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**THE LINK BETWEEN
ENVIRONMENT AND DEVELOPMENT:
A CASE STUDY OF THE KOTMALE CATCHMENT**

by

KAREN HANNESON, B. A.

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements for the degree of

Master of Arts

Norman Paterson School of International Affairs

Carleton University
Ottawa, Ontario
April 1989
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ABSTRACT

There is a growing awareness that development objectives cannot be fulfilled on a sustainable basis without consideration of the environment. Our Common Future discusses the need to link environment and development in decision making to achieve 'sustainable development'—to meet the needs of the present generation without compromising the ability of future generations to do the same. Sri Lanka is a country taking note of the warnings and advice given in Our Common Future.

The Kotmale Catchment is one area of the Accelerated Mahaweli Development Programme (AMDP) in Sri Lanka which can be looked at as a case study to bring the concepts of sustainable development to a smaller scale. The construction of the Kotmale Dam placed more people on hillsides that were already deforested, overpopulated and prone to erosion and landslides. The benefits of the AMDP were great on a national scale, but the people resettled on the Kotmale hillsides were not the beneficiaries of the development and found themselves living in an increasingly environmentally degraded area. In the past few years, international donors and the Sri Lankan government have realized that the environmental degradation in the area was not only affecting the local people, but could affect the long term success of the project as a whole. New ways are being sought to merge the achievement of development objectives with environmental rehabilitation and maintenance in the area. Education and extension services can promote better land use practices. Minor export crops can be encouraged, being both economically and environmentally sound. Environmental legislation can be updated, coordinated and more effectively enforced. Donors, government and individual groups can work together to plan policies and programmes that promote an improved environment alongside improved livelihoods for the settlers. Some responsibility can be taken at all levels, international, national and local, for improving the environment so that development achievements can be sustained for future generations.

Case studies such as this are useful for bringing the environment–development linkage to a more manageable level. Consideration of many such case studies should lead to the beginning of a body of theory which joins the ideas of the two disciplines, ecology and development studies. They must be linked in theory, planning and actions, just as they are linked in the real world.

ACKNOWLEDGEMENTS

I have been fortunate in being able to visit Sri Lanka and conduct research on more than one occasion. The summer of 1986 was spent investigating increased rice production and crop diversification in one area of the AMDP for my Honours Research Essay in Geography. It was during and after this visit that the Kotmale Catchment was first identified as a possible topic for a graduate thesis in environmental policy and practice as it relates to development. Since then, a heightened awareness of the effects of development on the environment internationally and in Sri Lanka, has made such a topic even more pertinent. In May of 1988, I returned to Sri Lanka to spend three months looking at the relationship between development and the environment using the Kotmale Catchment as a case study. My research was encouraged and assisted by many helpful people in Sri Lanka.

Although some work was done in the study area itself, most research was conducted in Colombo. The Documentation Centre at the Planning and Monitoring Unit of the Mahaweli Authority of Sri Lanka provided much information. I would like to thank Dr. Abhaya Attanayake, Director of the PMU who discussed my research with me on several occasions and allowed me access to some pieces of research that had been and were being conducted in the study area. Mr. Thilakabandu of the Data Registry was most helpful in assisting me to locate materials on my subject available within the Mahaweli Authority. The friendly staff at the PMU should also be thanked; of particular help was Mrs. Chitragani de Silva who spent many hours putting a large portion of this thesis into a computer. I am also grateful to Lee Collier of the Chemistry Department for all his advice and help with the computer work done in Ottawa. Dr. John O'Manique of the School of International Affairs and Dr. Gray

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LIST OF ABBREVIATIONS

AGA	Assistant Government Agent
AMDP	Accelerated Mahaweli Development Programme
CEA	Central Environmental Authority
CIDA	Canadian International Development Agency
DWLC	Department of Wildlife Conservation
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ECU	Environmental Coordinating Unit
GOSL	Government of Sri Lanka
IUCN	International Union for Conservation of Nature and Natural Resources
JEDB	Janatha Estates Development Board
MASL	Mahaweli Authority of Sri Lanka
MECs	Minor Export Crops
MERP	Mahaweli Environmental Rehabilitation Project
PMU	Planning and Monitoring Unit
SIDA	Swedish International Development Agency
SLEC	Sri Lanka Environmental Congress
STC	State Plantation Corporation
TAMS	Tippetts, Abbott, McCarthy and Stratton
UMPDU	Upper Mahaweli Peripheral Development Unit
UNEP	United Nations Environmental Programme
WCED	World Commission on Environment and Development
WWF	World Wildlife Foundation International

CHAPTER I

INTRODUCTION

Awareness of environmental issues and of the need to integrate consideration of the environment with development efforts has been mounting over the last few decades throughout the world. More and more countries are realizing that they should heed the warnings and advice put forward by the World Commission on Environment and Development (WCED) in their recent publication, Our Common Future (1987). Development cannot be sustained if the environmental resource base and essential environmental processes on which it depends are not maintained or are diminished to a level from which they cannot recover. Similarly it cannot be maintained if decision-makers lose sight of long-term objectives—the overall goal being a sustainable improvement in the well-being of a country's people. Sustainable development involves a balance between fulfilling development objectives and considering the environment upon which their achievement is based. Ideally, they would occur simultaneously—the environment carefully considered during both project planning and implementation. Changes to the environment would be predicted and monitored and 'rehabilitation' would be an ongoing process. This, of course, seldom occurs this succinctly, just as development projects seldom begin in environments that have not already been disturbed or damaged in some way. Thus in most cases it is the timing of environmental awareness and local environmental rehabilitation relative to national development efforts that is crucial to the development process and to the sustainability of any successes it may achieve. The realization must come, the earlier in the process the better, that to ignore the environment is to threaten development.

Our Common Future discusses the difficulties in integrating these two large variables, environment and development. The report highlights the issues involved in their complex linkage, such as politics, economics and energy, at the global scale. It refers to the achievement of this linkage as a 'global challenge', one that must be met in order to maintain functioning environmental processes for future generations from which sustainable development can occur. However, although it is a global concern, generally such problems must be confronted at a smaller scale, be it national, regional or local. Case studies are needed to show the importance of the linkage and the difficulties to be met in achieving it. There is a lack of theoretical work at present on this subject, merely observations and suggestions such as those provided in Our Common Future. There has long been literature on various aspects of the environment and there has long been literature on development—but, until recently, they have been running on separate tracks. Though there is a new association emerging between the two streams, it will take time and the findings of many case studies before theoretical works can emerge. This paper attempts to bring the linkage discussed in Our Common Future to a local level, current situation. A case study of the Kotmale Catchment in Sri Lanka will show the difficulties in linking environment and development, even at a much reduced scale, and will enable an application of the ideas of the Brundtland Report (Our Common Future) to the project level showing the problems of time lags between environmental awareness and action, unpredictable variables and conflicting interests. It is at this level that people involved, whether they be foreign donors, government personnel or local residents, feel they can have some influence. This case study will highlight the complexity of integrating consideration of the environment with the achievement of development objectives as well as the need for a balance between the two large variables. It is hoped that it may give ideas and examples of the relationship between environment and development to those people

wishing to further the linkage in the real world at the project level or in the literature

While development is geared to national aspirations and objectives, environmental problems have tended to be localized – or at least perceived that way. Thus, unless environment and development are linked from the beginning, there is the likelihood that the local 'balance-sheet' will not be addressed until the national 'balance-sheet' shows substantial positive gains. This is partly in the nature of larger development projects and partly due to the political environment in which they take place. Figure 1.1 highlights the time lags that traditionally occur when development projects interact with the environment, as they inevitably do.

FIGURE 1.1

Time Frame for Development and
Environmental Action

Dev. = Development

Env. = Environment

First comes the relatively short time lag between decisions on national economic development objectives and the actions undertaken to achieve them. Then comes the period during which projects for this development change the environment. The environment may have already been disturbed, but the development process places further stress on it. The environmental 'plan' which may occur before development actions is generally neither comprehensive nor complete, perhaps addressing only one

aspect or area of the project. Finally there is the relatively longer time lag between decisions to rehabilitate or restore the environment and actions undertaken in local areas. Such delays are common on development projects, particularly large scale ones. It is important to recognize these time lags, to understand their possible effects on both the development process and the environment, and to work toward shortening the time lags involved.

This paper examines the Kotmale area in Sri Lanka where the local residents, development planners and, finally, the government, waited some time before realizing that environmental degradation was threatening the long term success of development in the area. The time lags discussed all occurred in the case of the Accelerated Mahaweli Development Programme (AMDP) in Sri Lanka, of which the Kotmale is a part, where the decision to implement and accelerate was based on national interests -- national energy needs, unemployment, agricultural deficiencies and balance of payments concerns. From 1977 through 1984, the project focused on large-scale economic development—building huge dams and reservoirs and irrigating large areas of land. The international donors concerned themselves with purely economic benefit-cost ratios, the Government of Sri Lanka (GOSL) concentrated on the national economy and locally, in one area of the AMDP, the Kotmale residents worried about family incomes. It was not until 1985 that international and national acknowledgement of local environmental degradation came to be expressed and acted upon. Environmental protection had become 'popular' internationally and within Sri Lanka as people began to see the short term nature of development successes if they are achieved at the expense of the environment. Concerned non-governmental organizations came into being and are gradually working environmental consciousness up into the political system and down to the grassroots level. The local Kotmale

residents became aware that they were not beneficiaries of the development process and saw the environmental degradation as a part of an unfulfilled government promise that they would be 'better-off' as a result of development. Through allotment of funds in various forms, including extension services, the international and national actors are trying to stimulate an awareness among the local residents that the environment in which they live is, to a large extent, their own responsibility. For sustainable development, the environment and what people need from it to earn their livelihoods must be considered. In cases such as the Kotmale, this environmental resource base and the capacity of environmental processes to support development must be improved. These environmental 'improvements' may be at a greater economic cost than if consideration of the environment had been translated into action earlier. The environment must, as the Brundtland Report states, not only be sustained, but also expanded so that future needs may be met.

When considering the link between environment and development, many problems can be anticipated: problems of definition, of measurement and of applying 'global' concepts to a micro-scale situation such as one area within a single development project. In considering the environmental degradation of the Kotmale Catchment, the term 'environment' could easily become all encompassing covering the flora, fauna, soils, terrain, hydrology, and the interactions of system components at all levels. In this thesis, 'environment' will be limited to vegetation, soil and slopes, concentrating on land use as it affects deforestation, soil erosion and landslip occurrence. These can be considered symptomatic or indicative of other aspects of the environment. Vegetation, for instance, affects animal life, the micro climate, soil nutrients, water-holding capacity and erosion. As well, these are the factors seen to be the most crucial at all levels:

1. to the development process—Preventing sedimentation and siltation of the reservoir will prolong project life. This means national gains in agricultural production and electricity generation will be long-lasting.

2. to the Mahaweli Authority of the GOSL—Prolonging reservoir life, preventing landslips, preventing settler encroachments onto natural forests and plantations and preventing illegal tree felling will all contribute to the success of the project as well as help prevent the destruction of environmental resources.

3. to the Kotmale settlers—Assuring fuelwood and timber supplies and choosing land uses and crops that both prevent soil erosion and improve nutrition and incomes are important to maintaining or improving the settlers' quality of life.

One uncertainty is whether local Kotmale residents are or can be convinced of the need to invest resources in environmental activities when incomes are low, population pressures great and land scarce—in other words, when development is the priority. It is not easy to accept that short-term gains should be forgone in the expectation of longer term progress and benefits. The government must convince the local residents of their commitment toward these environmental projects in order to stimulate local motivation and involvement. Development is a process of change which should improve the well-being of the people. Improvements should be in areas where they are needed or desired, whether they be financial, physical, social, or otherwise. The initial focus, however, may be on national aspirations, and tends to be measured in economic terms. Not all citizens will necessarily be better-off immediately, nor at the same time. Although not readily accepted, the fact is that sometimes short-term gains for the individual must be foregone for the long-term gains for the group or population. Reservoir evacuees who settled in the Kotmale Catchment felt their 'quality of life' suffered: incomes did not rise as anticipated, educational and extension services were lacking, families were moved away from their relatives and their traditional lands. Although 'quality of life' is a subjective term, having a varying interpretation over space and time, from one person to the next, from one culture to the next, certain physical, social and economic factors are basic enough to be discussed in

this paper with regard to the Kotmale settlers. The reservoir evacuees found a diminished 'quality of life' upon their move, while at the same time having rising expectations. The settlers must be convinced that this recent interest in the Kotmale Catchment's environment (since 1985) is not a fleeting interest on the part of the donors and the government and that it, with their participation, may bring about sustainable improvements in living standards and in the state of the environment.

The usefulness of looking at environment and development at the project scale comes from its manageability and its relevance to other projects. The case study of the Kotmale Catchment will not be an evaluation of the AMDP, nor will it seek to solve the problems highlighted. It will allow one, however, to see the potential for a synthesis of environment and development to be achieved in spirit and in action. The link between environment and development is more pertinent for most people at the local level rather than at the macro-scale considered in Our Common Future. Chapter II of this thesis, however, provides the basis for the shift in focus. The Brundtland Report discusses global or nationally oriented strategic imperatives for achieving an integration of economic and ecological consideration in decision making, just as they are integrated in the real world. Sri Lanka appears to have taken note; with over ninety laws directed toward the environment, many of which have been legislated in the last decade, that government cannot be accused of ignoring the importance of environmental protection. Despite the desire for rapid development, the government now requires environmental impact assessments on all proposed development projects. However, legislation alone is not effective; ideals must be translated into policy, action and enforcement. The government must listen to the concerns of the people living in the damaged environments, learn from them and work with them to make positive changes. These are things that, until very recently, governments have been much less

willing to do.

Although the AMDP did not directly cause the environmental problems in the Kotmale Catchment, it exacerbated those that had been developing over the past two centuries. The changes in land use and population pressure leading to the state of the pre project Kotmale environment are discussed in Chapter III. The Kotmale Catchment is an upstream area of the AMDP in which many people, displaced by the major Kotmale Dam and Reservoir, chose to resettle. A more thorough examination of the situation there should have preceded the development. As it was, the project moved more people into an area that was already overpopulated, deforested and prone to erosion and landslips. Such consideration would not have halted the AMDP, the implementation of which was necessitated by national concerns. It would, however, have identified the problems in the Kotmale Catchment environment that had been emerging over many years and for which remedial measures should have been taken. Now the donors and the GOSL must go back and take stock of the local 'balance--sheet' which, largely due to environmental degradation, has not fared as well as the national 'balance--sheet'. The national 'balance--sheet' has taken priority, partly due to its scope and partly due to the way in which gains can be measured in largely economic terms. The local 'balance--sheet' is less quantifiable, in a large part determined by the changes in quality of life experienced by individual families in the affected area. And although interest in the environment of the area is not entirely new, the need to take action on the interest is much more immediate and pressing now.

Chapter IV places the Kotmale Catchment within the framework of the overall AMDP as an area directly affected by the development process. In discussing the land use and settlement adjustments that occurred, one can see the need for greater

consideration of the environment within the development process and for shortening any time lags that occur once actions toward national objectives begin to affect the environment. Also evidenced is the problematical nature of the linkage, the difficulties in dealing with uncertain variables and in trying to please everyone at all levels, from national to local.

Chapter V takes a more detailed look at the environmental and developmental concerns of people and what is being done to encourage an active linkage between the two variables. It considers three of the new settlements in the Kotmale Catchment in detail showing changing land use in the area and its implications on the environment and on family income (one measurement of settler well-being). Accommodations can be made on both the development and environmental side of the linkage that will improve both variables more than if one was given priority at the expense of the other.

The Kotmale Catchment was first identified during the summer and fall of 1986 as being suitable for highlighting these factors as they relate to the development process and to environmental policy and practice. By May of 1988, on my return to Sri Lanka, I found that research in the Catchment area had begun:

1) The Mahaweli Authority of Sri Lanka (MASL), through its Upper Mahaweli Peripheral Development Unit (UMPDU), had carried out socio-economic studies of seventeen settlements that had been established to receive evacuees from lands inundated following construction of the Kotmale Reservoir. The data were collected in December, 1986 and January, 1987, and, to date, seven of the reports have been published in Sinhala and tabulated data are available for a further two. The three settlements used for detailed study in Chapter V were necessarily chosen from those on which reports have been published.

2) In October, 1987, the Canadian International Development Agency (CIDA), mobilized a team to prepare a project design for a possible Mahaweli Environmental Rehabilitation Project (MERP) to be focused on the Kotmale Catchment. While the final report of the design team was not available for consultation, one of the team member's reports was available for reference in the Documentation Center of the Planning and Monitoring Unit (PMU) of the MASL. Because the design team was contracted by CIDA, it has not been possible to quote directly from this source. It is acknowledged, however, that the bibliography attached to the draft report has proven invaluable.

3) In April, 1988, the MASL contracted land-use mapping of twenty-four settlements in the Kotmale Catchment. Seventeen of these were the evacuee settlements and seven were settlements more recently established to accommodate families whose homesteads had been threatened by the landslips of early 1986. These settlements were mapped in the field at a scale of 1:2000 and subsequently reduced for presentation to a scale of 1:4000. Professor C.M. Bandara of the Department of Geography at Perediniya University was in charge of this mapping project. The Director of the PMU, Dr.A. Attanayake authorized the use of material from these maps.

Obviously the availability of such detailed material has been of immeasurable help in preparing portions of the present paper. Literature and documents available in the PMU Documentation Center and at the Census Department were used extensively for pre-project and current accounts of the Kotmale Catchment. Almost all of this information would have been unavailable in Ottawa. Supplementing this were informal interviews with people involved in the AMDP both in Colombo and in the field. As well, maps and surveys held at the PMU were made available to me; these would have been unattainable in Canada. Crucial to the greater understanding of my case study area gained from researching in Sri Lanka, was the fact that, although most research was carried out in Colombo, time was spent in the project area. I was thus able to observe the land use patterns and the types of activity on the hillsides myself, rather than seeing land uses merely as percentages and names of crops given in the documentation. Seeing the settlements used as detailed case studies in Chapter V allowed some general confirmation of the map work that has been done on them.

Certain obstacles in the research were encountered. Ethnic unrest in the country caused some delays in the timing of field trips, as it was inadvisable to travel during the campaigning for provincial elections. The language barrier proved difficult in the Kotmale Catchment, however for research and interviews in Colombo it was possible to use English. Persistence and the help of several members of the PMU staff, allowed me to find most of the literature and data needed. The existence of the recent, detailed work that I was able to access in Sri Lanka is indicative of an increasing awareness of and preparation for positive environmental action by both local policy shapers and policy makers and by the international donor community. They are now seeking to redress the environmental degradation that is inhibiting the residents' ability to improve their livelihoods. Already the United Kingdom has signed agreements with the GOSL for thematic mapping and social forestry projects in the catchment adjacent to the Kotmale. The Federal Republic of Germany is implementing its Upper Mahaweli Watershed Management Project, designed to improve the institutional capability and technical expertise of the Upper Mahaweli Peripheral Development Unit of the MASL.

The problems being encountered in the Kotmale Catchment cannot be solved overnight. But to look at how the linkage between development objectives and environmental considerations progressed over time—at when, where, how and why it has developed—is to acknowledge that it is an integration of two large variables that is possible and that it is necessary. Attention is now being paid to development initiatives that improve the well-being of the Kotmale residents without compromising the ability of future generations to meet their needs as well. This is precisely the idea Our Common Future intended to promote. In the future, an analysis of the combined generalizations from this and similar detailed case studies may allow for the gradual development of a body of theory on the linkages between development and the

environment. The time lag between large-scale economic development and local environmental rehabilitation can and should be reduced. To do this, a coordinated effort is needed—among the international donors, the national government and the local residents. Sustainable development depends on such an effort. This paper will also emphasize that the development process often involves variables difficult to predict—a critical one in this case, predicting the number of evacuees who would opt to resettle upstream in the Kotmale Catchment. Thus it is not always easy to foretell the extent of the negative side of the local 'balance-sheet'. The need is for concerted action to redress the problems and work toward sustainable development—development that will improve the lives of the people not only of the present generation, but also for the generations which follow.

CHAPTER II

THE LINK BETWEEN ENVIRONMENT AND DEVELOPMENT

2.1 Our Common Future—An Overview

In 1987, the World Commission on Environment and Development (WCED) chaired by Prime Minister Gro Harlem Brundtland of Norway, published Our Common Future. Publicized as "the most important document of the decade on the future of the world" (backcover), it was a 'sign of the times' in the developed world, synthesizing and highlighting that world's growing concern with the Earth's environmental problems and the policies and activities which underlie these problems. Environmental issues began to generate concern at mid-twentieth century—just prior to when our ability to view Earth from space impressed upon us that the planet is not a series of compartmentalized units but is an interconnected 'whole'. The inhabitants all depend on the same biosphere—the pattern of greens, blues and browns seen from space—and yet these resources are shared in an unequal fashion among the world's communities. "The Earth is one but the world is not." (WCED, 1987: 27). The righting of these unequal consumption patterns and the alleviation of the poverty faced by millions of people means the need for continued and strengthened development efforts. But for such development to produce positive long term changes, the Brundtland Report calls for a new era of economic growth, "... one that must be based on policies that sustain and expand the environmental resource base." (WCED, 1987: 1).

The global challenge is thus 'sustainable development' a key concept in

Our Common Future in which it is defined as " . . . development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987: 43). The document stresses the impossibility of separating economic development issues from environmental issues; " . . . many forms of development erode the environmental resources upon which they must be based, and environmental degradation can undermine economic development." (WCED, 1987: 3). Thus the environment and economic development are tightly interrelated; to ignore the former is to threaten the latter.

The idea that technological advancement and economic growth cause environmental damage is not new. People have long debated whether there were enough resources to remain available for future generations. For many countries it became a national concern in the 1960s. Many industrialized countries began to see the results of their 'progress': " . . . air, water, and noise pollution, difficulties with solid-waste disposal, lack of land-use planning, and a general deterioration of quality of life in most urban areas." (Biswas and Biswas, 1984: 35).

2.2 The Stockholm Conference of 1972

Although the general public may have been aware of these urban problems, specialists were becoming aware of further environmental degradation and excessive resource consumption: "Increased consumption of fossil fuels, proliferation of nuclear reactors, accelerated deforestation and loss of productive soils, introduction of more than 1,000 man-made organic chemicals compounds every year, loss of genetic diversity, and other similar problems . . . " (Biswas and Biswas, 1984: 36). The

realization that these problems were real and immediate and that many transcended national boundaries encouraged the United Nations to convene the World Conference on the Human Environment in Stockholm in 1972. In the preparation for this conference, it became apparent that, for different reasons, both developed and developing countries did not believe environmental preservation and development were compatible. The developed countries realized that their increased use of raw materials and energy was incompatible with the 'population explosion' in the Third World. Developed countries became preoccupied with the finiteness of the physical environment and the limits to growth, with some groups advocating 'no-growth'—rarely looking beyond to the politico-socio-economic implications of this. The developing countries were frustrated, unable to see how their citizens could compete for the world's finite resources against the wealthier consumers of the industrialized countries. As well, they could see no reason why they should have to pay any price for the developed world's excesses of consumption and consequent pollution; when most of their residents could not even fulfil basic needs, how much sympathy should be spared for other people's excesses ?

To clarify some of the conflicting perceptions of the relationship between environment and development, the Stockholm Conference Secretariat convened a seminar on 'Environment and Development' in June 1971 in Switzerland. It sought to dispel the notion that 'environment' and 'development' were incompatible and that a country could not give attention to one as well as the other. The complementarity and interrelationship of the two was stressed. The meeting " . . . clarified [that] many environmental problems of Third World countries originated from under-development including lack of potable water and sanitation, burgeoning of squatter settlements, and lack of education, employment, and transportation. . . " (Biswas and Biswas, 1984: 36).

The Stockholm Conference thus recognized the "pollution of poverty" and stressed the need for all countries to realize the link between environment and development and their complementarity.

2.3 World Reaction in the 1970s and 1980s

In 1974, the UNEP and UNCTAD jointly held a Symposium on Resource Use, Environment, and Development Strategies in Cocoyoc, Mexico, resulting in the Cocoyoc Declaration which further reinforced the theme " . . . that environment and development objectives are harmonious and mutually reinforcing . . . " (Biswas and Biswas, 1984: 36).

This as well as other activities of the UN Environment Programme—under such labels as ecodevelopment, environmental management, and environment and development—have significantly contributed to our understanding of environment—development interrelationships, and indeed it is now widely accepted that environment and development are 'two sides of the same coin'.
(Tolba, 1982).

Conservation organizations grew in importance and credibility. The International Union for Conservation of Nature and Natural Resources (IUCN) began in 1971 with a small number of scientific members; it is now the largest scientific conservation

organization in the world (Daily News (Colombo), Jan. 23, 1988: 11) and was involved in forming the 1980 World Conservation Strategy.

The message of this Strategy is simple: protect the natural resources on which life immediately depends. IUCN cooperated with agencies in over one hundred countries to produce the Strategy, with support from the United Nations Environmental Programme (UNEP) and WWF (World Wildlife Foundation International). (Daily News (Colombo), January 23, 1988: 11).

Such a strategy illustrates a consensus on the linking of environment and development and highlights environmental issues as 'people' issues.

Despite this apparent 'coming-together' of world opinion on environment and development, many people still believe that 'environmental conservation' or the word 'environment' in general, suggests " . . . the personal preferences of those privileged enough to live beyond the stringencies and deprivations of basic human needs . . . environmental concerns are a luxury that poorer, developing countries simply cannot afford." (Schramm, 1980: 788). Such views are decreasing in number and the environment is being given more attention by individual countries and by international aid organizations. The World Bank recently (January 27, 1988) appointed Kenneth Piddington as its first Director of the Environment, having been under considerable pressure from environmental groups concerned by some of their projects' disregard for the environment. The World Bank assures that the new Director " . . . will play a key role in the top priority area of developing strategies to integrate environmental considerations into our overall lending, policy and research activities." (Barber B. Conable quoted in Daily News, January 30, 1988: 5). Thus there is a growing realization that environmental concerns should be evaluated as another set of

'economic' values " . . . which compete within the boundaries of finite means and available resources." (Schramm, 1980: 788). If environmental implications of development projects, especially large ones, are ignored, their economic costs and consequences will be much greater than if attempts are made to include them in project costs and give them adequate attention from the outset.

Thus the Brundtland Report and its concept of 'sustainable development' is a synthesis of ideas that have been emerging for at least two decades. It stresses the complex cause and effect relationship between environment and development. Environmental stresses are themselves linked to one another: for example, deforestation increases soil erosion which increases the siltation of rivers, lakes and reservoirs. Individual or sets of environmental problems are also related to patterns of economic development: for example, certain agricultural policies may lead to land, water and soil degradation. In turn, these environmental disturbances and economic concerns are linked to many socio-political factors (e.g., women in society, population policy and land use and land tenure policies). All of these interrelationships operate from local to national to international levels—which only serves to increase the complexity and the difficulties we face in dealing with these linkages. "Ecological interactions do not respect the boundaries of individual ownership and political jurisdiction." (WCED, 1987: 46). Even within an individual country the search for common interest is difficult as both development and environmental problems seldom

have solutions that would leave everyone better off. Our Common Future gives several strategic imperatives:

- 1) reviving growth;
- 2) changing the quality of growth;
- 3) meeting essential needs for jobs, food, energy, water and sanitation;
- 4) ensuring a sustainable level of population;
- 5) conserving and enhancing the resource base;
- 6) reorienting technology and managing risk; and
- 7) merging environment and economics in decision making

(WCED, 1987: 49)

The last of these points is the common theme that should prevail for the achievement of any of them—there must be an integration of economic and ecological considerations in decision making just as they are integrated in the real world.

2.4 Recent Sri Lankan Commentary

The satisfaction of human needs and aspirations is the major objective of development. The Third World governments, continuously strive to improve the quality of life of their people, trying to provide them with ample food, better clothing and reliable shelter. To achieve such noble goals attempts are being made to produce more food, create more jobs and produce more consumer goods. (Daily News, January 1, 1988: 13)

In these efforts Sri Lanka is not alone among developing countries who view the developed nations as models—showing industrialization as the key to the improvement

of the quality of life, the key to development. But an " . . . essential component of sustainable development is the development of environmental policy, laws and institutions that focus on environmental issues." (Daily News, Jan. 5, 1988: 14). A recent overview of Asia's environmental protection efforts by the Environmental Co-ordinating Unit (ECU) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) described the efforts in four words—"Too little, too slowly." (Daily News, Jan. 22, 1988: 4). They cite the three major environmental pressures as being " . . . population, economic growth and the increasing capital and technological intensity of that growth." (Daily News, Jan. 22, 1988: 4). The pressures have reached the point where the U.N. considers the ESCAP region has " . . . some of the most devastated land on earth." The overview names " . . . deforestation as the most severe terrestrial problem from a list that includes soil erosion, water-logging and salinity and species extinction" (Daily News, Jan. 22, 1988: 4). The region's countries are generally aware of these and other problems and most are tackling them as best they can, Sri Lanka being no exception.

Concern over environmental degradation in Sri Lanka, as evidenced in legislation, goes back to British colonial times when there were regulations on clearance of forests above a certain elevation and along rivers and roads. This century, concerns over deforestation, soil loss, coastal erosion, the mining of corals and other environmental problems are mounting. They are being given increasing attention by scientists and some legislators. Groups of environmentalists are calling for further policies, laws and institutions to protect the environment. "The environmental policy act of 1981 and creation of an environmental authority is only a first step towards achieving these goals." (Daily News, Jan. 5, 1988: 14). The Central Environmental Authority (CEA) is more an agency of evaluation than one of implementation. It must

become more of an umbrella for the large number of departments, ministries and agencies that deal with the environment.

At present there are more than ninety pieces of law covering a wide range of environmental problems (Daily News, June 28, 1988: 17). However, the government is aware that legislation alone cannot get to the roots of the problems particularly when one considers the difficulties faced in enforcement. In 1984, the Prime Minister put the Central Environmental Authority in charge of organizing Environmental Pioneer Brigades in schools. These are programmes headed by teachers and designed to train children "... how to act in harmony with the environment ..." and "... how environmental equilibrium could be maintained ..." (Daily News, Jan. 19, 1988: 6). This programme may still be a small one, but it does show a desire to foster awareness of environmental issues among the children who must live with the environment with which they are left. Older students are forming groups of their own like "Soba Daham Sisu Haula" (The society who loves the natural environment) which has organized several excursions to Yala sanctuary, protested against illegal felling in the Dunhinda jungles and held an exhibition of rare medicinal herbs—and this organization is less than a year old (Daily News, Jan. 6, 1988: 14).

Sri Lankan environmental NGOs have become a strong force, and their reputation is spreading even abroad, said Mr M B Adikaram ... of the Sri Lanka Environmental Congress (SLEC), the apex body for a number of big and small environmental organizations, based mainly in rural areas. (Daily News, April 1, 1988: 9).

It is partly through the efforts of these NGOs that such items as the National Heritage

Wilderness Areas Act of 1988 have passed into law. But such organizations are hampered in two major ways: "... the lack of immediate funds and personnel willing to undertake the implementation of the environmental programs" (Daily News, April 1, 1988: 9). The lack of trained personnel is a constraint even for the government agencies. A further constraint, not yet well recognized, is the "... growing need to develop an institutional infrastructure capable of handling Research and Development (R&D) programs to study environmental issues." (Daily News, Jan. 5, 1988: 14). Sri Lanka requires Environmental Impact Assessments (EIA's) of new development projects—yet does not have the local capacity to carry them out. Foreign 'experts' are often brought in whose technical and ecological knowledge may be ill-suited to the conditions they are supposed to evaluate. Nonetheless, Environmental Impact Assessments do play an important role in encouraging more responsible development.

The Environmental Impact Assessment (E.I.A.) has also played an important part in the decision of the Director of Coast Conservation to refuse a permit to the Ceylon Electricity Board to build a coal fired power plant at Trincomalee. The opposition to this project is said to have been spearheaded by the NGO campaign committee. (Chief Justice Parinda Ranasinghe, Daily News, June 28, 1988: 6).

In the same article quoted above, the Chief Justice names several actions taken in the courts by Sri Lankan Environmental NGOs and by individual persons, and says, "These

proceedings indicate the presence of an alert, responsible and vibrant group of environmentalists who would do any community proud."

In approaching the final decade of this century the magic term seems to be "sustainable development" or "development without destruction of our environment".

Our aim should be to seek to build a more balanced and a stable internal economy, with greater social equity and with improved environmental and natural resource management. To reach these it requires to implement culturally and ecologically sound technologies and techniques with the full participation of local people. Furthermore, close attention needs to be paid to the condition of the biological and physical environments and to the natural resource base it represents.

(Daily News, Jan. 5, 1988: 14).

In June of 1988, the Institute of Fundamental Studies, the Central Environmental Authority (CEA) and the Department of Education organized a seminar to mark World Environment Day. The crucial need for conservation was stressed—based on the limited and dwindling natural resources of Sri Lanka and the degradation of those resources which remain. Many examples were cited: accelerated sea erosion due to unrestricted coral mining; the disappearance of the mangroves due to the quest for fuelwood and building supplies; deforestation and some desertification of the Dry Zone due to high intensity chena cultivation; heavy erosion and landslips due to clearing of steep slopes in the hill country; and the pollution of water bodies, atmosphere and soil caused by the lack of regulation governing industry locations.

With such a variety of environmental problems, there is no simple solution, nor can these problems be solved by legislation alone though the enforcement of legislation is certainly mandatory. Many of the measures suggested at this Sri Lankan seminar correspond to ideas found in Our Common Future including:

- 1) Poverty alleviation for which all programs should be modelled on the Sri Lankan National Conservation Strategy, now nearing completion;
- 2) adoption of a population policy (which should be related to the carrying capacity of the resource base);
- 3) environmental parameters incorporated into the national planning process (functional ecosystem evaluation to precede economic analysis). This would keep the economic planners from treating environmental functions as free goods and services.
- 4) Environmental Impact Assessments on all development programs and projects (although Sri Lanka was one of the first developing countries to make this mandatory, it must go further and make the polluter pay for adverse impacts until they are corrected).
- 5) integrated approach to national planning (decision making process must take environment as well as socio-economic factors into account); (Daily News, June 13, 1988: 4)

These policies would all help put Sri Lanka on the path of sustainable development.

Mr.K.H.J.Wijayadasa, Chairman of the CEA, expressed a full understanding of what 'sustainable development' implies:

It is a process of change in which economic and fiscal policies, trade and foreign policies, energy, agricultural and industrial policies all aim to induce development paths that are economically, socially and ecologically sustainable. (Daily News, June 13,1988: 4)

But this knowledge must be expressed in more than rhetoric, if it is to have any applicable effect on environment and development in Sri Lanka.

The following chapter traces some of the historical processes in one area of the developing world—the Kotmale Catchment Area of Sri Lanka—which have influenced the interrelationship between the environmental system and the need for improving local life quality. This chapter is necessary in order to show that the present environmental degradation is a product of more than just the immediate past and that current environmental awareness has been developing gradually in the area, though little action has been taken until recently. Chapter III thus establishes a baseline of the environment and development situation in the Kotmale Catchment which was then further influenced by the influx of people placed there by the development process.

CHAPTER III

THE KOTMALE CATCHMENT; LANDSCAPE AND LAND USE TO 1979

With growing population and greater human interference in the environment, it is uncommon for projects to come into an area that has been undisturbed by humans or in which patterns of human activity have remained constant. Patterns of development, land use changes and population growth in the Kotmale Catchment prior to the building of the dam influence the current environmental resource base and the options available to those wishing to coordinate development objectives with an environment which has limits to its ability to sustain the demands placed upon it. The catchment of the Kotmale Oya has experienced a series of environmental impacts; the construction of the Kotmale Dam and the consequent creation of the reservoir is but the latest example, albeit the most dramatic one, of human interference in the environmental system. Gradual development and changes in social and political forces in the area over the last two centuries had been causing incremental environmental damages. This chapter will describe these changes and establish the baseline conditions that existed when the AMDP came into the area. The Kotmale Dam and reservoir intensified pre-existing processes of degradation and introduced some different variables. One significant change has been an increased awareness and sensitivity to environmental change. Awareness of the environment as it relates to land use changes and population pressures is not entirely new, as this chapter will document. However the importance of the environment as it relates to the lives of the Kotmale residents was not understood until after the AMDP had placed further stresses on this baseline environment. It has been realized that the lives of people cannot be improved on a sustainable basis in this area without immediate remedial action toward the existing environmental degradation

and unless strong policy initiatives are introduced. Part of the complexity involved in linking environment and development comes from the need to consider not only the baseline conditions but also the processes of development and environmental change behind the current situation.

3.1 Geography and Overview of the Kotmale Catchment

The Kotmale Oya (River) originates in the Central Massif of the Horton Plains plateau at an elevation of about 2100 m in the South Central Highlands of Sri Lanka. With a catchment area of 550 square kilometers, the Kotmale travels 70 km to its confluence with the Mahaweli River, at an elevation of approximately 560 m. Approximately one-third of the Kotmale Catchment lies at elevations greater than 1200 m. The topography is rugged at the higher elevations, with steep slopes and hard gneissic rock outcrops along the top of the valley. At elevations below 1500 m, lower montane rainforest was the original natural vegetation; upper montane rainforest grew above 1500 m. There remain only relatively small patches of natural forest, most has been replaced by grassland and even much of the steepest land has been brought under cultivation.

The dominant features of the Kotmale Valley, profoundly influenced by the underlying geological structures, are the scarps which form prominent cliff faces in the valley. "Slopes of 50–60 degrees are common, and in exceptional cases slopes of even 80 degrees are present. . . ." (Siriname in Gorrie, 1954: 9). The dominant rock types are a highly metamorphosed series of pyroxene gneisses and granulites which have a 'well-developed system of fissures and joint planes'. Table 3.1 from Russell gives

Characteristics of soils, bedrock and topography in the Kotmale basin. Solutional processes have produced open-textured soils and amplified a distinctive fracture pattern in the bedrock. The water movement through the bedrock and the weathering of the bedrock are evident in the escarpments, steep cliffs, gullies and sites of mass movement.

Located in the humid montane zone, the Kotmale Catchment receives between 3000 and 6000 mm of annual rainfall. Significant to slope stability is the fact that a large percentage of this may fall during a few intensive storms, particularly during the southwest monsoon. This makes landslides an ongoing threat. The major landslips of 1947 were confined to scarp faces and most were related to drainage channels either man made or natural. Figure 3.1 from Russell shows the Relationship between Landslide Activity and Rainfall. However, although the fundamental problems may have been geological and topographical in nature, as long as the land was under forest it remained fairly stable. Slope and land use together are important in determining erosion and soil loss " . . . and form the basis of the U.S Soil Loss Equation." (Russell, 1980: 44). In the Kotmale area, there were some alarming combinations of slope and land use. "The average slope and the steepest slope used for any given crop such as tea, manioc or paddy are far greater than in any other country with a comparable population." (Gorrie, 1954: 13). On the more stable slopes, the predominant soils are Red Yellow Podzolics. Although not high in nutrients, they are moderately good physically and are of relatively low erodibility. Fractures in the bedrock, however, allow considerable seepage to the lower slopes where the saturated soils may be subject to artesian pressures. In the valley bottoms, gleys and bog soils are largely devoted to paddy (rice cultivation).

Table 3.1

Characteristics of Soils, Bedrock and
Topography in the Kotmale basin

Region Sub- Region	Approx Area (km ²)	Soil Type	Bedrock	Mean Slope Angle	Final Rate of Infiltration (cm/hr)
Low Surface Flat Hilltops	50	Compacted sandy weathered gneiss	Gneiss, metasediments	12	22.4
Low Surface Hillslope	162	Hillwash, loose sandy transported soils	Gneiss, metasediments	20	32.1
Gorge Valley Floors	57	Hillwash, slightly finer and more compact than 2	Charnockite, Gneiss	20	30.0
Gorge Steep Hillside (Also eastern escarpment)	170	Skeletal soil, loose & sandy	Charnockite & Quartzite & some Gneiss	33	138
High Level Surface	15	Deep weathered sandy with thick humic horizon at surface	Predominantly Quartzite	12	175

Source: Russell, 1980: 26

FIGURE 3.1
RELATIONSHIP BETWEEN LANDSLIDE ACTIVITY
(MAINLY MUDSLIDES)
AND RAINFALL
 (No direct relationship shown between landslides
 and seismic activity)

Source: Russell, 1980: 42

No large earthquakes have been recorded to date in Sri Lanka, and seismic activity has not been responsible for landslides which have occurred in the past. It is thus unlikely that an earthquake will affect the lives of the Kotmale residents, the project structures or the Kotmale environment. These are much more likely to be affected by the activities of humans than by the geological, structural and topographical conditions inherent in the Kotmale area.

3.2 Pre-Colonial Land Use and Population

The Kotmale area has a history of habitation at least as far back as the fifth century B.C. when Prince Vijaya landed in Sri Lanka with his Northern Indian followers to found the Sinhala 'race'. Some claim there was a small indigenous population prior to this, about whom little information exists (de Silva, 1986: 7). Many villages in the area date from about 150 B.C. when Prince Gamini resided there – he was later (137 B.C.) to become one of the most famous of Sinhalese kings with sovereignty over most of the island (de Silva, 1986: 11). During this period, Sinhalese rule emanated from Anuradhapura in the North Central Region of Sri Lanka. In the tenth century A.D., after invasions and a brief period of rule by the Cola Empire of Southern India, the Sinhalese moved their kingdom capital south eastwards, to Polonnaruwa. From 1255 onward, Sinhalese kings and their people increasingly moved into the central hills of the Wet Zone until they reached Kandy. From here the Sinhalese kings maintained control over large portions of the island. Colonization, first by the Portuguese (late 16th to mid-17th century) and then the Dutch (until the end of the 18th century) had little impact on the Kandyan Sinhalese, as the control of these colonial rulers did not extend beyond the coastal region.

Throughout this period, up until the coming of the British in the 19th century, the Kandyan Kingdom, which included the Kotmale Watershed, was ruled as a feudal society, headed by a king. Villages could be identified on the basis of their overlordship but were basically similar in terms of their socio-economic organization. The state was an agrarian bureaucracy of three main levels: the monarch and royal household, the territories or provinces divided into the smaller units of villages and departments which managed specialized services. Villages maintained both paddy lands and chena lands (slash and burn agriculture). Tributes on the former were exacted by the overlords in rent in kind and in forced labour services (on the basis of caste). Feudal aristocracy held land and tribute-exacting capacity on the basis of their position in the three tier agrarian bureaucracy.

The population of the Kandyan Kingdom was relatively sparse. This is evidenced by the British Census Report of 1824 which put its population at 256,834—likely it was even less prior to 1815, and thus labour was often a limiting factor. This, combined with a shortage of cash, caused the kings to provide land as 'payment' in return for their right to exact services and produce. The kings gave out land rights that were hierarchical (not absolute) in nature, actively encouraging the opening of new land for cultivation.

The lands under this hierarchical organization from which the producers, the overlords and king had rights to the produce, were the paddy lands. Prescriptive rights were given to individuals or families when land was regularly cultivated and as long as it remained so and tributes were paid, the rights to the land remained with the family. Despite the feudalistic nature of this rainfed paddy farming it was the preferred occupation for several reasons:

. . . traditional attachment of peasants to their ancestral paddy fields, the prestige associated with wet rice cultivation as the virtually highest caste occupation, . . . the preference for the consumption of rice over other grains and the self-identity of the Sinhalese as a nation of rice cultivators.

(Bandarage, 1983: 30)

The abundance of land allowed a second form of agriculture: the communalistic high land or dry chena agriculture. The relationship between the feudalistic paddy production and the chena high land agriculture was fundamental to peasants' livelihoods. The slash and burn agriculture was crucial to peasant subsistence. All forests, with the exception of those held by the king, largely as protection against invasion, were available for cultivation by the peasants. Individuals or families cultivating the land de facto 'owned' it and its produce but, as with paddy, a system of communal labour was used. Individual land rights were vague and any uncultivated land was, or reverted to being, common village land. Overlords were unable to exact tributes on these chena 'landholdings' which grew several types of dry grains. Thus the chena lands provided subsistence security and a degree of political autonomy for the peasants. Homestead garden cultivation of fruits, vegetables and spices was another category of agriculture which contributed to peasant subsistence. Many European plants such as carrots and radishes, had been introduced to these gardens, some by the Kings' people who had travelled to the coastal region, others brought to the hills by captured Europeans (Knox, 1681: 4).

Uncultivated forest land, village owned, was also a source of supplementary, 'untaxable', subsistence from which peasants could obtain honey, timber and other forest products. Some forest areas, however, were reserved by order of the king. "All

these counties are divided each from other by great woods. Which none may fell, being preserved for fortifications. In most of them there are watches kept constantly, but in troublesome times in all." (Knox, 1681: 4)

The two principal modes of agriculture—the paddy and the chena—were closely interrelated. The former satisfied the peasant's obligation to the overlord and the king. The latter contributed to the family's subsistence. With the relative abundance of land, and the relative scarcity of money and labour, the combination of these modes of production was a satisfactory arrangement for the king, the overlords and the peasants. It also constituted a sustainable arrangement with respect to the environment. With the relatively sparse population and the abundance of land, the land under chena cropping could be allowed to recover for several years between periods of cultivation. Paddy was grown on the valley bottoms and relied mainly upon rainfall, though there were small irrigation networks operating. Most of the upper slopes and hilltops remained under the natural vegetation of tropical montane and submontane rainforest. "The hills are covered with wood and great rocks, so that 'tis scarce possible to get up anywhere, but only in the paths . . ." (Knox, 1681 : 5 & 6).

3.3 The Colonial Period (1815–1947)

In 1815, the Kandyan Kingdom became a British colony. It was politically ceded to the British by a group of dissatisfied Kandyan nobility, not militarily conquered. The British initially agreed to govern according to customary laws and institutions but as dissatisfaction among the feudal nobility, Buddhist clergy and the peasantry grew to the point of open rebellion in 1817, the 1815 Kandyan Convention

was altered by legislation in 1818 to bring the Kandyan provinces and chiefs more firmly under British control. Changes were introduced to offset the power of feudal overlords—such as a free peasantry who were required to pay grain taxes to the British administration. A network of roads was built and with the introduction of the plantation economy in the 1830s, it marked the end of the centuries-old isolation of the Kandyan Kingdom though the Kandyan Sinhalese still maintained their separate identity. Kotmale was one of the divisions of the Kandyan colony and its socio-economic setting and patterns of land use were fairly typical of the hill zone where money and markets were of little significance to the peasants during the early colonial years.

Cinnamon was the most attractive field for prospective European investors but the government encouraged other crops—the most promising being coffee.

Investors in coffee were readily accommodated in regard to loans, and waste land (i.e. jungle or scrub jungle). Coffee holdings were exempted from the prevailing taxes on land, and the export duty on coffee was abolished—all these measures originated from [Governor] Barnes who deliberately devoted the resources of the state to promote coffee culture. (de Silva, 1981: 243)

Even before 1833, some British provincial officials were cultivating coffee on the highlands using rajakariya labour—compulsory services to the state (without the traditional sanction of the King) introduced by the British after the 1817-1818 rebellion. However, such labour was deemed unsuitable for large scale plantations and for the constant care and attention demanded by coffee cultivation. When rajakariya was abolished in 1833, the expected influx of paid Sinhalese labour did not occur and

the planters resorted to importing seasonal Tamil labour from Southern India. The Kandyan Sinhalese showed little desire for these estate jobs. Two planters gave different reasons for this:

They have, as a rule, their own paddy fields, their own cows, bullocks, their own fruit-gardens; and the tending and managing of these occupy all their attention. Their wants are easily supplied, and unless they wish to present their wives with a new cloth, or to procure a gun or power and shot for themselves, they really have no inducement to work on the coffee plantations.

The [Kandyan] has such a reverence for his patrimonial lands, that were his gain to be quadrupled, he would not abandon their culture . . . Besides, working for hire is repulsive to their national feelings, and is looked upon as almost slavery. The being obliged to obey orders and to do just what they are commanded is galling to them." (Two unnamed planters quoted in de Silva, 1981: 273-74)

In 1836 alone, approximately 4000 acres of mountain forest were felled and planted. In a short time, the sale of crown lands exceeded 40,000 acres per year. (Tennei, 1856: 734). "In the six years from 1838 to 1843 . . . 130 plantations were opened up in the Central Province . . . [most] within 30 miles of Kandy." (de Silva, 1981: 269).

There was a fall in coffee prices in 1845 which jolted investors, especially when combined with the commercial crisis of 1847-48 in Britain. Other plantation crops were investigated (such as indigo, sugar, cotton, tobacco and, more successfully, coconut); however, as coffee began to recover in the early 1850s, its overwhelming success allowed it to maintain preeminence. Although tea and cinchona established

footholds in plantation districts in the 1860s, from 1850 -1880 coffee was the "catalyst of modernization" (de Silva. 1981: 282).

The rapid expansion of plantation agriculture created an unprecedented demand for waste lands. With several senior civil servants actively engaged in plantation agriculture . . . the urgency of the need to provide land for the expansion of capitalist agriculture was appreciated with greater alacrity . . .
(de Silva, 1981: 275)

Up to 1832, waste lands at disposal of the Crown were allocated on a land grant system. In 1833, the principle of selling Crown lands by auction was adopted, along with the idea of a minimum upset price (5 shillings per acre). The latter was designed to deter speculators and afford encouragement to capitalists wishing to enter into plantation agriculture. Ordinance 12 of 1840 was enacted to provide planters with the clarity of title and land tenure required for modern commerce. Above all, this ordinance was designed " . . . to prevent encroachment on government land" (Karmaratne, 1987: 36) based on the principle that all uncultivated lands belonged to the Crown. Due to clumsy wording, Ordinance 12 was amended in 1841 by Ordinance 9 which only slightly softened the negative impact implied for the peasantry by reducing the time needed for prescriptive rights to land from 30 years to 5 years. The ordinances regarding chena lands were enacted more for the sake of plantations than for environmental conservation though some more forward looking British saw them as serving both purposes. From 1836 onwards, George Turnour, Government Agent for Kandy, explained in letter after letter to the colonial office that laws:

'... could not be applied and enforced effectively to prevent the practice of encroachment on government forests in the course of chena cultivation and the felling of timber for firewood and building purposes.', practices which were '... taking away the shade to the detriment of the soil, causing erosion of the top soil and thereby making these lands unsuitable for the growth of coffee.'
(Karunaratna, 1987: 28).

Thus interest in the Kotmale environment and land uses affecting it began over a century ago. In some cases, however, it was coincidental, corresponding with a neglect of peasant interests in land sales by the government, planters and Kandyan headmen.

The British were not at all sympathetic to or tolerant of chena cultivation, seeing it as a 'backward' form of agriculture, and one which 'destroyed' the forests. The British encouraged paddy fields, garden lands and small cash crop plots. Between 1850 and 1880 they hardened the official position against chena cultivation by requiring peasants to seek government permits, increasingly difficult to obtain, for licence to cultivate chena crops. Showing some environmental consideration, no licences were given out to clear lands for chena within one mile of a road or rivers (Karunaratne, 1987: 43). Thus chena lands gradually lost their traditional importance for the peasants. The attitude of the government towards chena crops and their neglect of peasant agriculture in general, were in part responsible for the Kandyan Rebellion of 1848 (cut short by the British) when peasants voiced violent opposition to the heavy taxes the British were introducing. Ordinances and licenses alike proved ineffective in preventing peasant encroachments and the 'chena question' raged on well into the twentieth century.

By 1856, coffee plantations covered an extensive area of the Kotmale watershed (see Fig 3.2) and between 1855 and 1860, the government spent over 1 million pounds on roads, many networking the hill region for communication and market and port access. Plans were already in motion for a railway. Many of the British who travelled these early roads decribed the environment well, in their accounts of the scenery:

The road still passes through rich and romantic scenery; mountains forest clad to their summits; valleys brightened by fertilizing streams, villages and hamlets embosomed amidst trees.
(Tennet, 1856: 700)

and

. . . a prospect of indescribable beauty and magnificence; embracing far and wide mountains, forests, rivers, cataracts and plains.
(Tennet 1856: 752).

But even then the dangers of environmental deterioration were foretold, the deforestation and loss of plant and animal habitats:

The plantations . . . which fifteen years ago were concealed by the trees of the Black forest, are now fenced with roses and covered in all directions with luxuriant coffee bushes.

Pusilawa and the surrounding valleys and forests have furnished large collections of objects, illustrative of the zoology of the island; but this is a source of enjoyment of which th successors of the present generation will be deprived, by the felling of the forests and the destruction of the jungle, which now afford protection to multitudes of animals, birds, reptiles and insects. (Tennet, 1856: 753).

FIGURE 3.2
COFFEE PLANTATIONS IN
RESERVOIR WATERSHED DURING 1856
(Shaded Areas)

Source: Tennet, 1956

By the 1880s, virtually all of these coffee plantations were out of production and large numbers of Indian Tamil labourers were sent back to Southern India. This collapse of the coffee economy was due to a coffee leaf disease (*Hemileia vastatrix*) as well as an increase in Brazil's share of world supply and an economic depression in Britain during the early 1880s. Initially, when the leaf blight first appeared in 1869, yields per acre declined but as prices remained high, planters continued to expand into virgin forests at higher elevations. Competition for forest land was great and land prices rose dramatically. But prices began to fluctuate and eventually fell drastically leading to the final downfall of Sri Lanka's coffee industry. Because of the country's overdependence on this one crop, the economic development of Sri Lanka was arrested for almost a decade. The peasants in the hill region were severely affected as they did not have the money to expand production to high elevations and they continued to pay heavy taxes to the British.

In 1873 Dr. Hooker, Director of the Royal Gardens at Kew, triggered a chain reaction of concern for forest conservation when he wrote to British officials at Downing Street drawing attention to the Annual Report of the Royal Botanical Gardens at Peradeniya near Kandy. The report referred to the extensive felling of the forests in Ceylon for coffee and other plantations (Karunaratne, 1987: 60 and 80). This led to investigations and acknowledgement of diminished forests and increased erosion. In 1875 " . . . the sale of lands for coffee plantations was prohibited above the altitude of 5000 feet." (Karunaratne, 1987: 60). Thus belts of forests were reserved on either side of streams and roads and along the tops of the main ridges to prevent both soil erosion and rapid moisture evaporation. These measures were only partially effective as many such lands had already been sold and, as with the ongoing chena questions, they were

difficult to enforce. Governor Gregory studied the disappearance of the forests and blamed it on four main causes:

- 1) chena cultivation . . . after which, even if given the chance, it took 40–50 years for new forest to grow;
- 2) absence of an established system of cutting timber and replanting in the crown forests;
- 3) sale of valuable forests at inadequate value;
- 4) want of proper reserves being maintained in the coffee districts; (Karunaratne, 1987: 62)

Attempts to correct these difficulties met with continued delays and were not pursued as vigorously as possible due to the continued paralleled interests of the estate planters and the government. In the 1870s and 1880s, there was a sharp decrease in land sales and the government reduced their strict control over Crown land. But in the late 1880s, tea was found to be a very successful 'substitute' for coffee in a plantation setting. Planters initially turned to both tea and cinchone to fill the void left by coffee but the latter soon failed while tea " . . . survived to become the bedrock of the island's economy by the last decade of the nineteenth century, a position which it still holds." (de Silva, 1981: 288). There was an astonishing recovery of the plantation economy between 1880 and 1910 the pattern of dominance of tea, rubber and coconut¹ became established. Land again became a commodity in high demand and conflicts over it were between the same interest groups as during the height of coffee: planters the colonial state, native overlords, local capitalists and peasant agriculturalists. Of these interest groups, the colonial state, with the authority to plan land development, favoured the interests of the estate owners. In 1897, they passed Ordinance Number 1, "Relating to claims to Forest, Chena Waste and Unoccupied

¹Coconut plantations are most associated with the low elevation wet zone of Western Sri Lanka, rubber with intermediate elevations (1500–2500 ft. above sea level) and tea in lowland, intermediate and highland sites.

Lands," . . . in order to prevent peasant encroachments and the sale of Crown Lands." (Karunaratne, 1987: 83). This was really a reiteration of previous restrictions and came to be known as the Wastelands Ordinance. Any forests, wastelands or lands that needed several years interval between plantings (i.e., chena lands) became property of the Crown. Thus peasants were deprived of what had once been a means of subsistence—their chena lands. The large tracts of land that were expropriated belonged to both the royal and feudal villages. Overlords lost a large portion of their highlands, but for the rest they were generally granted private property rights. The peasants were the hardest hit.

Ordinance Number I was very satisfactory to the tea planters. The following passage was published in 1893:

The forest land, of which perhaps there still remains 80,000 acres, is now confined to the tops of the hills and the mountainous country [in Nuwara Eliya District] . . . It is fortunate for the planting enterprise that the sale of land at high elevations has been stopped; or the remaining forest would soon disappear in the eager rush for good estate land. There are still very large reserves of forest for timber and firewood purposes in the hands of the Crown . . . What the planters would have done when the stock of fuel on their own estates was exhausted, if these large reserves were not in existence, it is hard to say; but as it is, they will be of the greatest assistance to the tea enterprise, when the want of firewood in the estates themselves begins to be felt. (Le Mesurier, 1893: 11 & 12).

At the end of the 19th Century, most of these lands alienated by the state (except those above 1500 m) were sold to planters for tea estates. Smaller portions were sold to local elites and entrepreneurs, partially instigating the emergence of an indigenous Sri

Lankan middle class. Most of the land formerly under coffee cultivation was replanted with tea " . . . but large areas have been abandoned and unfortunately have not reverted to the original tree jungle but have remained in grass as patna" (Gorrie, 1954: 5). The extent to which erosion accompanied these replanting activities, further clearings and conversion to patna continued to be appreciated by technical officers and many planters since the earlier warnings by Dr. J.D. Hooker in 1873 (Gorrie, 1954: 5). In the late nineteenth century " . . . with the increasing population, the spread of cultivation, the natural reproduction process of the forests was diminishing due to gradual soil erosion, and would require expensive artificial aids such as modern fertilizers." (Karunaratne, 1987: 76). To cope with such problems, the Forest Department was established in 1887. It faced, however, the same constraints in enforcing its decisions as had been encountered earlier by the Colonial Government such as continued encroachments, illegal felling and demand for fuelwood.

Private property rights and contractual cash relationships were introduced into all categories of land use. Cultivators were given freehold rights to their ancestral paddy fields but many soon lost these rights due to defaults on paddy taxes. Ordinance 5 of 1866 empowered government to seize the lands of those who defaulted and to sell the lands to recover arrears of taxes on paddy and dry grain. Forced removal from the land was not done extensively until about ten years after the Ordinance was introduced. Paddy remained the most important crop for the villagers in the Kotmale Division of Nuwara Eliya District. There were 2,036 acres under rice cultivation in 1883 (LeMesuriers, 1893: 81) but rice continued to be imported due to the availability of inexpensive and high-quality rice from abroad, the inefficient production and variable quality of local rice, and the fact that the Indian labourers would not eat local rice. Chena products, principally finger millet and maize were next

in importance; however, communal village rights to high lands were eliminated by the introduction of private property rights and concepts of land as a commodity. Thus the ability of chena crops to act as virtual guarantee of subsistence, even during poor paddy years, and as a symbol of peasant political autonomy, was lost. Property and class relations began to converge. Those with property were of a higher class and economic standing. Those without had to supplement their subsistence from a dwindling supply of chena lands and from their homestead gardens.

With the full support of the British Crown, tea estates expanded rapidly through the 1880s and beyond. The Sinhalese, finding it necessary to seek supplementary income due to increases in population and decreases in chena and forest land for their use, looked to the estates for employment. Although coffee production had been possible for smallholders, tea production was more difficult for peasants to enter into on their own. Production and processing called for heavy capital investment in large factories and expensive machinery. Planters and officials, however, were unsure about the varying availability and supplementary nature of much of the Sinhalese labour who continued to attach greater prestige to their rice crops and traditional village life. Therefore, once again Tamil labourers were brought in from Southern India—first just men, then whole families. This labour importation permanently changed the demographic and social relations in the area, as most became permanent residents. Tea, as opposed to coffee, requires great care on a year round basis, so migration was no longer seasonal. The Kandyan Sinhalese were resentful of the Indian Tamils (who came to predominate on the estates), yet they were not always interested in joining them as estate labourers, for reasons similar to the ones previously mentioned in relation to coffee plantation work. Estate labour was seen as a low caste occupation and one which demanded too much time away from the preferred paddy fields and

traditional village environment.

In the last two decades of the nineteenth century and the first two of the twentieth century, population and the amount of land under estates both rose dramatically. The two were necessarily incompatible as villages became increasingly constrained by the tea estates. Conflicts between the two sectors—village and estate—became more common and more pronounced. Thus, moving into the 1920s, the government gradually came to favour some alienation of small plots for the rural landless. Restrictions on the alienation of Crown land for estate development began in 1925. These restrictions were formalized by the 1928 Land Commission.

Restricting estates and providing land to the landless was begun by the Sinhalese-dominated government when they were elected in 1931. Despite the seeming generosity of alienating land en-bloc to landless households, there were many controls imposed by the state. These included controls on land fragmentation, long-term leases rather than freehold, and liability of allottees to small annual payments. Thus peasants still did not own their land, and were now faced with but another bureaucracy. (Not until 1981, did a 'land gift' programme begin by which recipients of state land were granted full ownership.) There were some important political consequences of the land alienation procedures. The three main ones were:

- 1) Stimulus to local politicisation
- 2) National state 'soft' in relation to Crown land; and
- 3) Crown lands have never become major national electoral issue (Moore, 1985: 43)

As Sri Lankan politics developed towards and through Independence, power came to be concentrated at the national level and the British model of a welfare state was constructed. Local level political and administrative institutions lagged in effectiveness and strength.

The century of colonial rule had left the Kotmale residents with a much diminished environment. Huge extents of the highland areas of natural climax forests had been cleared first for coffee and then for tea estates. Expansion of commercial planting syndicates was largely over by the 1930s—many could already foresee what independence would bring. After this, most land clearing in Sri Lanka was done for two purposes:

- 1) government irrigation development projects
- 2) peasant resettlement by extension of existing hill villages

Both of these were important in the Kotmale area (Gorrie, 1954: 5) where population pressure and the demand for food crops were both growing rapidly. The expansion of hill villages was perhaps more important with regard to the long term degradation of the environment. The village extensions were largely carried out at the expense of remaining Crown forest. As mentioned previously, the extent to which erosion accompanied this clearing had long been appreciated by technical officers and many planters, though little in the way of enforced legislation had been instituted to prevent it.

In 1931, a Soil Erosion Committee of both officials and planters

"... fixed the blame impartially on bad land use practices which tended to expose the bare soil unduly to attack by the falling raindrops, whether in estates, smallholdings, government clearing or patna grass fires." (Gorrie, 1954: 6). The committee suggested a five year education programme to be followed by legislation. The former never did occur and the latter not until 20 years later with Ordinance No. 25 of 1951. This Soil Conservation Act was left open for rules and planning to be introduced as trained staff became available:

- a) to control or restrict the uses of land which contribute to soil erosion or the exaggeration of flood conditions, and
- b) to encourage the use of approved soil conservation methods and raise the present standard of agricultural practice.

(Gorrie, 1954: 6)

A rapidly expanding population (see Section 3.5) strained the capacity of what land was available for peasants cultivation and fueled peasant resentments against the estates. With the State's 'soft' attitude toward Crown land, peasants were able to 'mine' the fuelwood and other forest products with no one giving thought to the future consequences of these government policies and peasant actions. At the time, the environment was not a major issue in Sri Lanka, nor was it elsewhere. Giving land to the landless, giving the peasants the opportunity to feed themselves, providing education and health care—these were some of the priorities. Central politics, as well, were wrapped up in the machinations of achieving independence.

3.4 Independence to Construction of Dam (1947–1979)

Soon after independence, the government enacted several pieces of legislation to effect land reforms. Most significant for the Kotmale area were the decisive actions against the estate sector—largely based on what Moore (1985: 67) called the "Sinhalese myth of the plantation impact" which portrays the estate as the evil foe of wholesome village life. Lands held by public companies were nationalized and a ceiling on individual ownership was established (10.1 hectares irrigated land and 20.2 hectares unirrigated land). The state thus acquired 400,000 hectares, most of which went to two public sector corporations: the State Plantation Corporation and the Janatha Estates Development Board (JEDB) (Moore, 1985: 82). Thus this land transfer enabled the continued operation of tea estates—albeit at a reduced scale—and most of the short term benefits took the form of estate jobs for those with influence. The total amount of land given to villages was relatively small (63,000 hectares, approximately) and was mainly the poorer quality land. Topographic conditions and the reluctance of the Sinhalese to leave their villages and paddy lands in the valley bottoms, made it difficult for the government to translate villager resentments against the estates and Indian Tamil labour "... into stable and productive tenure reforms." (Moore, 1985: 82).

In August 1947, there were major landslides in the Kotmale area which gave impetus to plans for surveying the area and investigating possibilities for reforestation certain sections, thus minimizing the dangers of landslides for the resident population. The investigations culminated in R.M. Corrie's Report on Kotmale Landslips and Adjoining River Catchments of 1954. It was determined that although heavy rainfall might have been the immediate cause of hill slope failure, rain alone could not have caused the damage "... if conditions favourable for sliding had not been present in the

area" (Siriname in Gorrie, 1954: 10). The conditions inherent in the Kotmale area were described at the beginning of this chapter. But although there may be a natural tendency for slope failure, superimposed are conditions for which humans are responsible. An examination of these conditions in the Kotmale area in the mid-1950s will highlight the state of the environment and its vulnerability to further pressures.

Conditions imposed on the Kotmale area are directly attributable to human actions and include: forest fires, removal of forest cover on upper slopes, burning of the patna grassland, inefficient drainage of steep slopes under plantation crops, dry cropping of steep slopes for food crops, and the ponding of water for paddy cultivation on terraces above unstable slopes (Gorrie, 1954: 10). With regard to landslips, these changes often diminish or destroy the land's ability to function as a safe water storing unit. It is often difficult to assess the longer term value and effects of these factors which contribute to environmental degradation.

Some areas of forest that were originally cleared for coffee cultivation were never replanted with tea and remained as treeless patna. Although patna covered only 1600 hectares in the Central Kotmale area, (Table 3.2) its effect on the economy was great due to it being burned at least once a year. "Not only does the fire spread into adjoining forest and weaken it until it eventually becomes patna. The effect of the fire on the patna itself is to render it useless as a water filter." (Gorrie, 1954: 20). 'Useless' may be too strong a term, but it does certainly diminish its ability to trap water and to keep the heavy rains from having direct access to the soil. Surface run-off, soil and ash were washed unhindered into the river.

TABLE 3.2
Surface Cover/Land Use – 1954
for Approximate Kotmale Catchment

<u>Surface Cover/Use</u>	<u>Hectares</u>	<u>%</u>
Forest	20,403	28.8
Patna	1,634	2.3
Tea & Other Crops	31,373	44.2
Village Cultivation	5,061	7.1
Rocks & Waste	12,483	17.6
	<hr/>	<hr/>
	70,954	100.0
	<hr/>	<hr/>

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Actual area of Kotmale Catchment is 55,085 hectares;
 this data covers a more extensive area.

Adapted from Table 14 of Gorrie, 1954: 37

This treeless patna generally adjoined the upper level of the main block of tea estates. Tea was and is highly variable in its propensity for erosiveness. Drains below a well-kept, dense crop (about 14,800 bushes/hectare) generally run clear—a condition usually more typical of the larger estates. Drains from poor, sparse tea crops are filled with a rich brown mud mixture in suspension—usually a typical condition of small-holdings and divided estates. There were cases, however, where even the larger estates were in extremely poor condition (i.e., small bush size, dispersed spread of individual bushes, small number of bushes per acre and neglect of contour trenches). Improvements in maintenance were likely neglected due to the financial commitments involved and the lack of incentives or encouragement by the government.

By the 1950s it was a generally accepted principle that all new tea planting should be done in contour hedges as opposed to the old square planting system. The former had been proven to be more efficient for storing both moisture and nutrients. However, the established estates carried out very little replanting of whole fields. They generally planted the occasional new bush to fill in gaps in the old square pattern as tea bushes continue producing after they are 50 or 60 years old. Another problem was the tendency for villages to request land for housing allotments from within existing tea estates. Turned into small-holdings, the production and quality of tea suffered and erosion increased.

On the lower side of the tea estates was a belt of village land which maintained " . . . an impression of tree cover because many of the holdings are mixed gardens." (Gorrie, 1954: 17). But very little of the original natural forest was left in the lower valleys except for " . . . a few hundred acres of streamside reserve whose preservation appears to have been largely a matter of luck." (Gorrie, 1954: 17). Virtually all of the

lower valley slopes were terraced paddy fields, each narrow terrace forming a self-contained tank to hold a pond of water. This does not initially appear damaging; however, there was a tendency to use too much water in each paddy field. With no attempt to provide a drainage system to drain off surplus water safely, the field spent a large proportion of time waterlogged. The surplus water " . . . often works deep down and rots the deeper layers of montmorillonite or China clay which are transformed into a greasy slip—way over which the whole mass starts to creep or skid down the valley slope."(Gorrie, 1954: 22). This slip or creep erosion was apparent in the Kotmale valley. And it had long been known that its remedy lay in strict economy of irrigation water, storm-water drains and crop rotation. Then, as now, these are difficult to enforce.

In 1954, there were about 160 hectares (or 12% of the cultivated area investigated) under mixed gardens (see Table 3.3). This land use generally caused little erosion as the gardens were grown on partially terraced land and usually on fairly gentle lower slopes. However, even then, scope existed for better stone terracing.

Sections of the upper slopes (interspersed with patna and tea) were used by villagers for unirrigated annual crops such as maize, manioc, tobacco, potatoes and dry season rotations such as finger millet and chilies—i.e. much the same as chena crops discussed earlier. There is potential for any of these crops, or combinations of them to be grown with relatively little soil loss if the field is terraced with supporting walls of stone or turf. But grown on untterraced slopes, as most were, they can all initiate problems, causing 370–490 tons of soil/hectare/year to be lost, which represents a depth of 1/2" of top soil (Gorrie, 1954: 22).

Table 3.3
Survey of Seven Villages in the Kotmale Area
Land Use—1954

	<u>Hectares</u>
Forests (Crown/State)	51
Streamside Reservations	8
Patna	38
Pasture, Waste & Fallow	81
Landslip Areas	73
Cardamom (in association with trees)	127
Tea Small Holdings	388
Mixed Gardens	158
Unirrigated Crops	61
Paddy	340
	<hr/>
Total	1325
	=====

Madakumbura, Mawela, Tispane, Rambodagama,
 Kadadorapitiya, Delutalamada, Dunukedeniya.

Source: Gorrie, 1954.

Tobacco had become so popular at that time that smallholders were stripping steep hillsides of trees and weed cover and planting tobacco without any attempt to contour or terrace.

In pre-colonial times, and even through much of nineteenth century there had been few enough people and sufficient land for fallow years to be left between chena crops to allow the forest to come in and re-establish some fertility. But by the mid-twentieth century or earlier, the scarcity of land and population pressure necessitated the continuous cropping of the single plot of land owned by an individual. Such a plot of land will soon deteriorate and eventually be " . . . reduced to a scree of stones." (Gorrie, 1954: 23). The worst crop for hastening this deterioration was manioc, followed closely by maize and tobacco—all of which were popular with the Kotmale residents.

It had been decided earlier in the twentieth century that the form of afforestation (to both prevent soil loss and help maintain fertility) most likely to appeal to villagers was trees plus an undercrop of cardamoms (a small understory spice tree). In 1934 civil and forest department efforts led to the formation of a cooperative society geared to helping peasants afforest their land in this fashion. But success in the next few decades was limited as farmers who rented their highland plot or had short-term leases were reluctant to invest time and money. As well, there was a lack of planting supervision.

Village allotments were often carved out of the forests and patna. They tended to be on less protected steeper land and the forests around them lacked an upper canopy. In 1954 one third of the families in each Kotmale village were landless and

lived in a rented house. Of the 7,504 families in the Kotmale Revenue Division, 2723 were landless and 1463 owned less than 1.0 hectare (Gorrie, 1954: 32). This landlessness did not imply abject poverty, however, as many villagers could earn wages from neighbouring estates. Often the failure of the village extensions was due to the inexperience of these people in cultivating steep slopes and lack of extension services to help them learn.

Also on the hill tops above the main block of tea estates, was about 20,000 acres under forest, " . . . a ludicrously small percentage . . ." (Gorrie, 1954: 19) of the area of Kotmale (about 29%). Virtually all of this amount was already being reduced, badly disturbed and thinned out. Reductions were occurring for village extensions and under the Food Production (Estates) Ordinance—often on the steep slopes immediately above the tea. Disturbances which rendered the forests less effective were caused by theft, hunting, fuelwood cutting, clearance for food production and village expansion. Some sections were thinned out to be underplanted with cardamoms. Though cardamoms themselves are generally quite good for countering erosion, it was just one more instance of tree removal and forest deterioration. The fact that many of the 1947 landslips had their origins in the disturbed forests on steep slopes is evidence of their poor condition.

The Kotmale area had a slightly greater area under forests if the fuelwood plots for the estates were counted. Approximately 420 hectares of the estates were used for fuel production (Gorrie, 1954: 19). The species which had long been used for this purpose was red gum (*Eucalyptus robusta*) which gave adequate firewood yields on eight year rotation above 1220 m. However, this species had other problems associated with it, including its limited utility for timber. Thus estates were already beginning to

experiment with other species; the one which appeared most promising was *Acacia decurrens* which was seeding profusely.

Thus although there was a natural tendency for slope failures in the Kotmale area, superimposed were a variety of factors for which man is responsible. Forty years ago these factors were acknowledged:

Further deterioration of steep unstable slopes by deforestation, chena firing, etc., should be arrested. Stabilization of slipped areas and unstable slopes is achieved by proper land use by soil conservation methods.

(Gorrie, 1954: 12)

Remedial measures were known which could have accommodated all of the different land uses. The exposed ridges could have been reforested, and several areas of forest reserved for preservation. More suitable crops could have been investigated for replanting for estate fuel supplies and for using as a shade over cardamom. If it was not possible to prevent burning of the patna, then fire belts could have been cut in the steep patna to keep burning from spreading both further into the patna as well as into the forests.

Enforced regulations could have ensured that tea estates must replant a certain small area of older tea bushes each year with the new form of contour hedges. This would have lessened the economic cost of replacing huge areas of tea all at once. As well regulations regarding ownership of estates were needed as estates that changed hands often or were broken-up generally deteriorated. For tea small-holdings, some actual attempts were made to improve cultivation practices with four officers and eight instructors in the field for such a purpose (Gorrie, 1954: 21). Special steps needed to

be taken to have the ground fully covered (for example with cut mana grass) wherever spaces between bushes left the soil exposed. As well, the use of the mamoty for scraping the soil surface during weeding had to be avoided. Thus it was realized more technical and monetary assistance was needed. But this realization was not immediately put into action, or perhaps some of the current environmental degradation would not be so severe.

It was known that better paddy land practices could be achieved by three main means:

- 1) By controlling water supplies and only watering when needed;
 - 2) By ensuring every paddy block had its storm water drains separated from its irrigation inlets; and
 - 3) By alternating unirrigated crops such as vegetables with paddy to give the ground a chance to dry out.
- (Gorrie, 1954: 22)

However, to enforce any of the above measures the Irrigation Ordinance needed revision and more personnel were needed in the field.

Means by which the annual highland crops could safely be grown were also realized and there needed to be an insistence on stone terracing to support the narrow strips of fully-leveled land. Annual crops needed more than contour ditches and hedges in order to save the topsoil as they necessitate "... a complete disturbance and exposure of the surface soil at least once every harvest." (Gorrie, 1954: 18). Stone terraces were also needed for many of the mixed gardens.

It was realized that village extensions often failed due to a lack of careful planning and insufficient instruction for the people—for instance on techniques for steeper slopes and alternate tree crops for their mixed gardens besides jak and breadfruit.

All of these remedial measures were known when Gorrie conducted his investigations and his report was published in 1954. And yet the basic problems of environmental degradation due to inappropriate land use practices continued over the next three decades—as did the Kotmale area's reputation for being a landslip prone area. Many of these "should have beens" were never given active consideration and with the land use practices continuing, population pressure and the demand for food increasing—the environmental situation could only worsen.

3.5 Population Change (1871–1981)

Table 3.4 illustrates the increases in population density that have occurred in Nuwara Eliya District over the past century. Kotmale is one of five Assistant Government Agent (A.G.A.) Divisions contained within Nuwara Eliya District. The A.G.A. Division of Kotmale has, in recent years, been a large portion but not the entire area of the catchment. Due to changing boundaries and different census methods over the years (not always providing a breakdown of the District into AGA Divisions or clarifying the size of the AGA Divisions), it is more difficult to guarantee the accuracy of the figures for Kotmale AGA Division. Table 3.5 gives the most accurate information available for Kotmale and shows that population density through the years is even greater in Kotmale than in Nuwara Eliya District as a whole (see Table 3.4)

TABLE 3.4

Nuwara Eliya District—Population 1871–1981(Area = 1232.4 km²)

<u>Year</u>	<u>Population</u>	<u>Density</u> (persons/sq.km)
1871	58,787	47.7
1881	99,210	80.5
1891	110,333	89.5
1901	153,607	124.6
1911	155,462	126.1
1921	167,162	135.6
1931	235,775	191.3
1946	268,121	217.6
1953	325,254	263.9
1963	397,756	322.7
1971	450,278	365.4
1981 ¹	436,601	354.3

¹ During the intercensal period (1971–1981), the A.G.A. of Ambagamuwa was transferred to Nuwara Eliya from Kandy. The 1981 Figures found here are reduced accordingly.

Sources:

Turner, L.J.B. Report on the Census of Ceylon, 1931—Vol. 1. Colombo: Ceylon Government Press, 1931.

Ranasinghe, A.G. Census of Ceylon—1946 — Vol. 1, Part II. Colombo: Ceylon Government Press, 1951.

Department of Census and Statistics. Sri Lanka Census of Population—1963. Colombo: Government Press, 1986.

Department of Census and Statistics. Census of Population—1971—Vol. 1, Part V. Government Press, 1974.

Department of Census and Statistics. Census of Population and Housing, Sri Lanka—1981: Colombo: Government Press, 1981.

Table 3.5
Kotmale AGA Division

<u>Year</u>	<u>Area (km2)</u>	<u>Population</u>	<u>Population Density</u> (persons/km2)
1827 ¹		1,400	2.8
1901	470.6	93,476	198.6
1911	"	86,475	183.8
1921	"	91,451	194.0
1931	"	127,881	271.7
1946	211.6	67,124	317.2
1963	"	99,451	470.0
1971	"	100,311	474.1
1981	"	90,619	428.3

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Sources : Same as preceding table.

¹ Department of Census. Return of the population of the Island of Ceylon. Colombo: Government Press, 1827.

The population density of Nuwara Eliya District has climbed more than four-fold over the last century. High population growth rates which peaked at 3.6% in 1950 (de Silva, 1981: 506) throughout the island reflected the gradual decline in the crude death rate (which had fallen to 8.6 per 1000 people by 1960). But although population was increasing throughout Sri Lanka, population pressure was especially great in the Wet Zone. According to de Silva, by mid-century:

... population pressure had reached the point where the land resources of the wet zone were incapable of sustaining peasant agriculture against the competition of the plantations for land.

(de Silva, 1981: 408 and 409)

This population pressure on the land has continued to increase and in Kotmale it is especially severe. Compared to Sri Lanka as a whole, which has a population density (1981) of approximately 245 persons/km² (Census: 1981), Nuwara Eliya District has a very high density, with 354 persons/km². However, Kotmale AGA Division exceeds both of these figures, and very probably its own carrying capacity at present land management levels, with 428.3 persons/km². This is higher than the population densities in any of the other AGA divisions of Nuwara Eliya District (all in the hilly Wet Zone) as can be seen in Table 3.6. This puts serious pressure on the land, particularly when one considers: the steepness of the terrain, the percentage of land under large tea estates (even greater amounts earlier this century), and the proneness of the area to erosion and landslips. There are more and more people but less and less land for cultivation, forests for timber and fuelwood and plants and animal species endemic to the island.

TABLE 3.6
Nuwara Eliya District
Population Density by A.G.A. Division
(Rural – – 1981)

<u>Nuwara Eliya</u>	<u>Population</u>	<u>Area (km²)</u>	<u>Density (km²)</u>
Ambagamuwa	157,116	476.3	329.9
Kotmale	90,619	211.6	428.3
Nuwara Eliya	147,063	479.4	306.8
Uda Wewaheta	77,553	266.7	290.8
Walapane	93,938	269.9	348.0
Total	566,289	1703.9 ¹	332.3

=====

¹Total area does not correspond with than shown in Table 3.4 as
this includes Ambagamuwa and does not include urban areas.

Sources: Same as Table 3.4

The absolute decline in population between 1971 and 1981 is only, to a limited degree, ascribable to the evacuation of residents in the area that has been inundated by the Kotmale reservoir. Evacuees generally left the area in 1981 and 1982. Most of the decline is accounted for by the repatriation to India of stateless estate labour under the terms of the Shastri-Bandaranaike Pact of 1964 (de Silva, 1981: 528). At that time Tamils made up well over half of the population in the Kotmale A.G.A. (and almost all of the estate labour population). One cannot expect this decline in population to continue.

In 1981, only 6.2% of Nuwara Eliya's total population was urban. Thus at no time has urbanization played a major role in reducing population densities in rural areas. Throughout this century and even today, the Sinhalese attachment to ancestral lands greatly diminishes the pace of urbanization in Sri Lanka relative to many Third World countries.

This rapid population growth and high population density combined with rural poverty constitutes a major 'raison d'être' for the environmental degradation that is occurring in Kotmale (Interim Report of the Land Commission, 1986: 27). Higher populations make more demands on the resources available for subsistence and income earning activities, and as 'development' occurs in and around the area, people come to expect more than subsistence, therefore generating further pressures on the environment. This, combined with exploitive land use practices has worsened the situation as the twentieth century has progressed.

CHAPTER IV

THE KOTMALE CATCHMENT WITHIN THE ACCELERATED MAHAWELI DEVELOPMENT PROGRAMME

4.1 The Accelerated Mahaweli Development Programme

The Accelerated Mahaweli Development Programme (AMDP) is the largest development project Sri Lanka has undertaken. It is the most overt manifestation of the effort and resources Sri Lanka is devoting to improving the well-being of her population despite troubled times of ethnic conflict and a depressed export economy. Encompassing large areas and affecting thousands of families, it is hoped the benefits will touch the entire population.

The AMPD is a major water management scheme involving a series of dams, reservoirs and canals that coordinate to harness the hydroelectric and irrigation potential of the Mahaweli Ganga and adjacent river basins. Figure 4.1 shows the Mahaweli Ganga and the extent of the present project area. Originating in the Hatton Plateau, the river flows north while being joined by several tributaries—including the Kotmale Oya—until it enters the Indian Ocean near Seruwila, having travelled 315 km. The Mahaweli Ganga is thus the longest and largest river system in Sri Lanka. Where the gradient and volume of water permit, large dams and reservoirs have been constructed with aid and technical assistance from several donor countries—Great Britain, West Germany, Sweden and Canada.

The Mahaweli scheme was conceived in the late 1950s, and in the early 1960s preliminary studies were begun. In 1968 the UNDP conducted feasibility studies and soon after, the Mahaweli Programme, scheduled to occur over approximately thirty years, began in a series of steps with assistance from U.N. agencies and individual countries. In 1977, however, a 'strategy of Accelerating' the Mahaweli Programme (Attanayake et al, 1985: 54) was adopted due to increasing oil prices, rising construction costs, increasing rice imports, and a newly elected government. Within the goal of tackling Sri Lanka's most pressing economic problems, it was hoped the project would fulfill four main objectives:

- 1) Create greater employment opportunities
(In 1977, over one million people in Sri Lanka's population of fifteen million were unemployed.)
- 2) Increase food production
(In 1977, one third of the country's rice requirements had to be imported and imports of sugar, wheat, dairy products and cotton added to the drain on the country's resources.)
- 3) Generate hydro-electric energy
(At the time the project commenced, a system of rotating power cuts was being imposed and much of the existing power-generating capacity was based on fossil fuel imports.)
- 4) Improve Sri Lanka's balance of payment position
(There was a recognized need to reduce the importation of fuel and food.)

(based on Mahaweli Projects and Programme, 1987: 3)

To reach these objectives, the project was to be carried out in three over-lapping phases. The first phase consisted of the simultaneous construction of the major headworks and reservoir systems, downstream irrigation systems and related physical infrastructure such as roads, schools and health facilities. This was to occur over a very short time span of about eight years. The second phase involved the

selection and resettlement of over 750,000 Sri Lankans onto approximately 137,000 hectares of newly irrigated land to be opened in the downstream areas for agricultural development. ("The Mahaweli Ganga Development Project", 1978: 4). It also included building of social infrastructure, providing initial agricultural inputs and promoting community development. This second phase had two major components: settlement and production. These are still major foci of the project. The final phase, into which the AMDP is now moving, involves" . . . the transformation of the Mahaweli areas into major economic growth centres of Sri Lanka." (Mahaweli Projects and Programme 1987, 1986: 25). With the physical infrastructure, the given land, the irrigation, planned settlement clusters and various farmer and commercial incentives, great progress has been expected in the achievement of project objectives. And, according to Mahaweli Projects and Programmes 1987, the broad objectives are being fulfilled. The unemployment rate has been reduced, the country is on the threshold of self-sufficiency in rice, power production relative to demand is ensured until at least 1991, and the saving in foreign exchange up to mid-1987 was about Rs 3,250 million.

4.2 The Kotmale Project

The Kotmale Project is the furthest upstream of the five major headworks undertaken as part of the AMDP. It harnesses the hydro-electric potential of the Kotmale Oya with a regulating reservoir located about 6.5 km before the river flows into the Mahaweli Ganga. A series of " . . . tunnels and shafts leads the water to an underground power station (the first underground station in Sri Lanka) on the right bank of the Mahaweli Ganga another 6.5 km downstream of that confluence. (Mahaweli Projects and Programme 1988, 1987: 17). Although the main purpose of the

Kotmale Project is the provision of hydro-electric power, it also supplements the irrigation and power benefits derived from the river regulation at the Polgolla diversion and into the Victoria Reservoir (other project systems downriver from the Kotmale).

Table 4.1 shows the schedule of project completion. Construction began in 1979 and six years later power generation commenced. The power plant had to be shut down from September 1985 to March 1986 to repair leakages in the tunnel. It was reopened from March to May 1986 to meet the dry season irrigation demands downstream and then closed until December of 1987 to permanently repair the tunnel. The Kotmale Dam and Reservoir has since been capable of operating at full capacity. The Kotmale Power Plant "... generates 134 MW of power with a further 67 MW standby." When in full operation, it "... will be able to produce energy worth Rs 625 million annually." (Mahaweli Projects and Programme, 1987: 19). (This would enable the cost to be paid off in less than 17 years, as the total cost, including tunnel repairs, "... peripheral development and establishment overheads is estimated at Rs 10,240 Million." (Mahaweli Projects and Programme, 1987: 19). This is approximately US\$ 341.3 Million (Rs 30=US\$1). The Government of Sweden has given considerable financial assistance towards this—Rs 5487 Million in the form of grants and low interest loans. The "... Kotmale reservoir lies in a populated region and it inundates several important roads and villages."(Mahaweli Projects and Programme, 1985: 31), with a water surface area of 600 ha when it is at full supply level. Six main new roads totalling 48.4 km are being built to replace those flooded, and roads already in existence are being improved.

TABLE 4.1

Kotmale Project Schedule

<u>Date</u>	<u>Event</u>
1968	Preliminary Studies on Kotmale Project by USAID Final Report of UNDP/FAO
1973–1976	Feasibility of project confirmed by Water and Power Development Consultancy Service (India) Ltd.
1978	Agreement signed between Governments of Sri Lanka and Sweden. Negotiations for civil engineering works of project with Swedish firm.
February 1979	Construction work commenced with Swedish contractors and consultancy services by U.K. firm.
1981–1983	Residents evacuated from Reservoir site.
November 1984	Reservoir impounded.
June 1985	Commercial power generation commenced.
August 1985	Project ceremonially commissioned
Sep ^r . 1985	Power Plant Closed (except during March to May 1986) for repair of tunnel system.
December 1987	Power Plant re–opened.

Kotmale New Town is being built at Sangilimalama and will include administrative and commercial complexes, school, post offices, bus stand and government offices as well as provide amenities such as electricity, telephones and treated water. Overlooking the reservoir, on the right bank, an 83 m high Chaitiya (religious monument) is being built. This is hoped, in part, to compensate for the eight

Buddhist temples that were submerged when the Reservoir was filled. All of these activities are part of the Kotmale Project Peripheral Development. The resettlement of those residents who elected to remain upstream was also part of the Peripheral Development.

People from the villages flooded by the reservoir were given the option of resettling downstream on the newly irrigated lands, or in the surrounding area. Ideally, of course, these people would have been resettled " . . . in areas of similar soil capabilities, land use potentials and environmental constraints as those they are leaving." (Dasman, Milton and Freeman, 1973: 222). They would be moved as short a distance as possible, into areas not already inhabited by others. Such a situation rarely exists, however, and did not in the case of the Kotmale. The only options available to the resettlement planners were relocation in downstream areas and relocation on upland slopes. Downstream resettlement was the option most actively encouraged by the Mahaweli Authority. The settlers in the newly opened and irrigated lands were to be the foundation of the agricultural success of the project. They were provided with the lands, infrastructure and institutional support necessary for success—as measured in increased agricultural production, crop diversification and improved living standards. Resettlement of evacuees upland from the reservoir was hoped to be the option of secondary importance in the case of the Kotmale. It was the alternative offered to those families unwilling to take advantage of the benefits of downstream resettlement.

With the decision of project implementation, a socio-economic survey was conducted in the Kotmale Valley to determine the nature of the families to be affected by the construction and inundation of the Kotmale Reservoir and to set guidelines for compensation measures. Of the 2961 families who would have to be resettled

elsewhere, 2501 were within the area to be submerged, the remainder (460) being those living in the 'earthslip area' (Bulankulama, 1979: 10). In the Kotmale Reservoir area, this survey asked the resident families whether they would prefer compensation in cash and kind, cash only, or in kind only. Table 4.2 shows the results.

TABLE 4.2

Compensation Preferences

	<u>No of families</u>	<u>% families</u>
Cash & kind	2345	72.13%
Cash only	829	25.50%
Kind only	77	2.37%
	-----	-----
Total	3251	100.00%
	=====	=====

(Bulankulama, 1979: 105)

Note: Total includes landowners not resident in area.

This "... indicates the high value placed on property as a means of security and also the inadequacy for them to start life afresh solely on cash capital acquisition" (Bulankulame, 1979: 105). Thus, in the case of the Kotmale, it was decided against cash only, and in favour of cash and kind.

At the time of the survey, 82.01% (of 2429 families) expressed a preference for resettlement in downstream Mahaweli areas (System C and System II). Table 4.3, shows, however, that by 1988 not only had the absolute number of resettlers gone up dramatically, but so too had the percentage electing to remain upstream. Actual events

proved to be much different than predicted. The percentage wanting to move downstream was expected to be much closer to that found at Randenigala—Rantembe Dam and Reservoir or even at Victoria Dam and Reservoir. The advantages of moving downstream were compensation in cash and kind: 1.0 ha of irrigated land for agriculture, 0.2 ha for homestead, help feeding the family for one year (later extended to 18 months), moving assistance, land clearing, housing and latrine construction assistance and agricultural inputs such as seed and planting material free of cost. The cash and kind settlement offered to those remaining upstream was consciously less attractive: 0.4 to 0.6 ha of tea land (the amount depending upon whether it was clonal tea or seedling tea—the former more productive), 0.1 ha for homestead plus construction material and some agricultural inputs. The fact that so many remained upstream, regardless, shows their traditionalism and their attachment to their home area.

TABLE 4.3

Distribution of Evacuee Families¹

(as of June, 1988)

	Total Families Evacuated	Downstream		Upstream	
		No.	%	No.	%
	=====	===	===	===	===
Kotmale:					
Evacuees	3141	1700	54.1	1441	45.9
Earthslip Victims	768		0	768	100.0
Victoria	6017	4050	67.3	1967	32.7
Randenigala--					
Rantembe ²	1466	1250	85.3	216	14.7
	=====	=====	=====	=====	=====
	11392	7000	61.4	4392	38.6

¹ Average family size is 5.0 (rural).² Includes reservoirs, wildlife sanctuary and road cut evacuees.

Sources: Acquisition, Resettlement and Development Offices

Kotmale, Victoria and Randenigala - Rantembe.

To imply that if a smaller percentage had decided to remain upstream, as at Victoria (Table 4.3), the environmental situation and settler well-being would have been any better, is too simplistic. Even had more people decided to remain upstream in the Victoria Catchment, the problems would have been different and possibly less threatening, to the environment. The Victoria area was more developed—in terms of infrastructure, access to Kandy and hence held a greater range of employment opportunities in the first place. It was largely middle class families who lost their land there and the land they were given as compensation was located on either side of the Kandy to Mahiyangana road. This gave them an advantage in terms of accessibility and proximity to Kandy—a major town and market centre. The Kotmale Catchment had quite different characteristics. The area in which families were resettled was off to one side of the main Kandy–Nuwara Eliya road. This, combined with the more rugged relief on which settlements could be located, has made access difficult. With environmental degradation already evident in the area and such a geographical situation, even had fewer families elected to remain upstream in Kotmale, problems would have occurred while in Victoria they have been much less evident.

Table 4.4 summarizes potential upstream resettlement problems, many, though not all, of which occurred in the case of the Kotmale.

These difficulties may be made still worse if population growth places increasing pressure on the social and environmental systems of the relocation site. The cumulative impact of such problems may lead to severe degradation of both the human population and land resources of upland resettlements . . .

(Dasman, Milton and Freeman, 1973: 223)

The government was attempting to accommodate the evacuees in an area that was already over populated, environmentally degraded, prone to landslips and which lacked available land not only for conservation purposes, but for the settlers themselves.

TABLE 4.4
Summary of Problems Observed in Resettlement
of Populations from Reservoir Impoundment Areas

Environment & Resource Problems	Social & Human Problems
<hr/> <ol style="list-style-type: none"> 1. Land available for upland resettlement less productive than riverine & floodplain soils. If soils management not adequate, decline in fertility & erosion may occur. 2. Resettlement sites often productive forest land, which is thus converted to less productive agricultural uses. 3. Spontaneous resettlement in steep catchments leads to deforestation, resulting in erosion and runoff control problems. <hr/>	<hr/> <ol style="list-style-type: none"> 1. Population is exposed to new diseases to which they have little or no resistance. 2. Resettled population is in competition with previously established populations in resettlement area: land tenure problems. 3. New land tenure and ownership patterns among resettled population results in social strains, possibly eroding community ties. Extended families may be broken up. 4. Dietary shift, resulting from new food crops; possible imbalance in nutrition requirements. <hr/>
Production Problems	Management & Administrative Problems
<hr/> <ol style="list-style-type: none"> 1. In uplands, production technology based on flood-plain farming is unsuitable (different climatic and soil conditions). Temporary drop in production virtually inevitable and may be prolonged. <hr/>	<hr/> <ol style="list-style-type: none"> 1. Presettlement surveys & studies inadequate. 2. Studies made but no follow-up action programmes. 3. Inadequate notification and orientation of affected population. 4. Inadequate compensation to evacuated families. 5. Indifference to response of affected population. <hr/>

(based on Dasman, Milton and Freeman, 1973: 224)

4.3 The Kotmale Environment and Land Use in 1979–1980

In 1978 and 1979, Tippetts, Abbott, McCarthy, Stratton (TAMS), conducted an extensive environmental assessment of the AMDP areas for USAID, which included an investigation of the environment and land use in the Upper Catchment. Although they considered the Mahaweli Upper Catchment as a whole, their findings would be indicative of the Kotmale Catchment and useful in determining the nature of the environment in which the evacuees were resettled. Table 4.5 compares the TAMS findings to those of Hunting Survey Corporation conducted in 1958—the limitation being that only about 53% of the Upper Catchment could be compared (about 166,000 ha) due to aerial photograph overlap capability. It indicates the changes occurring in the two decades leading up to project implementation and the character of the area in which resettlement occurred.

The most notable changes were the decrease in area of intensive agriculture—well-managed tea, paddy and cocoa—(with the exception of coconut) from 87,000 to 63,000 ha and the reduction of forest area by half. Not only was the actual extent of forest reduced, but so too was its value with the higher yielding categories (Merchantable and Non-Merchantable Forest that is still useful for local timber and firewood needs) having been reduced from 8000 ha to 2000 ha. Not readily visible from the table is that what remained of the good timber was located in a few inaccessible blocks of Forest Reserves.

Table 4.5
Comparison of Land Use
1958-1979

<u>Land Use</u>	<u>1958</u> (<u>'000 ha</u>)	<u>%</u>	<u>1979</u> (<u>'000 ha</u>)	<u>%</u>
<u>Category I</u> ¹				
Settlement and				
Non-Agricultural Land	1	1	4	2
Homestead Garden	20	12	14	8
Cocoa	2	1	1	1
Well-Managed Tea	70	42	55	33
Paddy	15	9	7	4
Non-Productive Forest	10	6	7	4
(local fuelwood)				
Non-Merchantable Forest	6	4	1	1
(local timber and fuelwood)				
Merchantable Forest	2	1	1	1
Forest Plantations	1	1	1	1
<u>Category II</u>				
Coconut	4	2	5	3
Orchard	*		*	
Permanent				
Dry Cropping	12	7	29	17
Shifting Cultivation	12	7	12	7
Savanna or Patna	11	7	3	2
(grasslands)				
<u>Category III</u>				
Poorly-Managed Tea	--		3	2
Abandoned Tea	--		6	4
Scrub	--		17	10
TOTAL	<u>166</u>	<u>100</u>	<u>166</u>	<u>100</u>

* Less than 500 hectares

¹ Category I: 'favourable' land uses (environmentally/economically)

Category II: partially 'favourable' land uses

Category III: 'unfavourable' land uses

Source: Hunting Survey Corporation (1961); TAMS (1980)

Lands under adequately managed tea were reduced from 42% to 33% of the comparable land area while poorly managed and abandoned tea areas increased dramatically and there was some conversion of lands to dryland farming and scrub. Plantations remained about the same in extent, indicating the opening of new areas when older areas are abandoned. The 17,000 ha of scrub mapped in 1979 was not shown on the 1959 maps—and is likely the result of forest clearings plus the abandonment of some tea and dryland farming areas. Table 4.6 shows the dramatic increase in erosion rate that occurs as one moves to progressively less 'favourable' land uses. Admittedly this table contains generalizations, for instance not all crops have the same erosion rates, however, it does serve to indicate basic changes. The area under towns increased four-fold—though this may be less applicable to the Kotmale than to the Upper Catchment as a whole.

TABLE 4.6

Representative Rates of ErosionFrom Various Land Uses

<u>Land Use</u>	<u>Erosion Rate</u> (MT/km ² /yr)	<u>Relative to Forest = 1</u>
Forest	8.5	1
Grassland	85	10
Cropland	1,700	200
Harvested forest	4,250	500
Construction	17,000	2,000

Source: U.S. Environmental Protection Agency, 1973

Table 4.7 gives a more complete picture of what was occurring in terms of land use over the Upper Catchment as a whole (239,400 ha) in 1979. It also shows that over 75% of land use was occurring on slopes of greater than 21%, thus implying greater erosion and soil loss than on gentler slopes. As well, over 40% was occurring on the reddish brown earths--the soil type (of the three most common in the Upper Catchment) with the greatest susceptibility to erosion. A comment in the TAMS Report indicates the problems investigated by Gorrie and his recommendations of 1954 had not been acted upon "... if left unchecked, the rate of erosion will continue to increase and land usage in the upper catchment will steadily deteriorate." (TAMS, 1980: Vol.1, 25).

TABLE 4.7
Upper Catchment Land Use Area Summary
(hundreds of hectares)

Land Use Category ¹	<u>Soil and Slope (in degrees)</u>										
	Reddish Brown <u>Latosols</u>			Red Yellow <u>Podzolic</u>			Reddish Brown <u>Earths</u>			<u>Total</u>	<u>%</u>
	<u>0-20</u>	<u>21-40</u>	<u>41+</u>	<u>0-20</u>	<u>21-40</u>	<u>40+</u>	<u>0-20</u>	<u>21-40</u>	<u>41+</u>		
I	163	24		63	606	3	195	402	2	1458	60.9
II	41	38	*	46	143	7	43	226	*	544	22.8
III	6	48	4	13	143	13	5	124	27	383	15.9
Water	2			2			5			9	0.4
Total	212	110	4	124	892	23	248	752	29	2394	
%	9	5		5	37	1	10	32	1		100

¹ Refer to Table 4.5 for definitions.

* Less than 50 hectares

Source: TAMS, 1980

Table 4.8 shows that the Kotmale Catchment as a sub-unit was no better off than the Upper Catchment as a whole. Over 40% of the Kotmale Watershed was under poorly managed tea, patna, degraded forests, scrub and barren lands - none of which are conducive to preventing erosion, landslips or to maintaining the environment. Poorly managed tea consists of widely dispersed older bushes that leave large areas of land directly exposed to rainfall and the resulting runoff. Patna is patchy grassland which is occasionally burned, leaving the soil exposed. Even if not burned, grassland still has high erosion rates compared to forested land, as Table 4.6 showed. Degraded forests are ones that have been largely thinned out and patches of which have been cleared for homesteads. Scrub land lies, in the progression of degraded land, between patna and degraded forests as it is grassland with scattered bush vegetation. Barren lands are rocky lands and rock outcrops. Part of the harm in these land uses comes from the steepness of the slopes on which they occur. As well, none of them is even partially redeemed by being economically beneficial.

Thus the Kotmale Project was built and the evacuees resettled in an area already environmentally degraded. Over the past century and a half, a complex interaction of cultural, political and economic forces had created a man-made environment in the Kotmale Catchment that was deforested, and likely populated beyond the carrying capacity of the land.

Critics condemn the Mahaweli Authority for not being more aware of this situation when planning the Kotmale Project—or of the environmental effects of any

part of the AMDP. As Jayalath (1983) says:

Engineers and ecologists are in agreement . . . comprehensive pre–investment studies of all possible environmental impacts can reduce the number of future problems once dam and reservoir construction have begun . . . In spite of this importance, most of the resource development projects in Sri Lanka have begun with little consideration to these aspects. The Accelerated Mahaweli Development Project is no exception.

(Jayalath, 1983: 120)

Neither CIDA nor the Swedish International Development Agency (SIDA) can be blamed for this omission. CIDA was initially involved in the Madura Oya area which was covered in the downstream emphasis of the TAMS environmental assessment. It was not until very recently, post–dam construction, that CIDA became involved in the Kotmale area. SIDA committed to the Kotmale after work had already started as the GOSL started using commodity aid and single sourced the project (SKANSKA), rather than using competitive bidding. However, although critics may be correct in condemning the AMDP planners for not conducting an environmental impact assessment prior to the project implementation decision, it is difficult to judge the differences such a study would have made to the way in which the project was carried out. The national benefits foreseen from the AMDP were great and considered, by the government, worth the potential future local costs. This can partially be explained by value systems of governments which generally place economics and politics higher in rank than they do the environment. The TAMS/USAID report was a thorough environmental assessment which, although conducted too late to influence actual project implementation, did affect conservation areas, wildlife corridors, and highlighted potential problems extension workers would face in the downstream areas.

TABLE 4.8

Land Use in Kotmale Catchment

<u>Category</u>	<u>Land Use Type</u>	<u>Extent (hectares)</u>	<u>Percentage</u>
I	Settlement and Associated Non-Agricultural Land	1344	2.5
	Homestead and Market Gardens	2464	4.4
	Well Managed Seedling Tea	6304	11.5
	Clonal Tea	4048	7.4
	Terraced Paddy	1200	2.2
	Government Farms	32	—
	Dense Forests TOTAL	<u>11048</u> 26438	<u>20.2</u> 48.2
II	Small Holding Tea	2160	3.9
	Patna	3180	5.8
	Small Holding Mixed Crops TOTAL	<u>32</u> 5372	<u>—</u> 9.7
III	Poorly Managed Seedling Tea	10992	20.0
	Degraded Forests	6208	11.4
	Scrub Lands	2736	5.0
	Barren and Rocky Lands TOTAL	<u>816</u> 20752	<u>1.5</u> 37.9
	Water Bodies	2521	4.4
	TOTAL	<u>=====</u> 55085	<u>=====</u>

Source: Department of Irrigation, 1979

2 OF 2

MicroD

The TAMS/USAID report correctly foresaw many of the potential environmental difficulties that would have to be dealt with in the Upper Catchment and commented that the "Erosion impacts in the upper catchment are not a direct result of the proposed Accelerated Program . . ." (TAMS, 1980: Vol.1, 25), a fact that seems forgotten by some critics. To accuse the AMDP of causing the erosion and environmental degradation would be much too simplistic and erroneous—making the Kotmale Project and other upstream projects the scapegoats. Chapter II demonstrated the role of colonial land policies, the estate sector and population pressures in causing the current environmental problems.

The TAMS/USAID report forewarned project planners of difficulties the settlers and those already resident in the Kotmale Catchment would face. It proposed an 'acceptable' rate of erosion (in terms of reservoir operating life) of 10 metric tons/ha/annum (TAMS, 1980: Vol.1, 25). Provided the land is under well-managed land uses, on slopes of less than 20%, annual soil losses are generally much less than 7.0 mT/ha/annum (TAMS, 1980: Vol.1, 25). But the authors were aware that much of the land area was already exceeding the 'acceptable' quantity of soil loss—much of the land was under poorly-managed land uses and on slopes greater than 20%. There was a range of land uses (seen in earlier tables) which all varied from well-to poorly-managed. The TAMS/USAID study called for environmental improvement and a longer project life through an increase in area under better-managed land use classes.

The land given to the settlers upstream was not of the highest quality. Government tea estates (STC and JEDB estates) divided off portions of individual tea

estates to be subdivided into plots for the settlers. The government estates did not give up their prime tea lands or well-terraced areas. Instead they portioned off sections of deteriorating tea, abandoned tea, scrub and lands of difficult administration. Thus many settlers started at a disadvantage in terms of land quality.

The Mahaweli Authority partially tried to counteract such problems by ensuring the land for the settlers was in blocks of such a size that the families being moved to them would be forming their own new 'settlements' in which farmer initiatives could be encouraged and infrastructure could be set up to service them. Figure 4.2 shows the location of the seventeen new settlements and the number of families who were accommodated in each of them. (Balapokuna, Nugawela and Riverside will provide a more detailed study of land quality, land use and associated environmental problems in the following chapter.)

However, such 'strategies' could not prevent the problems which would almost inevitably occur on such degraded land in an area whose population carrying capacity had long since been reached. The incoming settlers were traditional and their decision to remain upstream was more than an indication of attachment to homelands. It was also symptomatic of settlers unwilling to take risks. Yet to be 'successful' in their new settlements involved taking chances and experimenting with new crops. In the Kotmale Valley, these new settlers had previously largely been rice farmers. Table 4.9 shows the land use in the area that was submerged, from whence these settlers came.

FIGURE 4.2

Movement to New Settlements

Table 4.9
Land Area To Be Submerged, 1979

	<u>Total Area (hectares)</u>	<u>Percent</u>
Paddy ¹ Land	532.3	24.5
Highland	1610.3	75.5
Total	2133.6	100.0

Source: Adapted from Bulankulame, 1979: 68

Paddy was the principal 'temporary' crop (more than one crop can be planted and harvested each year) and the most important one to the families' well-being. The principal permanent crops were tea and coconut—which gave some farmers experience with tea though it did not prepare them for the poor, sparse tea bushes they were given on the hillsides. The main subsidiary crops in the valley were coffee, arecanut (beetel palm) and kitul (kitul palm), cloves, pepper and cardomom (Bulankulame, 1979: 101). Although these could all be grown in their new settlements, all such crops require four to eight years to reach a level of production that would sustain a family and all require planting stock, fertilizers and other agricultural inputs that represent serious costs to the new settler. Yet training and extension services were not immediately available for the settlers, so inappropriate land use practices were begun which further degraded already poor land. It was only after 1984/1985 that Mahaweli Authority administrators identified the need for urgent action. The compensation payments had been used in disparate ways, employment opportunities associated with dam and road construction were rapidly declining and residents were increasingly vocal in their complaints.

¹Paddy is the actual rice 'plant' as it is growing and as it is harvested (before the removal of rice grains from the husk).

Actions had to be taken when it was seen that settler incomes were deteriorating as was the land on which they had settled. The creation of new 'settlements' does not inherently imply employment opportunities, credit and marketing facilities, physical and institutional infrastructure unless some effort is made to provide them, or at least start their development. Unable to cultivate their land successfully and faced with a deteriorating environment (partly self-induced, partly a 'given' at the time of settlement), the settlers needed government support and development efforts to improve or even maintain their quality of life.

Population pressure on the environment, which, combined with poverty, was at the root of many problems, was further increased after the landslides of 1986. It was largely from these landslips that the number of landslip victims predicted to need resettlement (460 families) rose to the actual 768 families (refer back to Table 4.3). The occurrence of these further landslides was indicative that few of the suggestions made by Gorrie and others earlier this century had been acted upon. Soil Conservation and Forest Acts and Ordinances cannot be effective in preventing environmental degradation unless they are acted upon and enforced. The 1986 landslides brought this fact, once again, to the attention of government planners and to environment conservationists.

The economic and environmental problems being faced are not unique to the new settlements. The older settlements—those already in existence on the hillsides prior to the Kotmale Dam—were just as badly-off. Some of the activities associated with dam construction benefit both the new and the old settlements. These include the roads being built and electricity lines installed which must often run through the old towns as they connect the new settlements. However most of the additional

programmes instigated by the Mahaweli Authority (local level infrastructure, agricultural inputs, training programmes) focus on the new settlements for which the Mahaweli Authority has some direct responsibility or the ability to instigate programmes. This may create some animosity and misunderstanding toward the Mahaweli Authority on the part of the older settlements as their conditions are often just as poor and their environment just as degraded as those in the newer settlements. This could prove to be a major constraint when dealing with environmental issues. The Mahaweli Authority, with little influence in the older settlements, may find it virtually impossible to promote or enforce soil conservation, reforestation initiatives, or better land use practices in general. There have recently been some attempts to combat this dichotomy and feeling of resentment and to make the older settlements feel a part of (and recipient of) the development process. An example is treacle bottling. Treacle comes from the sap of the kitul palm which grows readily on the Kotmale hillsides and is environmentally less damaging than many crops. (The roots aid in soil conservation and moisture retention.) This is an enterprise which can benefit both old and new settlements and raise family incomes.

Although the 'integration' of new and old settlements may take many years (for in part it must certainly be a natural process), it must be hoped that the integration of development in terms of quality of life and income improvements with environmental 'conservation' or 'enrichment', can be made much sooner through all the settlements in the Kotmale Catchment. Environmental programmes may first focus on the area immediately peripheral to the reservoir and in the new settlements in particular. But the understanding, information, and actions they promote can radiate out from there through the Catchment, it is hoped by development planners.

Thus, although the Kotmale Project may have exacerbated environmental problems in the area through increased population pressure on the land, it has also brought the problems to the attention of development planners. The factors responsible must now be addressed, not merely the symptoms. Lauterjung and Platz (1985) summarize these factors as follows:

- 1) Pressure of population on vacant areas, due to population increase, lack of appropriate new settlement alternatives, lack of non-agricultural employment opportunities
- 2) Vulnerability of the ecological system due to high intensity rainfalls and high share of steep areas
- 3) Changing economic conditions, for example . . . lacking fuelwood supply, unfavourable market development for tea
- 4) Weak institutional framework. . . no strong public institutions assuming responsibility for resource protection; no effective political backing; lacking allocation of public funds for institutions and protective measures; existing laws and rules not enforced sufficiently; NGOs not yet strong enough to fill this gap
- 5) Dominance of short-term . . . economic use of resources, due to resource protection [is] not . . . a political bestseller; licenses for felling trees depend largely on political influence and are exploited excessively when . . . granted; land ownership is frequently not [fixed] so that farmers have no interest in long term protective measures

(Lauterjung, H. and H. Platz, 1985)

The Land Commission (1986) agrees that it is these factors, combined with rural poverty, that are the crux of the problem. Although all of these factors play a role, the Kotmale area is likely most influenced by the population pressure and the vulnerability of the ecological system which now necessitates careful land use planning. The

short-sighted use of economic resources and the changing economic conditions were presumably more important in the past though they still are relevant. The institutional framework has been much strengthened in recent years though more definition and coordination of roles of the various departments, agencies and institutions is still needed.

It was hoped some of these factors could be addressed alongside or within the AMDP—though admittedly some did not become apparent to development planners until after the Kotmale Dam had been constructed, and the people resettled on the hillsides. The first and latter points might not have become nearly so blatant if such a large number of families had not decided to remain upstream. If the expected number had resettled downstream, the more optimistic outlook of TAMS regarding increases in well-managed land might have been more feasible. As it was, the development process merely served to accelerate the environmental degradation already occurring by not initially paying enough attention to the consequences of placing more people on already overpopulated, degraded land.

4.4 The Experience of the AMDP to 1988²

Critics of the AMDP can point to local 'balance sheets' such as that of the Kotmale Catchment and build up the negative column with such items as deforestation, soil erosion, flooded valley farmland and unexpected costs of tunnel repairs. But the AMDP was geared to meet an important set of national objectives with the realization

²Figures and data used in this section have been obtained from the Planning and Monitoring Unit of the MASL.

that such local shortfalls and unanticipated expenses might occur along the way. It is thus necessary to turn back to the macro-scale and gain a perspective on what the AMDP has achieved in its first eight years.

One of the most notable achievements of the Mahaweli Programme has been in the area of hydropower development. By the end of May 1988, 5355 GWH of electricity had been generated. In 1986, the AMDP produced 49.3% of national power output. In 1987 this declined to 31.3%, but this decrease was due to a nationwide drought and, as discussed earlier, the closure of the Kotmale power house for tunnel repairs. If one uses the fuel price per KWH in 1987 of Rs.1.84, foreign exchange savings (from fuel no longer imported) through May 1988 could have amounted to Rs.9.85 billion (or U.S. \$ 320 million). Admittedly, this figure must be interpreted with caution as the price of crude varied over time, the value of the rupee varied over time and capital costs for both thermal and hydropower generation have been ignored. However, it does serve to indicate the huge savings achieved. If one considers the modest power generation of the AMDP in 1987, savings of foreign exchange that would have been needed for fuel imports were equivalent to U.S.\$51.3 million. This was during a year when import oil prices to Sri Lanka increased and the exchange rate varied between 28.6 and 30.7 rupees to the U.S. dollar.

The second major goal of the AMDP was to increase food production and, in particular, to become self-sufficient in rice. The contribution the Mahaweli has made in this regard, is more easily documented. With a national population of approximately 16.3 million and per capita rice consumption of 110 kg per annum, the estimated 1988 requirement is 1.8 million metric tons of rice (or approximately 2.6 million metric tons of paddy).

Paddy production in the Mahaweli areas went from 81,815 mT in 1981 to 325,714 mT in 1985—this was a 300% increase—and production has continued to rise since then (Aboosaly, Daily News, Dec.24, 1987: 13). By the end of 1986, 5.9% of the total land area under paddy in Sri Lanka fell in the Mahaweli areas and it "... contributed 8.4 percent of the total paddy production ... "(Daily News, Dec.31, 1987: 12). In the crop year 1987, the total contribution of the Mahaweli Project³ was .9% of national paddy production and national rice imports declined to 146,000 mT (paddy equivalent) from 314,000 mT (paddy equivalent) in 1986. Of course not all of this decline is directly attributable to the AMDP. Although the Mahaweli yields were 4.8 mT/ha in 1987, rice yields nationally have improved from 2.8 mT/ha in 1979 to 3.6 mT/ha in 1987. As well, some smaller projects have also played a role in increasing paddy output. However, much of the increase is attributed to the irrigation provided to the newly opened agricultural lands in the Mahaweli areas. Table 4.10 shows the percentage of national production coming from the project areas. Prior to irrigation, much of these areas were used only for chena crops or for one crop of rice per year.

³The 'Mahaweli areas' include 'new' lands, lands receiving supplementary irrigation waters and the Uda Walawe Special Area in the south.

TABLE 4.10
Mahaweli and National Paddy Production

Maha ⁴ Season	Total Mahaweli Production (MT)	National Production (MT)	Percentage of Mahaweli Production
1978/79	40,572	1,393,529	2.9
79/80	57,976	1,453,830	4.0
80/81	91,504	1,522,876	6.0
81/82	82,759	1,363,243	6.1
82/83	176,592	1,785,924	9.9
83/84	163,957	1,353,354	12.1
84/85	215,675	1,751,025	12.3
85/86	236,888	1,688,138	14.0
86/87	269,814	1,377,812	19.5
87/88	252,578	1,560,724	16.7

Source: Ministry of Mahaweli Development, 1989

However, considering the contribution of the Mahaweli downstream areas (ie. not including the Uda Walawe Special Area), in the 1987 crop year, using the average price of imported rice, they provided a saving of approximately U.S.\$62.5 million that likely would have been spent on rice imports. It should be noted that as irrigation is extended in the downstream areas (particularly in Systems B and C), the contribution of the Mahaweli Project will increase. This will be very important as the goal of rice self-sufficiency represents a moving target. With the national population increasing at 1.7% to 1.8% per year⁵, there is an additional requirement of approximately 45,000 mT paddy per year, at least in the short term.

⁴Maha is the major crop season during which most of the annual rainfall occurs. Yala is the 'minor' crop season during which there is little rainfall.

⁵According to the Census Department, the annual population growth rate between 1971 and 1981 was 1.7%. The growth rate continues to be low because of violence, out-migration and deteriorating rural health care.

Crop diversification was also an important component within the goal of increased food production. Subsidiary food crops and export oriented crops have made steady progress in the Mahaweli areas, particularly in the Yala season. The Mahaweli Authority actively encourages such diversification—to assist in increasing settler incomes and to stimulate employment opportunities for the second generation. Forty-three percent of the country's demand for chilies is met from the Mahaweli areas, and large quantities of cowpea, maize, black gram, red onions and Bombay onions are also produced (Aboosally, Daily News, Dec.24, 1987: 13). One estimate by the Planning and Monitoring Unit of the MASL, is that such crops had a gross value in 1987 of approximately Rs. 650 million or U.S.\$21.9 million.

Other activities within the AMDP, including livestock rearing, dairy production, homestead gardening and fisheries in tanks and reservoirs, also generated valued output that is directly linked to the Mahaweli Programme and its economic and financial costs. A conservative estimate of the value of gross regional output would place the figure at approximately U.S.\$150 million in 1987. This further food diversification also promotes better nutrition for the settler families. These activities also contribute to another major goal of the AMDP—the alleviation of the chronic unemployment that existed throughout the country in the late 1970's.

To identify the contribution of the Mahaweli Programme to this target is extremely difficult. Obviously, the construction phase recruited and employed (and in many cases, trained) large numbers of Sri Lankans. In December 1983, 23,453 Sri Lankans and 604 foreigners were employed on the project. However, the most important, long term contribution (to this particular goal), will be in permanent

employment creation in the downstream agricultural areas. To the end of May, 1988, 52,500 farm families and approximately 6000 non-farm families had taken up residence in the downstream areas. Of these, 12% represent evacuee families from upstream areas (3% from the Kotmale Catchment) while the balance are resettlers and electoral selectees from various areas of the country. An unknown, but likely high, percentage of these settler families were to various degrees 'unemployed' or 'underemployed' (meeting subsistence or just slightly beyond) in their areas of origin. A Census survey of System 'H' area, carried out by the PMU in July and August of 1986 indicated that there were 1.4 persons employed per settler household in agriculture (78%) and non-agricultural (22%) activities. Using these figures, one can estimate the creation of 81,900 jobs. This is obviously an underestimation as outsiders—such as transporters, market vendors, food processors and other occupational categories—have experienced an increase in employment opportunities either directly or indirectly related to the Mahaweli investment. As well, such figures do not show the increases in incomes. A study of the Left Bank in System 'H' showed that farm incomes of settlers were almost two and a half times the incomes of the area's pre-project inhabitants. As well, more than " . . . 60% of the settlers had incomes exceeding those earned by 98% of the rural population in Sri Lanka."(Gunathilake, Daily News, Dec.24, 1987: 13).

However several factors, most particularly the ethnic conflict which escalated beginning in July 1983, have contributed to the current high levels of unemployment and underemployment. Thus while it may be said that the AMDP has made a substantial contribution to job creation and thus the alleviation of unemployment, no investment project could make major inroads in unemployment in Sri Lanka in the face of the current social insurgency (which is manifested in actions, such as the closure of

the universities, with far-reaching implications).

The foregoing paragraphs indicate that while the targets of 1979 had not been entirely met by the end of 1987, the AMDP had contributed greatly toward their achievement—especially in terms of hydro-power and food production. Up to the end of 1987, approximately U.S.\$1.8 billion had been spent on the AMDP, making significant progress of a set of national economic aspirations perceived and articulated as early as 1977. This figure includes major headworks (such as dams and reservoirs), downstream development and settlement costs plus the financial compensation paid to evacuees. The cost also includes socio-economic overhead costs such as schools, post offices, health centres, hospitals, roads, village centres and townships. Many of these expenditures would have been required over the past eight years even without the construction of the Mahaweli Project. These costs (the U.S.\$1.8 billion) were met by donor grants (30%), donor soft loans (30%) and local resources (40%). Approximately 50% of donor grants and loans was spent out of the country—on foreign equipment, materials and technical assistance.

One major concern with the AMDP is that, after eight years, there continue to be delays in meeting the national objectives. Some reasons for this have already been mentioned; others include unrealistic initial scheduling, physical factors and bureaucratic delays. While consideration of individual causes is beyond the scope of the present paper, it is suspected that all of these forces have been factors. However, the preceding paragraphs have shown the progress the AMDP has made despite such delays. Many parts of the Mahaweli Programme are still young, and many are still

underway. Thus there are still years ahead over which the AMDP's progress will be monitored and over which it will likely prove to be even more valuable in producing hydro-power, increasing food production, saving foreign exchange and alleviating unemployment.

CHAPTER V

Current Situation in Three Specific Settlements

5.1 Introduction

To consider the possibilities for promoting both environmental enhancement and settler well-being, it is useful to look at the land uses emerging in the new settlements. It is in these settlements that environmental programmes may focus and from which environmental awareness may emanate. The concentration that has been given to vegetation and soil cover when discussing the environment stems from this need to focus on what land uses do to affect the environment as it principally concerns the Kotmale residents, the Mahaweli Authority and the development objectives.

Three specific settlements are used to see how the settlers are making use of the tea lands they had been given. All three are located in the area immediately peripheral to the Kotmale Reservoir. This area is seen to be the most important in the Kotmale Catchment in terms of project effectiveness. The soil erosion and siltation that accompanies the clearing of land and changes in land use in this peripheral area could ultimately be a significant cost to the Mahaweli Project's effectiveness and the life-span of the system reservoirs. Thus good land use practices and environmental management are important in allowing full achievement of development objectives.

The selection of three specific settlements was guided by four main concerns. The first was accessibility. Nugawela is located just north and less than 1 km west of

the Kotmale Reservoir. Riverside is about 0.5 km further west of Nugawela. Both are on the main Gampola–Kotmale Dam Site road. Balapokuna is located slightly north and about 0.5 km from the easternmost edge of the Kotmale Reservoir. Portions of Balapokuna border the main Gampola–Nuwara Eliya Road, other portions border the Pundaluoya–Tawalamtenna Road. All three settlements are on the Right Bank of the reservoir—the most accessible by vehicle from major roadways (see Figure 5.1).

The second concern which the choice of the settlements addresses is data availability. To look at any of the older settlements would involve data gathering beyond current resource availability. It is only for the seventeen evacuee settlements that the Mahaweli Authority has up-to-date and comprehensive data available—namely the 1:4000 scale land-use maps carried out for the Upper Mahaweli Peripheral Development Unit in April and May of 1988 and the socio-economic surveys of December 1986.

Thirdly, also addressed by the three settlement focus, is the need for more detail in land use considerations. A larger area, such as the Kotmale Catchment or such as all seventeen new settlements, would mean reduced detail and possibly lessen the effectiveness of the case study approach. The settlement scale, when each one consists of between 25 and 63 families, provides more insight relative to what the settlers are doing with the land they have been given. Most have been resettled for at least five years—time enough to indicate the type of land use changes that are emerging. Land use data for the three specific settlements will show the extent and nature of land use changes in these former tea areas.

FIGURE 5.1

NEW SETTLEMENTS

IN THE KOTMALE CATCHMENT

Finally, the dynamic nature of the new settlements allows documentation of the changes that have occurred since resettlement. Land use patterns in the old settlements have been much more static over the last few decades and were not greatly affected by the Kotmale Dam and Reservoir scheme. The new settlements and accompanying land use changes, however, are a direct result of the development project. The dynamism of the settlements chosen for specific study is a very important component of their utility as case studies.

5.2 Land Use Patterns

Figures 5.2, 5.3 and 5.4 show the location of Nugawela, Riverside and Balapokuna relative to the main roads, the Kotmale River and the Kotmale Reservoir. All three fall on "steep to very steep mountain and ridge slopes with moderate to high elevation range" (Land Use Division, 1986: Land Unit Map). The exception to this is the southern portion of Balapokuna which lies on foothills. The dominant slope range is 30–60% though the steepest slope may be up to 90%. Slopes in the foothill area range between 16 and 30%, though the steepest slope could be up to 60%. All three of the settlements are dominated by the red yellow podzolic soils. These soils are classified as the second most susceptible to erosion (see Table 5.1) of the three main soil types found in the Kotmale Catchment. Red yellow podzolic soils are more prone to erosion than the reddish brown latosols, but less prone than the reddish brown earths.

FIGURE 5.2

Riverside

1: 31680

FIGURE 5.3

Nugawela

1: 21120

Figure 5.4

Balapokuna

1: 63360

TABLE 5.1

Annual Soil Loss From Erosion
(Metric Tons per Hectare)

<u>Soil Class/Slope</u>	<u>I</u>	<u>Land Use Class</u> <u>II</u>	<u>III</u>
Class I			
<u>Reddish Brown Latosol</u>			
0 - 20%	0.3	3	21
21 - 40%	2	22	138
41% +	5	50	321
Class II			
<u>Red Yellow Podzolic</u>			
0 - 20%	0.4	4	27
21 - 40%	3	28	178
41% +	6	65	415
Class III			
<u>Reddish Brown Earths</u>			
0 - 20%	0.5	5	33
21 - 40%	3	34	218
41% +	7	80	570

=====

Source: TAMS, 1980

The rock cover in all three settlements falls in the 0–10% category (Land Use Division, 1986: Land Unit Map). The exception to this is the northern half of Balapokuna which falls in the 10–20% rock cover category. The physical characteristics of the three settlements indicate that although the settlers were given land on steep slopes, the soil and rockiness of the land was not as bad as it is in many parts of the Kotmale Catchment. The information also indicates that most land uses are feasible given adequate terracing, supporting stone walls, contour planting and maintenance of a reasonable ground cover.

Table 5.2 gives the land use in the three selected settlements. It is evident that although all three have a large proportion of their land in teas (34.1% in Balapokuna, 45.1% in Riverside and 66.3% in Nugawela) only a small percentage of it is in the highest quality tea. Only Nugawela contains Tea 1 (and it only 6.6%), the highest quality tea land on which at least 80% of the cover is well-maintained tea. Tea 1 falls in Land Use Class I on Table 5.1 due to the high percentage of cover and the good drains and culverts that generally characterize this land use. Tea 2 is the second highest land use category in Nugawela and the third highest in Riverside. It is moderately good tea land where there is 60–80% surface cover of tea. This may have been Tea 1 a few years ago, but neglect or over-picking has resulted in its degradation since.

TABLE 5.2

Land Use in Three Selected Settlements
(in hectares and as a percentage)

Land Use	Nugawela		Riverside		Balapokuna	
	ha	%	ha	%	ha	%
Tea 1	2.21	6.6	—	—	—	—
Tea 2	8.29	24.9	3.00	13.6	0.44	1.8
Tea 3	9.57	28.7	6.51	29.7	4.75	19.2
Tea abandoned	2.04	6.1	0.40	1.8	3.23	13.1
Tea 3/Scrub/Grass	4.64	13.8	2.12	9.7	0.91	3.7
Tea abandoned Grass/Scrub	1.62	4.8	2.32	10.6	0.46	1.9
Minor Export Crops (mec)	0.17	0.5	0.52	2.4	—	—
Tea 2/Tea 3/Tea ab mec/palms/fruits and vegetables	3.22	9.5	6.84	31.2	4.81	19.4
Vegetables/Fruits/ Tea 3/Tea ab	0.76	2.3	0.23	1.0	0.66	2.6
Forest	0.95	2.8	—	—	—	—
Paddy	—	—	—	—	3.84	15.6
Bare Land and Public Land	—	—	—	—	1.12	4.6
Land Reform Commission	—	—	—	—	4.47	18.1
TOTAL	33.47	100 %	21.94	100%	24.69	100%

=====

The three highest land uses for each settlement are highlighted.

Source: Planning and Monitoring Unit Data, 1988.

The estates sold older or poorer tea lands to the Mahaweli Authority for settlement blocks where resettlement occurred. Nugawela and Riverside have a higher percentage of land in Tea 1 and Tea 2 than does Balapokuna (which only has 1.8%), probably because they are much more conspicuously surrounded by well-managed tea estates (see Figures 5.5, 5.6 and 5.7). Tea 2 might fall in Land Use Class I or II, depending on whether or not ground spaces are filled with shade trees or some type of ground cover. Consideration of older maps does indicate that both of these land use categories are liable to continue deteriorating (as mentioned above) until they are eventually replaced with other crops or vegetation. One problem is that they may be left to turn into Tea 3 and then abandoned tea before anything is done to improve land management and prevent further soil loss.

Tea 3, poor quality, commands the highest percentage of land use (as a category) in Nugawela and is second highest in both Riverside and Balapokuna. These lands exhibit a sparse cover of tea bushes (less than 60%) and "... show a pronounced breakdown in the terracing system and consequently are more susceptible to erosion."(USAID/TAMS, 1980: C-9). The representation of this poor land use as being a major one in these three settlements is indicative of the area as a whole. Table 5.3, which lists the combined land use totals for all of the new settlements, shows Tea 3 to be the dominant land use type. It is a land use which encourages heavy erosion. Table 5.1 shows that on open slopes of 21-40% on red yellow podzolic soil, Tea 3 can facilitate an annual soil loss of 178 mT/ha—extremely high when compared to the 'better' land use classes of Class I.

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FIGURE 5.5 LAND USE MAP

OF RIVERSIDE

LEGEND

FIGURE 5.6 LAND USE MAP OF NUO

LEGEND

Good tea land with over 80% cover (T1)	Palms	An
Moderately good tea land with 60-80% cover (T2)	Dry grass and patna	Wa
Poor tea land with less than 60% cover (T3)	Scrub	Str
Abandoned tea bushes in patna / scrubland	Forest	Tar
Minor export crops	Trees	Foc
Fruits	Permanent house	Ro
Vegetables	Temporary house	

GAWELA

mal sheds

ter supply tank

reams Dug wells

red roads Gravel roads

otpaths

ck outcrops

LEGEND

	Moderately good tea land with 60-80% cover [T2]		Dry grass and patna		Water
	Poor tea land with less than 60% cover [T3]		Homesteads		Slope
	Abandoned tea bushes in patna / scrubland		Temple		Stream
	Minor export crops		Permanent house		Tarred road
	Fruits		Temporary house		Footpath
	Vegetables		Animal sheds		Rock
	Palms				

FIGURE 5.7

LAND USE MAP OF BALAPOKUNA

TABLE 5.3

Land Use – – Kotmale Catchment

April–May 1988

<u>Land Use</u>	<u>Total for Seventeen Evacuee Settlements</u>	
	<u>Hectares</u>	<u>Percentage</u>
Tea 1	53.64	5.1
Tea 2	117.54	11.2
Tea 3	369.07	35.3
Tea abandoned	143.04	13.7
Grass/Scrub	137.68	13.2
Forest	76.27	7.3
Minor Export Crops	71.37	6.8
Fruits/Palms	8.56	0.8
Paddy	5.72	0.5
Homesteads/Vegetables	32.95	3.2
Public Lands	4.40	0.4
Land in Preparation	25.67	2.5
	=====	=====
TOTAL	1045.93	100.0

Source: Planning and Monitoring Unit, 1988

Abandoned tea is a further step below Tea 3. The tea bushes are sparser and no longer productive. Growing in the spaces between the bush remnants are grass, scrub and weeds. Of the three settlements, the highest percentage of abandoned tea is found in Balapokuna which has 13.1%. However, if one looks at combination land uses of Tea 3 and abandoned tea with grass or scrub, the proportion becomes somewhat more significant. Abandoned tea (Tea-ab.) may deteriorate into such a land use or into the scrub/grass category. Some of the grassland, or patna, however, may be the result of forest clearing and repeated burning during colonial times. All of these land uses (Tea 3, Tea-ab., Grass/Scrub) promote high rates of erosion and land degradation and must therefore be discouraged. Thus, it is important to consider what other land uses the settlers are exploring. Are they more environmentally and economically sound than merely letting the tea thin out and worsen until it is no longer productive and the land itself has lessened considerably in productivity and potential? The answer to this question would certainly be affirmative, as almost any land use would be an improvement over any combination of Tea 3, abandoned tea, grass and scrub.

Looking at the land use maps of the three settlements (Figures 5.5, 5.6 and 5.7) shows that the settlers are responding to encouragement given them by the Mahaweli Authority to go into minor export crops, palms and fruit-bearing trees. Minor export crops include pepper, cardamom, coffee and cloves or any mixture thereof. Palms include coconut, kitul and arecanut. These are all economically attractive to the settler families. Although only a small percentage of land is entirely devoted to minor export crops (MECs) (Riverside is the highest with 2.4% of land), a fairly high percentage is in either MECs or palms mixed with Tea 2, Tea 3, Tea-ab., fruits or vegetables. This mixture of MECs or palms with other land uses (particularly deteriorating tea lands) occupies the highest proportion of land in both Riverside (31.2%) and Balapokuna

(19.4%). In Nugawela it only occupies 9.5% of the land, but this will likely increase if the Tea 2 and Tea 3 lands deteriorate any further. As their tea becomes less productive, farmers become more receptive to the agricultural help offered by the Mahaweli Authority. This help takes the form of minor export crop seeds and seedlings, young fruit trees, assistance in improving tea lands (to return them to the Tea 1 category), programmes to promote mulberry trees (for sericulture), and training and extension services. These are all efforts to help the settlers improve their livelihoods while at the same time bettering land use practices. All of the minor export crops, palms and trees being encouraged fall into Land Use Classes I and II, and most fall into Class I. This reduces soil erosion, landslip susceptibility, prevents fast surface runoff and helps maintain soil fertility as it encourages more diversified cropping patterns based on perennials and more continuous ground cover and shading.

The land use maps of the three settlements show the tendency to plant homestead gardens which often include the minor export crops and palms. They also are often made up of fruits and vegetables which the settlers start growing in patches of Tea 3 or Tea-ab. Fruits include jak, banana, mango, papaya and citrus (mainly oranges). Vegetables include beets, carrots, onions with potatoes dominating. The proportion of land devoted to fruits and vegetables with Tea 3 or Tea-ab. is relatively small (ranging from 1% in Riverside to 2.6% in Balapokuna), partially because it makes economic sense to phase out the Tea 3 and Tea-ab. and plant minor export crops and palms. Table 5.4 gives the incidence of economic trees, shrubs and palms. The tea bushes are virtually all mature ones, indicating their presence on the land before the settlers arrived. Only in Balapokuna are there some immature tea bushes which could have been planted in the last three or four years.

TABLE 5.4
Incidence of Economic Tress/Shrubs/Palms
On Homesteads

Plant	Nugawela (n=63)		Riverside (n=25)		Balapokuna (n=53)	
	Mature	Immature	Mature	Immature	Mature	Immature
=====	=====	=====	=====	=====	=====	=====
Tea	32	—	14	—	42	10
Coconut	—	40	—	18	—	28
Jak	7	29	5	17	13	16
Mango	—	22	1	7	—	14
Bananas	3	29	4	19	2	14
Papaya	4	19	2	4	6	5
Orange	—	10	—	6	—	10
Kitul	3	2	—	11	—	13
Coffee	3	18	2	16	—	25
Pepper	1	16	2	18	—	10
Cloves	—	n.a.	—	15	—	19
Other	—	23	—	—	—	1
=====	=====	=====	=====	=====	=====	=====

Note: Riverside data has been adjusted for comparability purposes with Balapokuna and Nugawela. The margin of error is minor, based on an analysis of data from a total of seventeen similar (ie., new) settlements.

Source: Socio-Economic Survey Reports on the New Mahaweli Settlements
in Kotmale, 1986–1987
Upper Mahaweli Peripheral Development Unit, Kandy

All other crops listed in Table 5.4 were planted by the settlers with the possible exception of some of the jak trees. The popularity of coconut is encouraging in an economic sense, but it is to be hoped that it does not become overly dominant, as it falls into Land Use Class II in terms of soil erosion. Though as the objective is to accommodate both environment and economy, homestead gardens which include coconut trees are encouraging. The other homestead crops which appear to be popular in the three settlements include the fruits: jak, banana and mango and the MECs: coffee, pepper and cloves. These homestead gardens are quite environmentally sound with their mixture of crops and high degree of ground cover—as a category they fall into Land Use Class I, the least prone to heavy erosion.

Of the three settlements considered, only Nugawela has any forest cover (2.8%) and it occurs on one block of land. When considering all of the Mahaweli settlements (refer back to Table 5.3) there are small pockets of forest land totaling 7.3% of the seventeen evacuee settlements, remnants of original forest commonly found along drainage channels. However, this higher percentage is somewhat misleading as most of the forests are found in the single settlement of Doragalla. Thus the three settlements we are considering are probably more indicative of the average (ie. little to no forest cover). It would be useful to encourage some form or degree of forestation along streams and rivers to help prevent soil loss and siltation and to provide fuelwood (for which there would need to be a strictly enforced reforestation programme).

Of the three remaining land uses listed on Table 5.2, only Balapokuna has any of its land area described under these categories. Paddy occupies 15.6% of its land area. Looking at Figure 5.4, paddy is seen to occur in the southern portion of Balapokuna which was earlier described as being in a 'foothill' landscape. If well

managed (terracing, stone support walls, restrained water use) paddy can be a fairly sound land use practice in this area.

Bare land and public land occupies 4.6% of the land area in Balapokuna. This category would include cemeteries, schoolgrounds and rocky outcrops. The fact that none appears to occur (according to Table 5.2) in either of the other two settlements may be more indicative of one of the problems of having multiple land use surveyors and mappers, then it is indicative of a lack of public facilities or the absence of rocky land.

Lands under the category of Land Reform Commission were those given to people in the 1970's, under land reform provisions. These, which occur only in Balapokuna, were not mapped by the April 1988 investigators. It is planned that this omission will be rectified (as these land uses are also important for any environmental analysis of the area) by August of 1988.

5.3 Environmental and Socio-Economic Sustainability

As farmers gradually make the transition from deteriorating tea lands to a mixture of MECs, palms, fruits and vegetables or, alternatively, to a homestead garden amid a plot of well-managed tea, they are improving their land use practices both environmentally and economically. When resettlement occurred, many families saw a deterioration in their 'quality of life'. They had lost their traditional lands and social networks. Given tea lands, not of the best quality, on unfamiliar soil and slope conditions, and having to build a shelter and begin planting immature (non-bearing)

plants— their living standards and incomes would necessarily suffer a set-back. This was partially alleviated by employment opportunities for some evacuees during the construction phase and by the compensation payments made for lost land and permanent crops. This occurred at the same time as what was 'acceptable' to the settlers was rising—they expected to be beneficiaries of the development process of which they were part. Government reaction to the situation in the Kotmale Catchment came in 1985 and 1986—finally surfacing for four main reasons:

- 1) increased local interest in environmental issues;
- 2) lack of income improvements among the settlers who became more vocal in their dissatisfaction;
- 3) more landslips in 1986 and the need to assist the victims;
- 4) increasing donor interest in environmental issues.

The second of these is one of the more measureable and easily documented indicators of the lack of improvement in the 'quality of life' of the settlers. Table 5.5 shows the average income increases experienced by the evacuees. Between 1979 and 1986, their incomes went up very marginally, almost a decrease, compared with the increase experienced between 1972 and 1979 when they were still living in the Kotmale Valley. Over the years, and with a move necessitated by development activities, settlers quite reasonably expected an improvement in their incomes and purchasing power. Such expectations were obviously not met. Although income is the most measureable, other indicators can also be considered. Table 5.6 shows some of the dissatisfactions of the residents, expressed in terms of suggestions. The high unemployment in the area (52% in Balapokuna, 38% in Riverside and 47% in Nugawela) leads to suggestions such as

establishment of cottage industries, credit assistance, assisting economic development, providing boats and nets for fishing. Desire for a housing scheme seems to depend on what the settlers have already managed. Out of the 25 families in Riverside, all but two have permanent homesteads. However, in the other two settlements, where the number of families with permanent homesteads forms only a slight majority, a housing scheme is seen as a priority. The desire for more land is one with little chance of being fulfilled, and if it were, it might only encourage more wasteful land use practices. One of the major problems cited by farmers in interviews (UMPDU, 1987) is the wild boar problem—posing a threat to both crops and young children. However, this is not dominant on their list of recommendations and may in part be expressed to encourage the government to give the residents back their guns (taken away at the time of the insurgency in 1983). It should be noted that Table 5.6 does not imply any concerns are held by the residents regarding the environment, except the erosion and boar problem. Environmental concerns are perceived by the Kotmale residents to be a government responsibility. This is an attitude that will have to be changed through educational and community awareness programmes. But the settlers will likely be most responsive if such programmes are integrated in training and extension services that are seen to improve their lives economically as well as being environmentally sound.

TABLE 5.5

Household Annual Cash Income Estimates
Kotmale Reservoir Area Evacuees

<u>Year</u>	<u>Number of Households</u>	<u>Current Rs.</u>	<u>Constant (1986)Rs.</u>
1972	2239	2,280	9,162
1979	2961	4,852	11,644
1986	141	12,072	12,072
1986*	681	11,715	11,715

=====

Note. 1986 constant rupee figures were derived by using the consumer price index (all items), as published by the Central Bank.

Sources: 1972 — Ariyaratna and Manampery, 1972
 1979 — Bulankulame, 1979
 1986 — UMPDU Socio-economic reports for
 Riverside, Nugawela and Balapokuna, 1987
 1986* — UMPDU Figures from nine evacuee settlements, 1987

TABLE 5.6

	<u>Suggestions/Recommendations of 'Evacuee' Settlers</u>		
	<u>Nugawela</u>	<u>Riverside</u>	<u>Balapokuna</u>
Not enough land available/ provide other land for cultivation	10	3	1
Establish plant nursery system	2	—	—
Resolve land tenure disputes	1	—	—
Establish a housing scheme	6	1	5
Water supply system	—	1	3
Stop wild animal (boar) damage	—	—	1
Provide barbed wire at a reasonable price	1	—	—
Agricultural extension	—	1	2
Assist in erosion prevention	—	1	—
Lands for youth	—	2	—
Assist economic development	2	10	—
Establish cottage industries	2	—	7
Provide access to existing cottage industry	1	—	—
Credit assistance	4	—	6
Provide employment	1	—	—
Assist small industries	—	—	1
Assist in getting boats and nets	—	2	—
Assistance for societies	—	3	—
Better road and bus services	—	—	1

=====

Source: UMPDU, 1987

What is most needed is the stimulation of employment/income generating activities and the encouragement of crops appropriate within such a need and within the environmental constraints of the area. Table 5.7 shows the land uses for which the agro-ecological region in which all three settlements fall (most of the area immediately peripheral to the Reservoir) is best suited (Dimantha, 1986).

According to this particular survey, the encouragement of economic crops (spices, coffee, cocoa, fruit trees, for example) appears to be a wise course of action. This is especially true when one considers that the settlers will be familiar with many of the possible minor export crops. Although they may not have grown them for commercial purposes in their old villages, they likely grew several different plants for home consumption and local marketing in their homestead gardens. Table 5.8 shows the crops grown by the evacuees in their former villages in the Kotmale Valley. Many of these are among those now being encouraged by the Mahaweli Authority.

TABLE 5.7

Land Suitability Ratings
For Land Units in Agro-Ecological Region WM2

<u>Land Suitability</u>	<u>Recommended Crops</u>
Highly Suitable (S1)	Fuelwood Forest
Moderately Suitable (S2)	Mixed Garden Economic Forestry Fruit Trees Coffee Cocoa Spice Crops Pasture
Marginally Suitable (S3)	Tea (estates) Coconut
Non-Suitable (N)	Paddy Tea (small-holder) Mulberry Vegetable Crops

=====

Source: Dimantha, 1986

TABLE 5.8
Crops Grown in the Kotmale Valley
 (quantity in bushes or trees)
 (does not include paddy)

<u>Crops/Trees</u>		<u>Number</u>	<u>Percentage</u>
Arecanut	bearing (b)	1,518	2.73
	non-bearing (nb)	1,633	65.40
Tea	b	49,285	88.82
	nb	242	9.96
Coffee	b	3,384	6.10
	nb	410	16.42
Pepper	b	117	.21
	nb	14	.56
Jak	b	159	.29
	nb	21	.84
Sapu	b	97	.17
	nb	27	1.08
Cardomom	b	682	1.23
	nb	13	.52
Cloves	b	38	.07
	nb	24	.96
Coconut	b	108	.19
	r-b	24	.96
Kitul	b	59	.11
	nb	79	3.16
Breadfruit	b	5	.01
	nb	4	.16
Tuna	b	35	.06
	nb	6	.24
Nutmeg	b	3	.01
	nb	—	—
		=====	=====
TOTAL	b	55,490	100
	nb	2,497	100

=====

Source: Bulankulame, 1979:98

The mixed cropping being developed and actively supported by the Mahaweli Authority through seedling provision, various crop inputs and other forms of assistance, is somewhat analagous to an extended homestead or Kandyan garden. But the role of the multi-species gardens has changed from its role in historical times when it supplemented the main forms of agriculture—paddy and chena.

[The] new 'home-farmsteads' (small farms where the farmer has also his house in the farm as distinct from farmsteads) . . . in limited areas of land per holding will invariably have to support a few heads of animals and poultry thus forming a micro plant-animal-human ecosystem.

(Bavappa & Jacob, 1982: 47)

As this one plot of land is generally the farmer's only source of income, productivity must be maximized. Hence, there is the encouragement of multi-species cropping which:

. . . is essentially a combination of large number of crops so chosen as to meet the continued food, cash and other needs of the family which in their successive growth will utilize the airspace and soil in higher intensities and harvest solar energy at different storeys giving sustainable and increased overall yield from the land.

(Bavappa & Jacob, 1982: 48)

In 1978 the viability of one-hectare of intense multi-species cropping was investigated at the mid-country research station of the Department of Minor Export Crops, supported by UNDP/FAO. Figure 5.8 shows the model for high intensity cropping that was planted on what had been one hectare of marginally eroded tea (Jacob and Alles, 1987: 132). Table 5.9 gives the estimated annual return (net) of such a plot when

all crops have reached full potential to be almost U.S. \$3,000. However, at that time, and now, mixed gardens were not operating at anywhere near this efficiency and productivity. A survey of thirty farms carried out in 1973 indicated a mean farm income of Rs.4,085/ha/annum and a mean non-cash food income of Rs.271/ha/annum (quoted in Jacob and Alles, 1987: 131). This is less than U.S. \$650 at the exchange rate of 1973. Operating costs are generally low—about Rs.710 per ha—almost 90% of which goes towards the cost of hired labour (Jacob and Alles, 1987: 128). Labour is hired despite the fact that there is generally family labour available that is not otherwise employed. This is partly due to the skilled nature of harvesting certain crops such as black pepper, cloves and tea. If a training programme were instigated perhaps more of the available family labour could be utilized.

FIGURE 5.8
Model for High-Intensity Species Cropping
 (this portion of the plot would be 50m x 40m)

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M D D D D C D D D D H D D D D I D D D D
G X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
G X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
L X.X.X.X C X.X.X.X H X.X.X.X I X.X.X.X
C X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
G X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
K X.X.X.X C X.X.X.X H X.X.X.X I X.X.X.X
G X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
G X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
F X.X.X.X B X.X.X.X B X.X.X.X B X.X.X.X
J E E E E C E E E E H E E E E I E E E E
  
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Crop Code		Spacing	No/hectare
Large Canopy			
C	Coconut	12.2 x 12.2 m	36
H	Nutmeg	"	12
I	Clove	"	12
J	Jak	"	3
K	Breadfruit	"	3
L	Avocado	"	3
M	Mango	"	3
Medium Canopy			
X	Pepper	2.44 x 2.44 m	1296
B	Coffee(Robusta)	"	220
D	Arecanut	"	24
E	Banana	"	24
F	Papaw	"	22
G	Lime	"	22
Small Canopy			
.	Dwarf Coffee (San Ramon)	1.22 x 1.22 m	1926

Source: Bavappa and Jacob, 1982: 48

TABLE 5.9
Estimated Annual Return From A
One-Hectare Mixed Cropping Model
Planted at Delpitiya, November 1978
 (Yeilds in kg/plant or no.of fruits/plant)

Crops	No. of Plants (after seven years)	Total Yeild	Unit Price*	Total Value*
Pepper (kg)	1296	1296	25.00	32,400
Coffee R (kg)	220	165	30.00	4,950
Coffee S (kg)	1914	957	30.00	28,710
Clove (kg)	12	18	100.00	1,800
Nutmeg (no.)	12	6000	0.20	1,200
Coconut (no.)	36	1810	1.50	2,700
Mango (no.)	3	150	0.50	75
Jak fruit (no.)	3	45	2.00	90
Breadfruit (no.)	3	150	1.00	150
Avocado (no.)	3	3	0.20	30
Arecanut (no.)	24	2400	0.20	480
Banana (no. bunches)	24	24	10.00	240
Lime (no.)	44	4400	20.00	880
TOTAL	3594			73,705

Note: R = Robusta coffee

S = San Ramon coffee

* = Value in Sri Lanka rupees at 1983 price,

1 US \$ = SL Rs. 25 (approximately)

Source: Jacob and Alles, 1987: 135

Research stations and surveys of actual homestead gardens show how with " . . . more research back-up and extension efforts, the efficiency of the system can be improved considerably." (Jacob and Alles, 1987: 131). The settlers need training and extension services to maximize productivity and restructure their present cropping patterns by learning about:

- 1) choosing the appropriate mixture of crops;
- 2) increasing the use of available air space;
- 3) properly placing the crop species;
- 4) pruning and training the canopy.

(Bavappa and Jacob, 1982: 50)

Besides improving the farmer's economic returns, such education would promote a more environmentally sound land use arrangement. This would occur in several ways:

- soil tillage would be minimized;
 - grass and weed growth could be cut and used as mulch around plants, or fed to animals;
 - soil could be protected against beating rain by canopy
 - a few large canopy trees would help, in a small part, the area's deforestation problem;
 - animals and birds could be supported as well as the human family generating their income from the mixed gardens.
- (based on Bavappa and Jacob, 1982: 51)

However, before training and extension services can be expected to disseminate such knowledge and techniques, more research must be conducted for them to base

their work on. DeSilva and Premaratne (1985) point out that there is a difference between the "agronomic optimum" and the "economic optimum" combination of species in a mixed cropping system. Much of recent research has concentrated on the agronomic optimum (e.g. the Delpitiya Mixed Crop Model) to maximize crop productivity through optimal diversity and plant density. Yet, according to these authors, a maximum net return is the main objective of profit-conscious farmers and is to be achieved through an optimal crop mix. More test plots are needed to find an appropriate combination of these optima for smallholder farmers. As well, not mentioned by De Silva and Premaratne in their assessment of mixed cropping models, is the need to more fully understand the longer-term implications of particular cropping patterns on the environment (for instance overcrowding, soil nutrient depletion and leaching) that may occur in time. It is encouraging, however, that since 1985–86, the Mahaweli Authority has concerned itself with the Kotmale environment and the well-being of the area's residents. The increase in awareness and actions will be seen in the following section.

CHAPTER VI

CONCLUSION

Development represents the principal means of meeting human needs and improving the quality of life of the people. It entails not only the use of resources but also the modification of the environment in many ways. Conservation in its narrow sense means only the protection and preservation of the environment. That is why conservationists and developers are eternally in conflict with each other. Therefore, if we are to survive we must treat conservation as the rational management of resources for sustainable growth.

(Daily News, February 11, 1988: 5)

This rational management implies a balance between the achievement of development objectives and the preservation of an environment and the environmental processes needed to allow future generations to meet their own needs. Our Common Future stressed the need for such coordination of environment and development on a global scale and in national planning. This entails some environmental 'saving' or, putting it in economic terms, " . . . living off the earth's interest without encroaching on its capital." (Schokman, October 18, 1988: 5). Since the saving does not always bring immediate profit in economic terms to a nation or its individual inhabitants, it requires foresight and determination to enforce. In some cases, this realization comes after a certain amount of degradation of the environmental 'capital'. In this case, development advisors, land use planners, ecologists and the local people must work together to find a blend of economic development and environmental improvement and conservation, so that one is not exclusively promoted at the expense of the other. The two large variables must be weighted against one another and a balance must be found.

Sri Lanka is a country looking for this balance, making an effort to move from

an awareness of the environment to sound policy, programmes, institutions and action. The presence of the Sri Lanka Environmental Congress (SLEC) which acts as an umbrella organization for about 165 environmental groups (Wanigasundara, July 21, 1988: 4) is a demonstration of a national awareness. The fact that at least 150 "... are village organizations, small ... and representing mainly the poor in the countryside." (Wanigasundara, July 21, 1988: 4) shows that this awareness is reaching the local, rural people, those most affected by the deterioration of the environment. Organizations such as the SLEC are pressing the government to update, organize and coordinate their environmental laws and policies. There is no single authority to organize and enforce environmental laws, these tasks being left to individual government departments, agencies and local bodies. The fact that the Central Environmental Authority, established in 1980, is located outside the Ministry of Lands and Land Development "... undoubtedly affects its capability to go into matters connected with land and water resources." (Madduma Bandara et al., 1986: 10). There are recommendations to establish it within the Ministry and give it greater powers. This would seem desirable given the multiplicity of institutions dealing with the environment and the lack of coordination between these institutions. Greater powers might also give the environment greater weight in the search for a balance between environment and development.

The case study of the Kotmale Catchment used in this thesis brings this need to balance economics and the environment and the need to put environmental awareness into action down to a much smaller scale. The TAMS/USAID Environmental Assessment of the AMP undertaken in 1979-81 helped to formulate the Environmental Plan of Action in 1981. Out of this came the Mahaweli Environmental Project (MEP)

which began in 1982 and represents " . . . an attempt at simultaneous planning for both development needs and ecological priorities; not an emphasis on one to the virtual exclusion of the other." (Kuruppu, March 29, 1988: 12). The major components of this project are national park infrastructure development, strengthening the Department of Wildlife Conservation (DWLC) planning and management system and developing DWLC research and training capability. This project shows awareness and action, though somewhat delayed, on the environment affected by and surrounding the AMDP areas. The work of this project is fairly high profile at the national level, however, and thus came before consideration of the Upper Mahaweli Catchment of which the Kotmale is a part. As the realization grew that the Upper Catchment could seriously affect the success of the project in achieving its national development objectives (through such things as siltation and sedimentation of reservoirs and channels), there was a heightened awareness of the environmental conditions of the Upper Catchment and actions in the area.

Chapter III showed that the baseline conditions in the Kotmale Catchment were a product of policies and actions which had occurred over the past two centuries. The Kotmale Dam and Reservoir scheme moved hundreds of people onto hillsides that were already deforested, prone to erosion, and overpopulated. As Chapter IV demonstrated, with the influx of more people, the situation could only worsen. But with the successes of the overall AMDP, the attention of most people—particularly the international donors and the national government—was focussed on the strides the AMDP was making towards achieving national economic development objectives.

It was not until 1985 that the MASL " . . . created its Environment, Forestry and Conservation Unit. . . " (Madduma Bandara et al., 1986: 10) specifically for the Upper

Mahaweli Basin. The multiplicity of institutions, even at this more regional level, was contributing " . . . to the failure of evolving a cohesive policy in dealing with the problem of land degradation."(Madduma Bandara et al., 1986: 11). It is to be hoped that this Unit can plan and organize projects which consider the objectives of watershed management:

. . . based on the fundamental tenet that, land, water and biotic resources are interdependent and therefore, must be considered in their natural unity in order to meet the challenges of land degradation and ensure sustained productivity from such lands, as well as those lands and water bodies that depend on them.

(Madduma Banadara et al., 1986: 15)

The Unit realizes that landslides are just one manifestation of land degradation and that they must look at causes and not merely at the symptoms of the problem. A major focus is on reforestation. A variety of organizations are assisting in these programmes (USAID, ADB, JEDB, IRDP, the Forest Department and several NGO's such as Nation Builders). The overall Environmental Plan of Action has instigated many offers of assistance from a large number of donor agencies (USAID, CIDA, UNICEF, EEC, IUCN, WB, GTZ).

In Chapters IV and V the changes in land use in the Kotmale Catchment over the past several years were seen and some of the implications of these changes were discussed. The solution means that everyone concerned, from the international donors to the national government to the individual settlers must take some responsibility for the Kotmale environment. Although the international donors can instigate programmes, and although the government can create and enforce policies and legislation, the local residents of the Kotmale area are those whose quality of life is most affected by the state of their environment. It is also they who most need and desire the promised

benefits of development and must therefore find ways of merging improved livelihoods with an environment which will sustain these improvements for themselves and for future generations:

. . . the rural poor produce our food. They may not comprehend the sophisticated science of ecology, but its principles permeate their consciousness. They know that the soil and water, which sustain their cultivations, must be protected; the rivers they bathe in must be clean; that the trees which conserve the stability of the soil and protect the source of water and oxygenate the air is their life-blood.

We do not want to over-romanticise. We know that village people are among the human predators who strip the forests. That is mainly a question of poverty and joblessness. Environmental education alone will not change this; an alternative livelihood must be found for them.
(Daily News, June 25, 1988: 6)

In Chapter V it was shown that minor export crops and some improvements in tea lands might be the way to do this, along with extension services advising and demonstrating improved cultivation practices. This means a shift towards mixed tree-home garden land use, incorporating economic crops. It means the replacement of marginal tea and scrub lands with better tea, tree crops or forestry according to the terrain and slope characteristics. To ensure the success of these measures means legislation, policies and enforcement of proper road tracing, bank stabilization, contouring and proper homestead and village layout development.

Despite the many changes since the last century, some of the solutions to the present problems lie in the knowledge of past Kormale generations and their concept of the Kandyan home garden. With increased populations, changing economic and social conditions and greater aspirations of farmer families, many modifications are obviously needed. Although more scientific and of higher intensity, the premise is the same and has already been suggested:

What we need today is a more organized approach. If every landowner of a village is encouraged to plant his garden systematically with carefully selected species developing into layers of trees, shrubs, herbs and ground communities, within a relatively short span of time, the whole village could be transformed into a complex of communities which would together evolve gradually into a semi-natural 'forest'.
(Premadasa, February 14, 1989: 6 and 7)

This all-encompassing garden-forest is unlikely to be possible in the Kotmale Catchment due to land pressure. But it is visions such as this that often lead to realistic, sustainable solutions. The integration of the two large variables—development and the environment—is not only necessary, it is feasible and it must be implemented at all levels. If the merger did not occur yesterday, it must occur today. The time lags between development actions at the national level and environmental actions at the local level can and should be reduced, as case studies such as the Kotmale indicate. Changes in variables difficult to predict should be carefully monitored, and with concurrent environmental consideration their effects would be minimized.

With more and more attention being given to the Kotmale, local environmental rehabilitation should continue and the residents should see some improvements in their livelihoods at the same time, as they move to MECs and receive more attention from international donors, the government and extension workers. Improvements in quality of life may be gradual but should be noticed soon. It is hoped that internal political disturbances and unrest in Sri Lanka do not halt the work of institutions and personnel in the area. It would be terrible for the environmental and developmental coordination now underway in the Kotmale Catchment, and in Sri Lanka as a whole, to be brought to a standstill.

The scale of many of the issues on the global environmental agenda is huge, but it is usually at a much smaller scale that these issues must be tackled. This thesis has shown a local level example of environmental degradation which does have solutions, some of which can be found by examining the historical land uses in the area and others which come out of current development efforts which have increased the attention being given to the area. It may take many such case studies to formulate theories which link the two disciplines of ecology and development studies but one hopes it will not take too many such case studies to highlight the importance of linking environment and development. Even this one case study points to some important concepts, major ones being that environmental capital should not be depleted and the environment is not a free good. Development planners must assess the 'cost' of any changes that might be made to the environment during the fulfilment of the development objectives.

This assessment of the environment must occur at all stages of the development process, from planning to action. The Time Frame for Development and Environmental Action (Figure 1.1) that has traditionally occurred must be modified so that development and the environment are linked from the initial stage of considering national development objectives. Figure 6.1 shows the optimal time frame.

FIGURE 6.1

Ideal Time Frame for Development and
Environmental Action

The environmental plan should be comprehensive. With continual monitoring of environmental changes once the development action begins, necessary modifications to the environmental plan and actions could be made immediately.

In the Kotmale Catchment, people have long considered the soil as a free good, but really it should be seen as environmental capital. With the changes in land use and the increased population pressure over the past two centuries, there has been more and more soil 'lost' to the rivers, streams, and now to the reservoir, through increased erosion and landslips. This loss of environmental capital is a cost which development planners must consider. Local residents should be made aware of the implication this loss will have for them in the long term. Any theory linking environment and development must examine ways of encouraging the maintenance of environmental capital while at the same time allowing the local people to improve their quality of life using environmental 'interest'. This will involve both education and economic incentives. The education will provide an understanding of the long-term implications

of different land uses and cultivation practices. The economic incentives will allow short-term gains to be realized. It is likely that Kotmale residents understand the importance of maintaining the soil and the forests, but with their need for immediate security, it is difficult for them to be convinced to alter their behavior. Thus the techniques developed for the maintenance of environmental capital must provide some short-term economic return. In this case study, the Mahaweli Authority could finance the planting of forest throughout the Kotmale area; this would mean the growth and retention of environmental capital at the expense of any possibilities for immediate profit for the settlers. The encouragement of minor export crops and better tea lands, however, provides a solution much more realistic, allowing for the long-term maintenance of the soil as well as for short-term improvements in the livelihoods of the settlers. The training and extension services provided in the area will encourage a continued link between short-term economic gains and long-term maintenance of the environment through education and assistance. These are the sort of solutions that should be developed within any theory that looks at ways to link environment and development in the real world.

A further point which should be taken from this case study is that current development projects should not be made the scapegoats for all of the environmental problems now being experienced. Any theory developed should have the capacity to view the long-term, both past and future, in examining the causes and solutions of particular problems. In this particular case study, any increases in erosion that occurred after the Kotmale Dam was built cannot be blamed solely on the Dam. The link between environment and development is too long-term and holistic to be considered by abstracting contemporary problems from the processes of which they are a part.

Development affects our relationship to the environment and attempts to improve what we get out of this relationship. But humans should remember that we are part of the environment and a member in the web of environmental processes.

The earth does not belong to man: man belongs to the earth.
All things are connected like the blood which unites a family.
Whatever befalls the earth, befalls the sons of the earth.
Man did not weave the web of life, he is merely a strand in it.
Whatever he does to this web, he does to himself.

(American Indian Chief quoted in Daily News,
June 25, 1988: 6)

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