda	5401	2,000	1,062	19.4	576	29%	0.018	2,095
		Maduru Oya	Kandegama	5402	2,100	453	9.2	638	30%	0.020	5,263
		Maduru Oya	Maduru Oya Bridge	5403	na	158	1.5	293		0.009	180

Table 4.1-3 ANNUAL AVERAGE RUN-OFF AT THE GAUSING SATATIONS (2/2)

Code	River Basin	River	Hydrometric Station	Station No.	Precipitation	Catchment Area	Averege Discharge		Run-off	Specific Discharge	Max. Discharge
					mm	km2	m3/s	mm	coefficient	m3/sec/km2	m3/sec
60	Mahaweli Ganga	Mahaweli Ganga	Manapitiya	6001	2,300	7,418	201.6	856	37%	0.027	3,718
		Gal Oya	Gal Oya Junction	6002	1,520	199	1.8	280	18%	0.009	566
		Amban Ganga	Angamedila	6003	2,110	1,363	33.2	767	36%	0.024	1,664
		Mahaweli Ganga	Peradeniya	6004	2,920	1,167	65.3	1,765	60%	0.056	2,113
		Mahaweli Ganga	Gurudeniya	6005	2,790	1,418	76.4	1,700	61%	0.054	5,947
		Nalanda Oya	Nalanda	6006	1,900	126	3.2	795	42%	0.025	623
		Mahaweli Ganga	Weragantota	6007	2,440	4,092	147.7	1,137	47%	0.036	9,140
		Amban Ganga	Elahera	6008	2,200	774	29.0	1,183	54%	0.037	1,600
		Kotmale Oya	Morape	6009	2,700	555	30.9	1,754	65%	0.056	2,055
		Aluth Oya	Althu Oya	6010	1,670	45	0.9	617	37%	0.020	156
		Mahaweli Ganga	Gampola	6011	2,570	951	64.0	2,123	83%	0.067	2,628
		Mahaweli Ganga	Kandskadutusri	6012	na	7,529	186.7	781		0.025	na
		Mahaweli Ganga	Nadumodara	6013	na	8,618	59.1	216		0.007	na
		Ulhitiya Oya	Ulhitiya	6014	2,302	357	4.5	401	17%	0.013	na
		Hulu Ganga	Teldeniya	6015	2,815	160	5.5	1,087	39%	0.034	796
		Mahaweli Ganga	Randenigala	6016	2,610	2,365	105.0	1,400	54%	0.044	3,651
		Badullu Oya	Kandaketiya	6017	2,130	387	13.3	1,082	51%	0.034	637
		Heppola Oya	Gadugudawa	6018	2,000	91	2.9	996	50%	0.032	113
		Loggal Oya	Meegahakiula	6019	2,425	196	8.1	1,302	54%	0.041	255
		Mahaweli Ganga	Watawala	6020	3,610	65	2.7	1,306	36%	0.042	238
		Kotmale Oya	Talawakelle	6021	2,302	297	16.0	1,699	74%	0.054	1,950
		Mahaweli Ganga	Bawagama	6022	4,170	169	14.2	2,653	64%	0.084	na
		Uma Oya	Telawakande	6023	1,920	520	10.0	609	32%	0.019	770
		Mahaweli Ganga	Allai-Kantalai	6024	2,130	9,606	155.0	508	24%	0.016	1,179
		Mahaweli Ganga	Nallanda	6025	4,000	188	40.2	6,739	168%	0.214	na
		Amban Ganga	Ambana	6026	2,585	520	14.8	896	35%	0.028	319
		Agra Oya	Hobnook	6027	2,350	121	5.2	1,366	58%	0.043	283
		Mahaweli Ganga	Victoria Falls	6028	2,520	1,653	89.5	1,707	68%	0.054	na
		Uma Oya	Welimada	6029	1,925	179	6.4	1,126	58%	0.036	623
		Kalu Ganaga	Wellewala	6030	2,560	194	11.0	1,790	70%	0.057	606
		Mahaweli Ganaga	Polgolla	6031	na	na	na	na			na
		Galmal Oya	Moragahamulla	6032	3,370	73	2.8	1,207	36%	0.038	453
		Mahaweli Ganaga	Rantambe	6033	2,470	3,113	65.5	663	27%	0.021	2,226
		Agra Oya	Caledonia	6034	2,370	183	9.2	1,592	67%	0.050	130
		Sudu Ganaga	Ukuwela	6051	na	na	47.8	na			na
		Minipe Yoda Ela	Minipe Anicut	6052	na	na	10.4	na			20
		Bowatenna-Dambulu Oya	Bowatenna Left Canal	6053	na	na	12.0	na			30
		Bowatenna-Hurulu Oya	Bowatenna Right Canal	6054	na	na	4.4	na			15
		Elehera-Minneriya Ela	Elehera Anicut	6055	na	na	19.8	na			60
		Parakrama Samudra-Yoda Ela	Angamedilla Anicut	6056	na	na	9.6	na			30
		Minneri Tank Canal	Diyabeduna	6057	na	na	12.6	na			na
		Gritale Tank Canal	Diyabeduna	6058	na	na	na	na			na
		Polgolla Tunnel	Polgolla Diversion	6059	na	na	33.3	na			na
		Minipe RB Canal	Minipe Right Bank	6060	na	na	10.3	na			na
		Dambagastala	Elgin Falls	6071	2,190	23	1.2	1,709	78%	0.052	31
		Heen Ganaga	Uduwalwala	6072	3,120	115	9.5	2,601	83%	0.083	na
		Mahaweli Ganga	Chundankadu	6073	na	na	199.0	na			na
		Verugala Aru	Kompanachchi	6074	na	na	11.3	na			na
		Kandakadu Ela	Kandakakdu	6075	na	na	45.3	na			na
		Adampan Aru	Adampan	6076	na	na	89.4	na			na
		Mahaweli Ganga	Hembarawa	6077	2,600	4,530	198.8	1,383	53%	0.044	na
		Maha Oya	Hanguranketa	6078	2,630	103	3.2	980	37%	0.031	425
		Mahaweli Ganga	Geli Oya	6079	3,000	1,066	73.2	2,164	72%	0.069	na
		Ambewela Oya	Erabedda	6080	na	na	1.0	na			na
		Mahaweli Ganga	Dastota	6081	2,920	5,510	158.6	909	31%	0.029	na
		Hasalaka Oya	Pallewatta	6082	3,900	116	2.8	755	19%	0.024	na
		Mahaweli Ganga	Kannadipitiya	6083	na	na	163.0	na			na
		Badulu Oya	Taldena	6084	na	na	9.0	na			na
		Kurundu Oya	Watumulla	6085	2,515	34	0.6	542	22%	0.018	na
		Verugal Aru	Verugal Ferry	6086	na	na	71.0	na			na
		Heppola Oya	Uraniya	6087	1,350	34	0.9	789	58%	0.026	65
93	Kala Oya	Kala Oya	Kadigala	9301	1,435	1,564	8.5	171	12%	0.005	na
		Kala Oya	Nochchiyagama	9302	1,460	1,948	15.6	252	17%	0.008	1,841
		Welimitiya Oya	Galewela	9303	1,185	41	1.2	951	80%	0.029	125
		Nala Oya	Dambulla	9305	1,350	18	0.1	231	17%	0.006	99
		Dambulu Oya	Ibbankatuwa	9306	1,415	70	3.3	1,474	104%	0.047	37
		Kala Oya	kumbukwewa	9307	1,430	1,160	10.4	282	20%	0.009	na
		Kalankutti Ela	kumbukwewa	9308	na	117	1.5	397		0.013	na
102	Maha Oya	Maha Oya	Alawwa	H201	2,385	804	23.3	913	38%	0.029	2,039
		Maha Oya	Badalgama	H202	2,270	1,360	45.8	1,061	47%	0.034	1,982
		Maha Oya	Girilla	H203	2,450	1,191	41.6	1,101	45%	0.035	1,812

Table 4.1-4 MAJOR RESERVOIRS/TANK IN THR RIVER BASINS (1/3)

Code	River Basin	Name of Reservoir	Source Details	Main purpose: Irrigation	Hydro Power	Domestic
01	Kelani Ganga	Canyon Reservoir	Maskeliya Oya		*	
		Castlereagh Reservoir	Kehelgamu Oya		*	
		Kalatuwawa Reservior	Kalatuwawa Ela			*
		Lubgama Reservoir	Wak Oya			*
		Mousakelle Reservoir	Maskeliya Oya		*	
		Norton Reservoir	Mahalgam Oya		*	
		Polpitiya Reservoir	maskeliya Oya		*	
18	Walawe Ganga	Chandrika Wewa	Hulanda Oya	*		
		Embilipitiya Tank	Hulanda Oya	*		
		Hambegamuwa Tank	Mau Ara	*		
		Hingura Tank		*		
		Hingura kattuwa Tank		*		
		Hingurana Tank	Ambagaha Ela	*		
		Kadawera Tank		*		
		Mamadola Tank	Walawe R.B. Ch.	*		
		Oluwila Tank	Walawe R.B. Ch.	*		
		Ridiyagama Reservoir	Walawe L.B. Ch.	*		*
		Samanala Wewa	Walawe, Behlihuloya	*	*	
		Tunkema Maha Wewa		*		
		Uda Walawe Reservoir	Walawe Ganga	*	*	
22	Kirindi Oya	Balahuruwa Tank				
		Dambe Wewa	Dambe Minule Ara	*		
		Debara Wewa	Kirindi Oya L.B.Ch.	*		
		Ettili Wewa		*		
		Handapanagala Wewa	Maha Ara	*		
		Lunugamwehera Reservoir		*		
		Pannagamuwa Wewa	Kirindi Oya R.B.Ch.	*		
		Tissa Wewa	Kirindi Oya L.B.Ch.	*		
26	Menik Ganga	Halmillapillewa Tank		*		
		Karawila Wewa		*		
		Kongaha wewa		*		
		Sudupanawela Tank		*		
		Yuadaganawa Tank		*		
31	Kumbukkan Oya	Kumana Tank		*		
35	Wila Oya	Ettimola Wewa	Wila Oya	*		
		Kotiyagala Maha Wewa	Uva Ela	*		
		Panama Tank	Wila Oya	*		

Table 4.1-4 MAJOR RESERVOIRS/TANK IN THR RIVER BASINS (2/3)

Code	River Basin	Name of Reservoir	Source Details	Main purpose: Irrigation	Hydro Power	Domestic
36	Heada Oya	Katupellela Tank		*		
		Kehellanda Tank		*		
		Lahugala Tank	Heda Oya Ch.	*		
		Muthukandiya Tank		*		
		Naulla Tank		*		
		Nelumwewa		*		
		Redella Tank		*		
		Rotta Kulam		*		
		Thenagalkanda Tank		*		
44	Gal Oya	Alahena Tank	Gal Oya R.B.Ch.			
		Aligalge Tank	Gal Oya L.B.Ch.			
		Amparai Tank	Gal Oya L.B.Ch.			
		Chadayantolawa Tank	Veeragoda Tank	*		
		Dodangoda Tank				
		Ekgal Aru Tank	Ekgal Aru	*		
		Himidurawa Tank	Gal Oya L.B.Ch.			
		Irakhaman Tank	Ekgal Aru			
		Kondawattawan Tank	Gal Oya L.B.Ch.	*		*
		Malayadi Tank	Gal Oya R.B.Ch.			
		Namal Oya Tank	Namal Oya	*		
		Pallang Oya Tank	Pallang Oya			
		Senanayaka Samudra	Gal Oya	*	*	
		Valathipiddy Tank	Gal Oya L.B.Ch.			
		Veeragoda Tank	Gal Oya L.B.Ch.	*		
51	Unnichchai	Adachchal Kulam		*		
		Unnichchai Tank	Magalavattuvan River	*		
52	Mundeni Aru	Karadian Aru Tank	Karadian Aru	*		
		Kitulwewa tank		*		
		Mahaoya Tank		*		
		Periya Kulam		*		
		Pullumalai Tank		*		
		Rugam Tank	Mundeni Aru	*		
		Tempitiya Tank		*		
		Weligahakandiya Tank	Thevali Odai Aru	*		
54	Madru Oya	Aralaganwila Wewa		*		
		Gal Wewa	Wage Oya	*		
		Maduru Oya Reservoir	Mahaweli Ganga	*	*	
		Pimburettewa Tank		*		
		Vakaneri Tank		*		
		Wadamune Wewa		*		

Table 4.1-4 MAJOR RESERVOIRS/TANK IN THR RIVER BASINS (3/3)

Code	River Basin	Name of Reservoir	Source Details	Main purpose: Irrigation	Hydro Power	Domestic
60	Mahaweli Ganga	Allai Tank	Kallar Ch.	*		
		Ambewela Reservoir	Dambagastalawa Oya	*		
		Badulupitiya Tank		*		
		Ballawilla Wewa		*		
		Bogaha Wewa		*		
		Bowatenne Reservoir		*	*	
		Dambarawa Tank	Mapakadawewa Ch.	*		
		Dehigama Reservoir		*		
		Gallinda Maha wewa		*		
		Ginnoruwa Tank		*		
		Giritale Reservoir	Amban Ganga	*		
		Heenagalkandiya Tank		*		
		Illakanthai Kulam		*		
		Kande Ela tank	Kande Ela	*		
		Kandeganwela Tank		*		
		Karaugahawela Wewa	Gamburu Oya	*		
		Kaudulla Reservoir	Gal Oya, Alut Oya	*		
		Kotmale Reservoir	Kotmale Oya	*	*	
		Kuda Wewa		*		
		Mahawattena Wewa		*		
		Mapakada Wewa	Heppola Oya	*		
		Mawa Kulam	Mawakulam Aru	*		
		Minneriya Reservoir	Amban Ganga	*		*
		Moragahakanda Reservoir	Amban Ganga	*		
		Nabarala Wewa		*		
		Nagadeepa Naha Wewa		*		
		Nalanda Reservoir	Nalanda Oya	*		
		parakrama Samudra	Amban Ganga	*		*
		Polgolla Reservoir	Mahaweli Ganga	*	*	
		Randenigala Reservoir	Mahaweli Ganga	*	*	
		Rantembe Reservoir	Mahaweli Ganga	*	*	
		Ratkinda Reservoir		*	*	
		Rottuwa Kulam		*		
		Sorabora Wewa		*		
		Verugal Tank	Verugal River, Mavil Aru	*		
		Victoria Reservoir	Mahaweli Ganga	*	*	
		Walgam Wewa		*		
93	Kala Oya	Angamuwa Wewa	Lunu Oya	*		
		Dewahuwa Tank		*		
		Ihala Kalankuttiya Tank	Kalankuttiya Ela	*		
		Kala Wewa	Welimiti Oya	*		
		Kandalama tank	Nirisgori Oya	*		
		Kattiyawa Tank	Kattiyawa Ela	*		
		Rajangana Tank	Kala Oya	*		
		Siyambalagamuwa Tank	Siyambalangamuwa Oya	*		
		Theruwila Wewa		*		
		Usagala Siyambalangamuwa Wewa		*		

Table 4.2-1 AREA BY PROVINCE AND DISTRICT IN THE STUDY AREA

Unit: Square kilo Meters(Sq,km)

Province	District	Total Area	Large Inland Waters	Land Area	Agricultural Land		
					Small Holdings	Estate Sector	Total
Central	Matale	1,993.3	-	1,993.3	466.11	229.68	695.79
	Kandy	1,939.5	33.2	1,906.3	658.26	453.37	1,110.63
	Nuwara Eliya	1,741.2	20.7	1,720.5	239.89	739.23	979.12
	Sub-Total	5,674.0	53.9	5,620.1	1,364.26	1,421.28	2,785.54
Uva	Badulla	2,861.3	58.5	2,802.8	490.50	492.02	982.52
	Moneragala	5,638.7	93.1	5,545.6	546.77	93.13	639.90
	Sub-Total	8,500.0	151.6	8,348.4	1,037.27	585.15	1,622.42
Sabaragamuwa	Kegalla	1,692.8	-	1,692.8	680.42	468.14	1,148.56
	Ratnapra	3,275.4	20	3,255.4	831.95	526.35	1,358.30
	Sub-Total	4,968.2	20	4,948.2	1,512.37	994.49	2,506.86
Total		**19,142.2**	**225.5**	**18,916.7**	**3,913.90**	**3,000.92**	**6,914.82**
Sri Lanka		65,609.8	1,156.2	64,453.6	14,366.67	5,386.63	19,753.30

source ; 1. Statistical Abstract of Sri Lanka 1991, Dept of Consus & Statistics.

2. Agricultural Land according to the Cencus of Agriculture 1982

Table 4.2-2 NUMBER OF DIVISIONS, G.N. DOVISIONS AND VILLAGES IN THE STUDY AREA

Province	District	No. of Divisions	No. of G.N. Divisions	No. of Villages
Central	Matale	11	545	1,301
	Kandy	17	1,189	2,931
	Nuwara Eliya	5	427	1,299
Sub-Total		**33**	**2,161**	**5,531**
Uva	Badulla	14	532	2,359
	Moneragala	9	314	1,147
Sub-Total		**23**	**846**	**3,506**
Sabaragamuwa	Kegalla	10	573	1,520
	Ratnapura	16	575	2,293
Sub-Total		**26**	**1,148**	**3,813**
Total (7 Districts)		**82**	**4,155**	**12,850**
Sri Lanka (9 Provinces, 25 Districts)		256		

Source ; Inventory Survey from Divisional Secretaries' Offices, April. 1993

Table 4.2-3 ESTIMATE OF GDP BY PROVINCE AT CURRENT FACTOR COST PRICES

Provinces	Amount Rs. Million						Percentage Distribution(%)					
	1982	1986	1987	1988	1989	1990	1882	1986	1987	1988	1989	1990
Central	9,752	17,354	18,662	20,555	23,954	29,630	10.3%	10.6%	10.5%	10.1%	10.5%	10.2%
Sabaragamura	6,343	12,606	12,974	13,839	15,970	20,335	6.7%	7.7%	7.3%	6.8%	7.0%	7.0%
Uva	5,113	7,695	8,709	9,769	8,897	13,072	5.4%	4.7%	4.9%	4.8%	3.9%	4.5%
Study Area Total	21,208	37,654	40,345	44,163	48,822	63,037	22.4%	23.0%	22.7%	21.7%	21.4%	21.7%
Westerm	36,830	70,069	78,202	91,379	104,259	132,756	38.9%	42.8%	44.0%	44.9%	45.7%	45.7%
Southern	8,426	14,407	15,463	18,927	18,707	24,692	8.9%	8.8%	8.7%	9.3%	8.2%	8.5%
North West	10,036	17,681	18,129	20,148	21,445	28,178	10.6%	10.8%	10.2%	9.9%	9.4%	9.7%
North Central	4,450	8,349	8,531	9,972	9,354	11,620	4.7%	5.1%	4.8%	4.9%	4.1%	4.0%
Eastrern	7,101	8,022	9,775	10,176	14,601	19,173	7.5%	4.9%	5.5%	5.0%	6.4%	6.6%
Northern	6,628	7,367	7,465	8,751	10,951	11,329	7.0%	4.5%	4.2%	4.3%	4.8%	3.9%
Residual	0	164	-178	0	0	-290	0.0%	0.1%	-0.1%	0.0%	0.0%	-0.1%
National GDP	94,679	163,713	177,731	203,516	228,138	290,495	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Department of National Planning, MPPI; Original figures were adjusted by using the Annual Report of Central Bank of Sri Lanka

Table 4.2-4 ESTIMATE OF GDP BY PROVINCE AT CONTACT 1982 FACTOR COST PRICES

Provinces	Amount(Rs. Million)						Annual Growth Rate(%)				Average Growth
	1982	1986	1987	1988	1989	1990	1987	1988	1989	1990	Rate(1982-90)
Central	9,752	12,112	12,172	12,024	12,782	13,183	0.50	-1.21	6.30	3.14	3.4
Sabaragamura	6,343	8,798	8,462	8,095	8,521	9,047	-3.82	-4.34	5.26	6.17	4
Uva	5,113	5,370	5,680	5,714	4,747	5,478	5.77	0.60	-16.92	15.38	0.8
Study Area Total	21,208	26,280	26,314	25,834	26,050	27,708	0.13	-1.83	0.84	6.36	3
Westerm	36,830	48,904	51,006	53,453	55,630	59,065	4.30	4.80	4.07	6.17	5.4
Southern	8,426	10,055	10,085	11,072	9,982	10,986	0.30	9.78	-9.84	10.06	3
North West	10,036	10,225	11,824	11,786	11,443	12,537	15.63	-0.32	-2.91	9.56	2.5
North Central	4,450	5,827	5,564	5,833	4,991	5,170	-4.51	4.84	-14.44	3.58	1.7
Eastrern	7,101	5,599	6,376	5,953	7,791	8,530	13.88	-6.64	30.88	9.49	2.1
Northern	6,628	5,142	4,869	5,119	5,843	5,041	-5.31	5.14	14.14	-13.73	-3
Residual	0	2,229	-116	0	0	209					
National GDP	94,679	114,261	115,922	119,050	121,729	129,244	1.45	2.70	2.25	6.17	3.5

Source: Department of National Planning, MPPI; Original figures were adjusted by using the Annual Report, Central Bank of Sri Lanka