3.1 Introduction

The term "land resources" is usually used to refer to natural resources such as soils, minerals, and a wide range of ecosystems that occur as part of the topography, terrain and physiography of the land. Pre-colonial Barbados was well endowed with a wide range of these resources as might be expected of most natural tropical island ecosystems. In modern Barbados, however, much of the original biodiversity resources have been drastically depleted, and non-living resources are impacted by several competing uses.

The state of land resources is fundamentally a function of its geological structure and topography. Related to these are such features as erosion patterns and rates, shoreline configuration, soil chemistry, direction and rate of groundwater movement, slope stability and others. These and other physical characteristics are important in influencing the natural as well as man-made systems that develop and impact on the land. The nature and extent of human impact on the land is closely related to these physical conditions, as well as to the occurrence of fertile soils and valuable minerals. In the case of Barbados, the demand for land for housing development and attractive sites suitable for tourism development are becoming increasingly important.

This section primarily reviews agricultural resources, particularly issues of soil stability, conservation and management. Other land uses are included as they relate to impacts on agricultural land. Non-living resources such as minerals, and living land resources such as forestry will be dealt with in subsequent sections.

3.2 Land Use

Land allocated for various uses in Barbados has undergone notable change over the past three to four decades. The clearest data related to these changes are contained in the Barbados Report to Habitat II (1996). According to that report, over the period 1966-1976 the land allocated for urban development increased from 21.2 to 37.6 per cent, while the amount of arable land declined from 57.7 to 46.2 per cent. In 1976, 62.2 per cent of total rateable[1] land was used for sugar plantations and tenantries, 26.4 per cent for residential with agriculture and commerce, 9.8 per cent for residential alone and 1.6 per cent for tourism, commerce and industrial activities. Recent data for 1995/96 indicate that 27.3 per cent of total rateable land was used for residential purposes, while 63.3 per cent was used for agriculture and 9.1 per cent for business activity.

It is difficult to ascertain clear trends in land use change from these data. However, recent projections suggest that land previously allocated to agricultural use has been, or is at risk of being, reassigned to residential and other development (for example in the areas of St. Thomas, St. George and St. Michael). A 1997 review of socio-economic conditions and trends[2], for example, projected that by the year 2010 some 13 500 new housing lots would be needed, requiring 1 100 hectares of land, unless the demand could be met from existing vacant lots. It is further projected that approximately 1 400 hectares of land will be needed over the next 30 years to accommodate the expanding population.

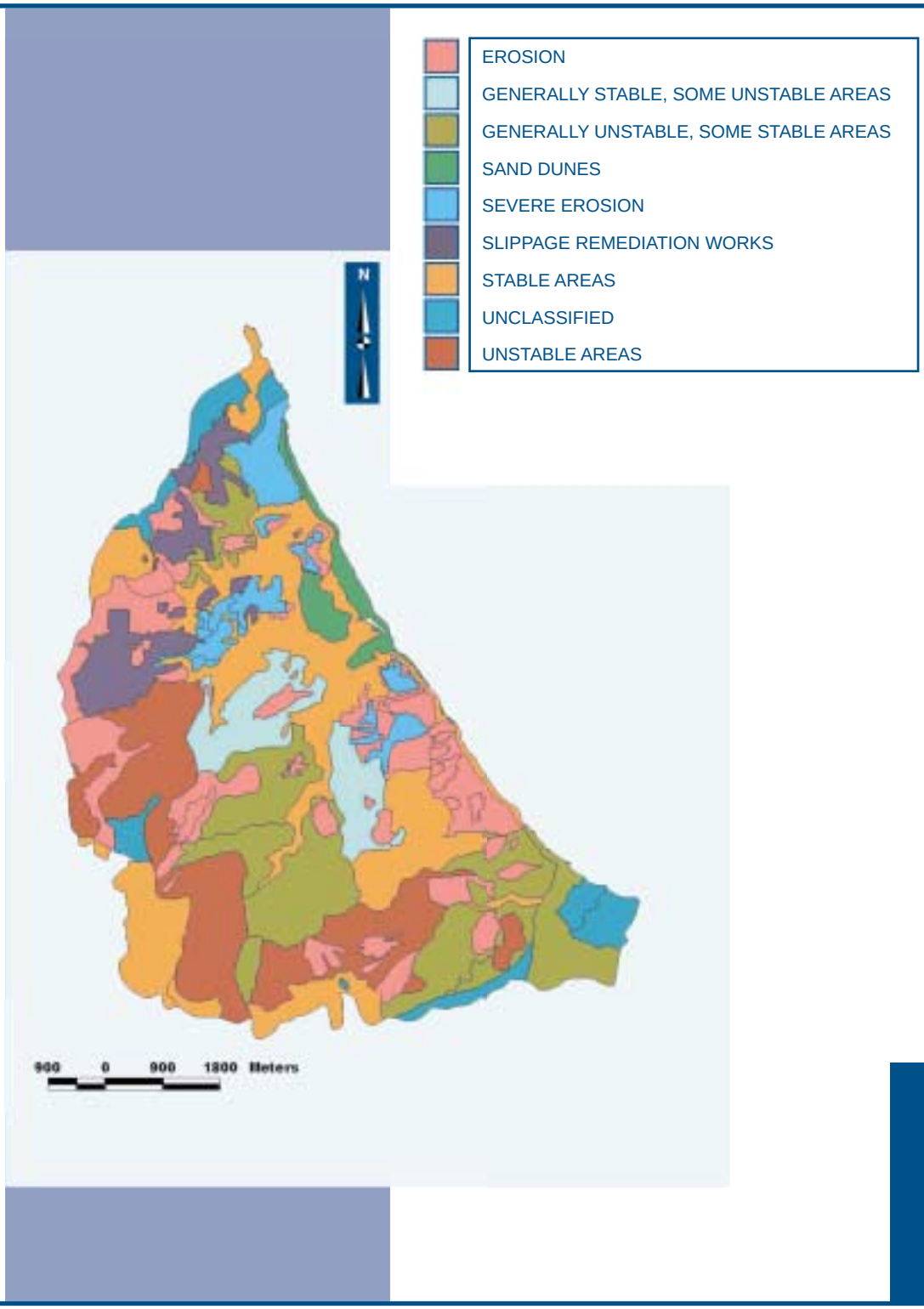
These changes give some indication of the pressures on Barbados' land resources that result in environmental impacts. Expanding settlement areas increase the coverage of hard surfaces that result in increased runoff and potential for flooding, while inappropriate agricultural practices lead to soil erosion.

3.3 Agricultural Land Use

The 1989 Agricultural Census indicates that about 80 per cent of the total land area (approximately 34 500ha) was allocated to agriculture, with the next highest allocations being natural pasture (7.55 per cent) and roads and buildings (7.18 per cent). By 1997 the National Report to the UN Commission on Sustainable Development (1996) recorded that the area under agriculture was 16 450 ha, while the 1997 review of socio-economic trends gave the figure as 21 000 ha in agriculture, of which 4 000 ha were idle. Both these latter reports suggest a substantial decline from the 1980 census figures.

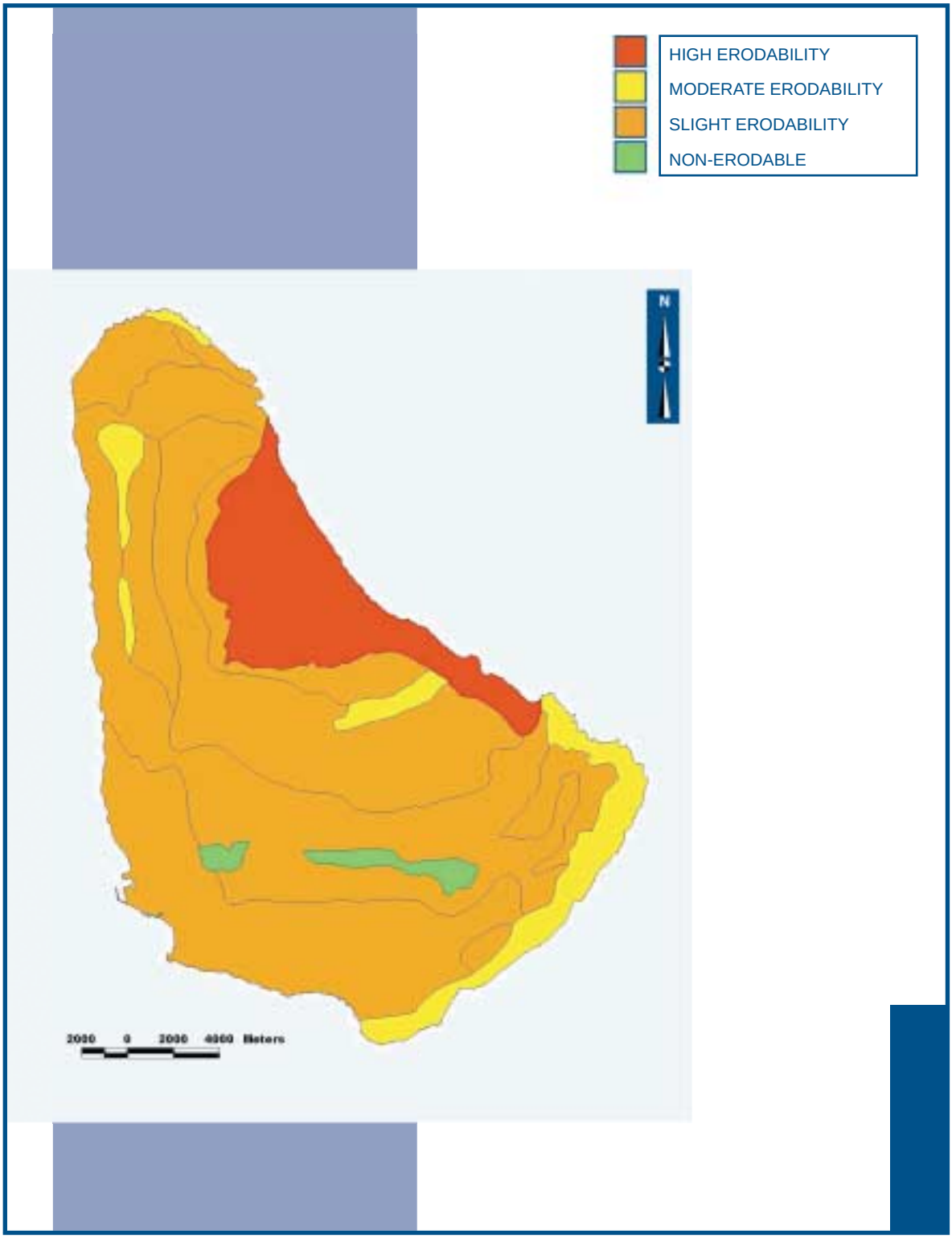
Other useful indicators of agricultural land use change are the change in acreage under sugar cane cultivation, change in the number of sugar estates and in the number of small holdings[3]. The area of sugar cane harvested declined from 20 200 ha in 1965 to 7 900 ha in 1993. The number of small holdings fell from 27 626 in 1961 with a total acreage

Map 3.1: Scotland District Slippage Rate



Source: The National Natural Resources Data Base, 1998.

Map 3.2: Island Wide Soils by Erodability Category



Source: The National Natural Resources Data Base, 1998.

of 12 546, to 16 951 in 1989 and an acreage of 7 880. Similarly, the number of estates declined from 286 in 1961 to 227 in 1989, with a corresponding decline in acreage from 71 910 to 45 395[4].

The decline in agricultural land is often attributed to socio-economic factors such as the growth in urban population and in non-agricultural activities in the economy, as well as declining values of agricultural commodities in international trade (e.g. sugar). Whatever the causes, the decline in acreage under agriculture as well as changes in agricultural practices also lead to increased pressure on, and declining quality of arable land in Barbados.

3.4 Impacts of Land Use

3.4.1 Land Slippage

The Scotland District area is naturally prone to land slippage due to its geologic and topographic characteristics. Historically this has been a major area of concern and, consequently, the focus of significant efforts to control human activity and stabilize the area. The Scotland District is composed of soft bedrock, soft and incompetent soils, steep and moderate slopes, and the issuance of ground water at the interface of the limestone cliff and underlying oceanic series to form surface water in this region. These factors all combine to cause mass movements of minor and major proportions.

The above-mentioned natural conditions are exacerbated by housing construction and inappropriate farming practices that involve the over-steepening and weakening of slopes. This has resulted in severe land slippage and associated damage to property and risk to life, particularly after prolonged periods of heavy rains. Map 3.1 shows slippage rates of lands in the Scotland District.

3.4.2 Soil Erosion

Map 3.2 shows the erodability of soils island-wide. The most highly erodable soils are clearly located in the Scotland District. Figure 3.1 shows erosion rates on plots of bare land over the period 1985 to 1990. However, the limestone regions have experienced significant levels of erosion due mainly to human activity, rather than to natural physical conditions as is the case in the Scotland District. The clearing of land and application of inappropriate agricultural techniques are the major causes of the problem.

The problems of topsoil loss began with extensive clearing of forest for agriculture during the colonial period, and consequent exposure of the underlying soil. The problem persists today due to several factors including[5]:

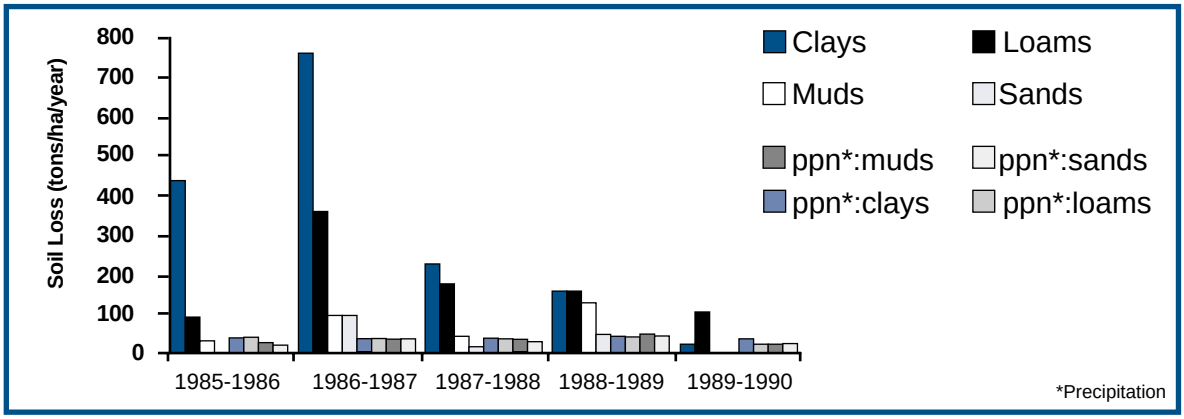
- The clearance of land for construction, which results in loss of surface shoots and subsurface roots, thereby increasing the vulnerability to landslides;
- The lack of maintenance and almost complete breakdown in the formerly extensive system of check-dams in gullies, and of cane-field suck-wells, both of which were used to direct surface water into the underground aquifer;
- The Use of non-specific herbicides that kill total ground cover and promote soil runoff, and
- The Replacement of the cane-hole planting system by cross-contour ploughing and furrowing, thereby encouraging runoff instead of water retention in the topsoil and aquifer.

These practices have several environmental impacts down-stream. First, the resultant runoff removes the topsoil and creates an environmental hazard in the near-shore marine area, especially to reef systems, and causes loss of soil structure and soil fertility in agricultural areas. Secondly, it carries pesticides and nutrient rich fertilizers to the sea, impacting negatively on the marine environment. Thirdly, it transports solid waste and organic wastes from gullies to the sea, with potential environmental and public health consequences.

3.4.3 Flooding

Surface drainage is a normal year-round occurrence in the Scotland District. In the limestone areas, however, prolonged heavy rainfall can cause flooding in certain known densely populated low-lying areas on the west and south coasts of the island. Annual runoff is estimated at between one and three per cent of precipitation. A major flood has historically occurred once every twelve years, but nuisance flooding occurs on an annual basis in flood-prone areas[6]. These areas are found in the

Figure 3.1: Soil Erosion on Bare Plots in the Scotland District 1985-90



Source: Soil Conservation Unit, 1992[7].

southern part of the island, across the St. George Valley and extending into areas around Hampton, Groves and River in St. Philip (Map 3.3. Also see Map 2.3 for Parish names).

The human activities that lead to flooding in Barbados include:

- clearance of vegetation;
- unauthorized construction on former wetland areas;
- unauthorized development in other flood-prone areas;
- urbanization which involves the spread of hard surfaces and causes increased runoff;
- inappropriate disposal of debris and solid waste in drainage structures and in natural gullies;
- failure to provide appropriate roadside drainage systems, and
- failure to provide adequate bridge and culvert capacity.

The result is the erosion of topsoil and the conveyance to the sea of this, along with animal waste and garbage from gullies, and pesticides and fertilizers. The potential environmental and health impacts include the spread of infection from stagnant water that remains after flooding, and contamination of groundwater and of near-shore marine areas. Also associated with flooding is blockage at outlets to watersheds, particularly in the Holetown, Speightstown, Brandons and Graeme Hall areas.

3.5 The Institutional and Policy Response

The overall responsibility for land-use planning resides with the Town and Country Development Planning Office (TCDPO) and its enforcement of the Town Planning Act (1963). The TCDPO also has responsibility for preparing the National Physical Development Plan every five years, to guide the efficient allocation of land among the various competing uses. The most recent is the revised 1998 Physical Development Plan (PDP), which covers a planning period extending up to the year 2010. With respect to developments affecting agricultural lands, the TCDPO is guided by the Ministry of Agriculture and Rural Development.

With respect to most activities associated with agricultural land, there is no direct government control. Existing legislation includes the Soil Conservation (Scotland District) Act (1959) which guides operations in that section of the island. This Act is executed by the Soil Conservation Unit (SCU) of the Ministry of Agriculture and Rural Development. Since 1957 the SCU has undertaken extensive slope rehabilitation works in the Scotland District. The Unit also reviews all development proposals involving permanent structures in the area, with the view to preventing construction in areas prone to erosion and land slippage.

Map 3.3: Surface Water

Source: The National Natural Resources Data Base, 1998.

The Agricultural Sector Plan (1993-2000) was prepared to ensure that practices within the agricultural sector serve to maximise productivity and ensure optimal use of land available for agriculture, promote the adoption of farming systems which are environmentally friendly, and ensure preservation of adequate areas of arable land for future generations. Strategies adopted under the Agricultural Sector Plan include the reservation of 45 000 acres of land for agricultural use, and provision of financial incentives to encourage the re-use of abandoned arable land for agriculture. Additional strategies for environmental protection and conservation include, among others, promoting measures to reduce soil erosion, proposed legislation for sound water and soil conservation strategies, promotion of organic farming and reduction in use of chemicals in agriculture, and farmer education programmes regarding the safe use of chemicals.

In general, the preferred strategy to reduce or eliminate adverse impacts of agricultural practices on the land is to educate agricultural operators about the issues and about alternative ways of meeting their production objectives. As part of this strategy the Ministry of Agriculture and Rural Development provides education and information pamphlets to the farming community. This activity is expected to continue and be expanded.

With respect to drainage control and flood prevention, the Drainage Unit of the Ministry of Public Works and Transport has responsibility for all aspects of evaluation of development, monitoring and reporting on such matters. This Unit functions under the Prevention of Floods Act (1952) which provides for flood prevention works and the designation of special flood areas.

A 1996 study of Storm Water Drainage in the Bridgetown urban area, the West Coast and the South Coast updated an earlier (1973) study. The 1996 study included recommendations regarding, among other things, groundwater recharge, control of storm water runoff from agricultural areas, and institutional and legislative matters. These recommendations are at varying stages of implementation.

The TCDPO also has responsibility under the 1963 Town and Country Planning Act, in areas relevant to the land use policies of the 1998 revised PDP. Specifically, the PDP requires, among other things, that all new construction and land clearing is done in accordance with a Sediment Control Plan, and that new development not be permitted in Observed Flood Areas unless storm water drainage deficiencies within the area have been corrected to the satisfaction of the Drainage Unit[8].

Finally, the proposed Environmental and Natural Resources Management Plan offers a number of recommended new management actions in all the areas of land resources management addressed in this section. These will be presented in the final section which deals with imperatives for action.

3.6 Conclusion

It appears that a considerable amount of the 80 per cent of total land area reported by the 1989 agricultural census to be under agriculture is changing fast. It is estimated that land continues to be alienated from agriculture at the rate of approximately 400 hectares annually, which is a much faster rate than the 80 hectares annually estimated in the 1988 PDP[9]. Several efforts are already under way to address the environmental implications of these changes. Further, the regeneration of natural vegetation on abandoned agricultural lands could have positive implications for biodiversity, runoff and aquifer recharge. However, given the importance of land and agriculture to the natural, cultural and economic character of the island, future policy could benefit from wider public discourse on the opportunities and constraints of competing land uses.

Notes

1. The Report does not provide a definition of “rateble land”.
2. Willms & Shier, 1997: Socio-Economic Conditions and Trends. Prepared as part of the project on Environmental Management and Land Use Planning for Sustainable Development. Minstry of the Environment
3. Farms under 10 acres in size.
4. Habitat II: Barbados National Report and Plan of Action, with statistics from the Censuses of Agriculture.
5. Willms and Shier, 1998. Environmental and Natural Resources Management Plan. Government of Barbados.
6. Soil Conservation Unit, 1992. Final Report: Ex-Post Evaluation of the Inter-American Development Bank/Government of Barbados Scotland District Soil Conservation Project.
7. Ibid.
8. Ibid.
9. See 2 above.